Teacher Edition

Science Focus 4

second edition

PDF Version

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

This grid contains information related to book four. A final version will be supplied which includes information for all four books once they are all released.

PRESCRIBED FOCUS AREAS OUTCOMES

STAGE 4

Outcomes	*Science Focus 1*									*Science Focus 2*								
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
4.1 identifies historical examples of how scientific knowledge has changed people's understanding of the world																		
4.2 uses examples to illustrate how models, theories and laws contribute to an understanding of phenomena																		
4.3 identifies areas of everyday life that have been affected by scientific developments																		
4.4 identifies choices made by people with regard to scientific developments																		
4.5 describes areas of current scientific research																		

STAGE 5

Outcomes	*Science Focus 3*									*Science Focus 4*								
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.1 explains how social factors influence the development and acceptance of scientific ideas														●				
5.2 describes the processes that are applied to test and validate models, theories and laws																		●
5.3 evaluates the impact of applications of science on society and the environment										●					●	●		
5.4 discusses evidence supporting different viewpoints											●		●				●	
5.5 analyses how current research might affect people's lives												●						●

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

PRESCRIBED FOCUS AREA – CORE CONTENT

STAGE 4

Outcomes		*Science Focus 1*									*Science Focus 2*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
4.1a)	identify some of the scientific ideas that different cultures have contributed to science throughout history																		
4.1b)	describe (using examples, including those developed by Aboriginal peoples) ideas developed by different cultures to explain the world around them																		
4.1c)	describe some models and theories that have been considered in science and then been modified or rejected as a result of available evidence																		
4.1d)	discuss examples where societal, religious or ethical values have had an impact on scientific developments																		
4.1e)	describe historical cases where developments in science have led to the development of new technologies																		
4.1f)	describe historical cases where developments or improvements in technology have transformed science																		
4.2a)	evaluate the role of creativity, curiosity, objectivity and logical reasoning in describing phenomena, carrying out investigations and in the devising and testing of hypotheses																		
4.2b)	distinguish between scientific argument and economic or legal argument																		
4.2c)	apply scientific processes to test the validity of ideas and theories																		
4.2d)	describe how an idea can gain acceptance in the scientific community as either theory or law																		
4.2e)	use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these																		
4.2f)	give examples that demonstrate the benefits and limitations of using models																		
4.2g)	identify that the nature of observations made depends upon the understanding that the observer brings to the situation																		

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes	*Science Focus 1*									*Science Focus 2*								
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
4.3a) identify and describe examples of scientific concepts and principles that have been used in technological developments (including Australian examples)																		
4.3b) discuss, using examples, the positive and negative impacts of applications of recent developments in science																		
4.3c) identify and describe examples where technological advances have impacted on science																		
4.3d) give reasons why society should support scientific research																		
4.4a) discuss viewpoints about some issues with a major scientific component																		
4.4b) give examples to show that different societal groups may use or weight criteria differently to make a decision about an issue involving a major scientific component																		
4.4c) identify choices that need to be or have been made when considering whether to use particular scientific advances																		
4.4d) analyse reasons why different cultures or groups within a society, including Aboriginal people, may have different views in relation to scientific issues																		
4.4e) discuss the place of social and ethical considerations in scientific practice and in applications of science																		
4.5a) describe some recent scientific contributions made by male and female scientists, including Australians, and discuss the effect of their contributions																		
4.5b) evaluate the potential impact of some issues raised in the mass media that require some scientific understanding																		
4.5c) identify scientific skills that can be useful in a broad range of careers																		
4.5d) identify possible career paths in science																		

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

PRESCRIBED FOCUS AREA – CORE CONTENT

STAGE 5

Outcomes	*Science Focus 3*									*Science Focus 4*								
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.1a) identify some of the scientific ideas that different cultures have contributed to science throughout history					●													
5.1b) describe (using examples, including those developed by Aboriginal peoples) ideas developed by different cultures to explain the world around them					●													
5.1c) describe some models and theories that have been considered in science and then been modified or rejected as a result of available evidence					●													
5.1d) discuss examples where societal, religious or ethical values have had an impact on scientific developments					●													
5.1e) describe historical cases where developments in science have led to the development of new technologies					●													
5.1f) describe historical cases where developments or improvements in technology have transformed science					●													
5.2a) evaluate the role of creativity, curiosity, objectivity and logical reasoning in describing phenomena, carrying out investigations and in the devising and testing of hypotheses					●				●									
5.2b) distinguish between scientific argument and economic or legal argument									●									
5.2c) apply scientific processes to test the validity of ideas and theories									●									
5.2d) describe how an idea can gain acceptance in the scientific community as either theory or law									●									
5.2e) use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these									●									
5.2f) give examples that demonstrate the benefits and limitations of using models									●									
5.2g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation									●									

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes	*Science Focus 3*									*Science Focus 4*								
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.3a) identify and describe examples of scientific concepts and principles that have been used in technological developments (including Australian examples)	●					●	●											
5.3b) discuss, using examples, the positive and negative impacts of applications of recent developments in science	●					●	●											
5.3c) identify and describe examples where technological advances have impacted on science	●					●	●											
5.3d) give reasons why society should support scientific research	●					●	●											
5.4a) discuss viewpoints about some issues with a major scientific component		●		●				●										
5.4b) give examples to show that different societal groups may use or weight criteria differently to make a decision about an issue involving a major scientific component		●		●				●										
5.4c) identify choices that need to be or have been made when considering whether to use particular scientific advances		●		●				●										
5.4d) analyse reasons why different cultures or groups within a society, including Aboriginal people, may have different views in relation to scientific issues		●		●				●										
5.4e) discuss the place of social and ethical considerations in scientific practice and in applications of science		●		●				●										
5.5a) describe some recent scientific contributions made by male and female scientists, including Australians, and discuss the effect of their contributions			●						●									
5.5b) evaluate the potential impact of some issues raised in the mass media that require some scientific understanding			●						●									
5.5c) identify scientific skills that can be useful in a broad range of careers			●						●									
5.5d) identify possible career paths in science			●						●									

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

DOMAIN – SKILL OUTCOMES

STAGE 4

Outcomes		*Science Focus 1*									*Science Focus 2*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
4.13	clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem																		
4.14	follows a sequence of instructions to undertake a first-hand investigation																		
4.15	uses given criteria to gather first-hand data																		
4.16	accesses information from identified secondary sources																		
4.17	evaluates the relevance of data and information																		
4.18	with guidance, presents information to an audience to achieve a particular outcome																		
4.19	draws conclusions based on the information available																		
4.20	uses an identified strategy to solve problems																		
4.21	uses creativity and imagination to suggest plausible solutions to familiar problems																		
4.22	undertakes variety of individual and team tasks with guidance																		

DOMAIN – SKILL OUTCOMES

STAGE 5

Outcomes	*Science Focus 3*									*Science Focus 4*								
	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.13 identifies a problem and independently produces an appropriate investigation plan										●	●	●	●	●	●	●		●
5.14 undertakes first-hand investigations independently with safety and competence										●	●	●	●	●	●	●	●	●
5.15 gathers first-hand data accurately										●	●	●	●	●	●	●	●	●
5.16 accesses information from a wide variety of secondary sources										●	●	●	●	●	●	●	●	●
5.17 explains trends, patterns and relationships in data and/or information from a variety of sources										●	●	●	●	●	●	●		●
5.18 selects and uses appropriate forms of communication to present information to an audience										●	●	●	●	●	●	●	●	●
5.19 uses critical thinking skills in evaluating information and drawing conclusions										●	●	●	●	●	●	●	●	●
5.20 selects and uses appropriate strategies to solve problems												●	●		●	●		
5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions											●	●	●	●	●	●		
5.22 independently plans, implements and evaluates the effectiveness of a variety of tasks as an individual and as a team member										●	●	●	●	●	●	●		●

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

SKILLS – CORE CONTENT

STAGE 4

	Science Focus 1									*Science Focus 2*								
Outcomes	**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**	**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**
4.13.1a) describe a problem, hypothesis or question that can be tested or researched																		
4.13.1b) propose possible sources of data and/or information relevant to the investigation																		
4.13.1c) identify what type of information or data needs to be collected																		
4.13.1d) justify why particular types of data or information are to be collected																		
4.13.1e) identify the appropriate units to be used in collecting data																		
4.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering information																		
4.13.1g) formulate a means of recording the data to be gathered or the information to be collected																		
4.13.2a) identify variables that need to be kept the same if first-hand data is to be collected																		
4.13.2b) specify the dependent and independent variables when planning controlled experiments																		
4.13.2c) describe a logical procedure for undertaking a simple or controlled experiment																		
4.13.2d) establish an appropriate timeline for an investigation																		
4.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task																		
4.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task																		
4.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field																		
4.14a) follow the planned procedure when performing an investigation																		
4.14b) use time and resources effectively																		

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

		Science Focus 1									*Science Focus 2*								
Outcomes		**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**	**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**
4.14c)	safely and efficiently construct, assemble and manipulate identified equipment																		
4.14d)	record data using the appropriate units																		
4.14e)	evaluate and modify experimental procedures																		
4.14f)	demonstrate the use of safe and hygienic work practices including the correct use of safety equipment																		
4.15a)	make and record observations and measurements accurately over a number of trials																		
4.15b)	use independently a range of data collection strategies and technologies such as dataloggers																		
4.16a)	use a range of sources, including CD-ROMs and the Internet, to access information																		
4.16b)	use a variety of techniques, such as key words, skimming and scanning, to identify appropriate information																		
4.16c)	extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio/visual resources																		
4.16d)	summarise information from identified oral and written secondary sources																		
4.17a)	collate information from a number of sources																		
4.17b)	distinguish between relevant and irrelevant information																		
4.17c)	check reliability of gathered data and information by comparing them with observations or information from other sources																		
4.17d)	organise data using a variety of methods including diagrams, tables, spreadsheets and databases																		
4.17e)	critically analyse the accuracy of scientific information presented in mass media																		
4.17f)	identify trends, patterns, relationships and contradictions in data and information																		
4.17g)	apply mathematical concepts and computer-based technologies to assist analysis of data and information																		

 ISBN 978 1 4425 1 5413

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		Science Focus 1									Science Focus 2								
Outcomes		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
4.18a)	select, and use appropriately, types of texts for different purposes and contexts including a discussion, explanation, procedure, exposition, recount, report, response or experimental records for oral or written presentation																		
4.18b)	select and use an appropriate medium to present data and information																		
4.18c)	select and use an appropriate method to acknowledge sources of information																		
4.18d)	use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities																		
4.18e)	use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly																		
4.18f)	select and draw the appropriate type of graph (from column graph, histogram, divided bar, sector or line graph) or diagram to convey information and relationships clearly and accurately																		
4.19a)	justify inferences in light of gathered information																		
4.19b)	identify data which support or discount a hypothesis, a question being investigated or a proposed solution to a problem																		
4.19c)	predict outcomes and generate plausible explanations directly related to observations made																		
4.19d)	make generalisations in relation to a relevant set of observations or experimental results																		
4.19e)	anticipate and/or respond to problems as they arise in practical situations																		
4.19f)	use models, including mathematical ones, to explain phenomena or make predictions																		
4.19g)	use cause-and-effect relationships to explain ideas																		
4.20a)	identify the nature of a presented problem																		
4.20b)	describe different strategies that could be employed to solve an identified problem																		
4.20c)	use identified strategies to develop a range of possible solutions to a particular problem																		

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

		Science Focus 1									*Science Focus 2*								
Outcomes		**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**	**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**
4.20d)	evaluate the appropriateness of different strategies for solving an identified problem																		
4.21a)	seek evidence to support claims																		
4.21b)	evaluate evidence for reliability and validity																		
4.21c)	produce creative solutions for problems																		
4.21d)	propose ideas that demonstrate coherence and logical progression																		
4.21e)	apply critical thinking in the consideration of proposals																		
4.21f)	formulate cause-and-effect relationships																		
4.22.1a)	independently plan and conduct investigations, communicate information and understandings and solve problems																		
4.22.1b)	set and work to realistic timelines and goals																		
4.22.1c)	accept responsibility for maintenance of a safe working environment for themselves and others																		
4.22.1d)	evaluate the effectiveness of their performance in completing the task																		
4.22.2a)	identify the specific roles needed when working in a team																		
4.22.2b)	match the tasks to the team members according to the requirements of the task and the skills of the individual																		
4.22.2c)	negotiate and allocate individual roles to members of the team																		
4.22.2d)	accept specific roles in a team while planning and conducting investigations, communicating information and understandings and solving problems																		
4.22.2e)	set and work to realistic timelines and goals as a group																		
4.22.2f)	accept personal responsibility for maintenance of a safe working environment for the team																		
4.22.2g)	monitor progress of the team towards completion of a task																		
4.22.2h)	evaluate the process used by the team and effectiveness of the team in completing the task																		

SKILLS – CORE CONTENT

STAGE 5

Outcomes		*Science Focus 3*									*Science Focus 4*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.13.1a)	describe a problem, hypothesis or question that can be tested or researched												3.2		5.3	6.1 6.3 6.6			9.2
5.13.1b)	propose possible sources of data and/or information relevant to the investigation												3.2		5.3	6.1 6.3 6.6			9.2
5.13.1c)	identify what type of information or data needs to be collected											2.3 2.4	3.2		5.3	6.1 6.3 6.6			9.2
5.13.1d)	justify why particular types of data or information are to be collected											2.3 2.4	3.2		5.3	6.1 6.3 6.6			9.2
5.13.1e)	identify the appropriate units to be used in collecting data												3.2		5.3	6.1 6.3 6.6			9.2
5.13.1f)	recommend the use of an appropriate technology or strategy for collecting data or gathering information												3.2		5.3	6.1 6.3 6.6	7.1		9.2
5.13.1g)	formulate a means of recording the data to be gathered or the information to be collected												3.2		5.3	6.1 6.3 6.6	7.1		9.2
5.13.2a)	identify variables that need to be kept the same if first-hand data is to be collected										1.1	2.3 2.4	3.2	4.2	5.3	6.1 6.3 6.6	7.1 7.2 7.3		9.2
5.13.2b)	specify the dependent and independent variables when planning controlled experiments										1.1	2.3 2.4	3.2		5.3	6.1 6.3 6.6	7.3		9.2

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes	*Science Focus 3*									*Science Focus 4*								
	Ch1	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**	**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**
5.13.2c) describes a logical procedure for undertaking a simple or controlled experiment											2.3 2.4	3.2		5.3	6.1 6.3 6.6	7.1 7.3		9.2
5.13.2d) establish an appropriate timeline for an investigation											2.3 2.4	3.2	4.3	5.3	6.1 6.3 6.6	7.3		9.2
5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task															6.1 6.3 6.6	7.3		9.2
5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task											2.3 2.4	4.2 4.3		5.3	6.1 6.3 6.6	7.1 7.3		9.2
5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field											2.3 2.4	4.3	4.3	5.3	6.1 6.3 6.6	7.1 7.3		9.2
5.14a) follow the planned procedure when performing an investigation										1.1 1.2	2.1 2.3 2.4 2.5 SF	3.1 3.2 3.3	4.1 4.3 4.4 4.5	5.2	6.1 6.3 6.5 6.7	7.1 7.2 7.3	8.2 8.4	
5.14b) use time and resources effectively										1.1		3.3	4.1 4.3		6.1 6.5 6.7	7.1 7.2 7.3	8.2 8.4	
5.14c) safely and efficiently construct, assemble and manipulate identified equipment										1.2	2.3 2.4 2.5 SF	3.1 3.3	4.1 4.3 4.5		6.1 6.3 6.5	7.1 7.2 7.3		
5.14d) record data using the appropriate units											2.1 2.3 2.4 2.5	3.2	4.5		6.1 6.2 6.5 6.7	7.1 7.2 7.3	8.2	

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Outcomes		*Science Focus 3*									*Science Focus 4*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.14e)	evaluate and modify experimental procedures											2.3 2.4 2.5	3.2 3.3	4.5		6.1 6.3 6.5	7.1 7.2 7.3	8.2	
5.14f)	demonstrate the use of safe and hygienic work practices, including the correct use of safety equipment											2.3 2.4 2.5	3.3	4.1 4.3 4.5		6.1 6.5	7.1 7.2 7.3		
5.15a)	make and record observations and measurements accurately										1.1 1.2	2.3 2.4 2.5 SF	3.1 3.3	4.1 4.5	5.2	6.1 6.2 6.3 6.5 6.6 6.7	7.1 7.2 7.3	8.2	9.2
5.15b)	use independently a range of data collection strategies and technologies such as dataloggers										1.1					6.1 6.2 6.4 6.6	7.1	8.2	9.2
5.16a)	use a range of sources, including CD-ROMs and the Internet, to access information										1.3	2.1 2.2 2.3 2.4 2.5	3.1 3.2 3.3 3.4 SF	4.1 4.2 4.3 4.4 4.5	5.1 5.2 5.3 5.4 SF	6.1 6.2 6.3 6.5 6.6 6.7	7.2 7.3 7.4	8.2	SF
5.16b)	use a variety of techniques, such as key words, skimming and scanning, to identify appropriate information										1.2 1.3	2.1	3.1 3.2 3.3 3.4 SF	4.1 4.2 4.3 4.4 4.5	5.1 5.2 5.3 5.4 SF	6.1 6.2 6.3 6.5 6.6 6.7	7.2 7.3 7.4		SF
5.16c)	extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio/visual resources											2.1 2.2	3.1 SF	4.1 4.2 4.3 4.4	5.1 5.2	6.1 6.2		8.2 8.3	SF

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes		*Science Focus 3*									*Science Focus 4*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.16d)	summarise information from identified oral and written secondary sources										1.2 1.3	2.2	3.1 3.2 3.3 SF	4.1 4.2 4.3 4.4 4.5	5.1 5.2	6.1 6.2 6.3 6.5 6.6 6.7		8.2	SF
5.17a)	collate information from a number of sources											2.3 2.4 2.5	3.2 3.3 3.4			6.1 6.2 6.6			9.1
5.17b)	distinguish between relevant and irrelevant information											2.2 2.4 2.5	3.3 3.4	4.4		6.2			9.1
5.17c)	check reliability of gathered data and information by comparing them with observations or information from other sources												3.1 3.2 3.4	4.1 4.4		6.2			
5.17d)	organise data using a variety of methods including diagrams, tables, spreadsheets and databases												3.1 3.2		5.1 5.2	6.2	7.1		9.1
5.17e)	critically analyse the accuracy of scientific information presented in the mass media												3.2 3.3 3.4			6.2	7.2		
5.17f)	identify trends, patterns, relationships and contradictions in data and information										1.3	2.3 2.4 2.5	3.1 3.2		5.1 5.2	6.1 6.5	7.1		9.1
5.17g)	apply mathematical concepts and computer-based technologies to assist analysis of data and information										1.1 1.3		3.2			6.1 6.7	7.1		SF
5.18a)	select, and use appropriately, types of texts for different purposes and contexts including a discussion, explanation, procedure, exposition, recount, report, response or experimental records for oral or written presentation										1.3	2.1 2.2 2.3 2.4 2.5	3.4 SF	4.2 4.4	5.4 SF	6.2 6.3 6.6	7.3	8.2 8.4	SF

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes		*Science Focus 3*									*Science Focus 4*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.18b)	select and use an appropriate medium to present data and information											2.1 2.2 2.3 2.4 2.5 SF	3.1 3.2 3.3 3.4 SF	4.2 4.3 4.4		6.2 6.3 6.6	7.2 7.4	8.2	SF
5.18c)	select and use an appropriate method to acknowledge sources of information											2.1 2.2	3.1 3.4 SF	4.2		6.3 6.6	7.4		9.2
5.18d)	use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities												3.1 SF	4.2		6.1 6.2	7.1		
5.18e)	use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly											2.3 2.4 2.5	3.1 3.2 SF	4.2		6.1		8.2	9.2
5.18f)	select and draw the appropriate type of graph (from column graph, histogram, divided bar, sector or line graph) or diagram to convey information and relationships clearly and accurately											2.2 2.3 2.4 2.5	3.1 3.2 SF	4.1		6.1 6.7		8.2	
5.19a)	justify inferences in light of gathered information										1.1	2.3 2.4 2.5	3.1 3.2	4.4	5.1 5.2 5.3 SF	6.3 6.5	7.1 7.2		9.2
5.19b)	identify data which support or discount a hypothesis, a question being investigated or a proposed solution to a problem										1.1	2.3 2.4 2.5 SF	3.2		5.1 5.2	6.3 6.5	7.1 7.2		9.2
5.19c)	predict outcomes and generate plausible explanations directly related to observations made											2.3 2.4 2.5 SF	3.1 3.2			6.3 6.5	7.1 7.2		

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes		*Science Focus 3*									*Science Focus 4*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.19d)	make generalisations in relation to a relevant set of observations or experimental results										1.2 1.3	2.1 2.3 2.4 2.5	3.1 3.2	4.1		6.3 6.5 6.7	7.1 7.2	8.2	
5.19e)	anticipate and/or respond to problems as they arise in practical situations												3.1	4.1	5.2	6.3 6.5	7.2		
5.19f)	use models, including mathematical ones, to explain phenomena or make predictions										1.1 1.3	2.3 2.4 2.5	3.1 3.2			6.3 6.5 6.7	7.2		
5.19g)	use cause-and-effect relationships to explain ideas										1.1 1.2	2.3 2.4 2.5	3.4	4.4		6.3 6.5 6.7	7.2		
5.20a)	identify the nature of a presented problem												3.3 3.4	4.1		6.5	7.2		9.2
5.20b)	describe different strategies that could be employed to solve an identified problem												4.3 3.4	4.1		6.5	7.2		9.2
5.20c)	use identified strategies to develop a range of possible solutions to a particular problem												3.3	4.1		6.5	7.2		
5.20d)	evaluate the appropriateness of different strategies for solving an identified problem												3.3			6.5	7.2		
5.21a)	seek evidence to support claims												3.2 3.4		SF	6.2 6.6			
5.21b)	evaluate evidence for reliability and validity												3.2 3.4		SF	6.2 6.6			
5.21c)	produce creative solutions for problems												3.2 3.4	4.1	SF	6.6 6.7			
5.21d)	propose ideas that demonstrate coherence and logical progression											2.2	3.2 3.4		SF	6.6 6.7			
5.21e)	apply critical thinking in the consideration of proposals												3.2 3.4		5.2 SF	6.2 6.6			

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes		*Science Focus 3*									*Science Focus 4*								
		Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9	Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
5.21f)	formulate cause-and-effect relationships											2.2	3.2 3.4			6.2 6.6	7.2		
5.22.1a)	independently plan and conduct investigations, communicate information and understandings and solve problems										1.1	2.3 2.4 2.5	3.2 3.3	4.4			7.2		9.1
5.22.1b)	set and work to realistic timelines and goals										1.1 1.2	2.3 2.4 2.5	3.2 3.3	4.4			7.3		9.1
5.22.1c)	accept responsibility for maintenance of a safe working environment for themselves and others										1.1 1.2	2.3 2.4 2.5	3.2 3.3				7.3		9.1
5.22.1d)	evaluate the effectiveness of their performance in completing the task										1.1	2.1 2.3 2.4 2.5	3.2 3.3				7.3		9.1
5.22.2a)	identify the specific roles needed when working in a team										1.2	2.2 SF	3.1	4.4	5.2	6.1 6.5 6.6	7.3		
5.22.2b)	match the tasks to the team members according to the requirements of the task and the skills of the individual										1.2		3.1		5.2	6.1 6.5 6.6	7.1		
5.22.2c)	negotiate and allocate individual roles to members of the team										1.2		3.1			6.1 6.5 6.6	7.1		
5.22.2d)	accept specific roles in a team while planning and conducting investigations, communicating information and understandings and solving problems										1.2		3.1	4.4		6.5 6.6			
5.22.2e)	set and work to realistic timelines and goals as a group												3.1	4.4	5.2	6.5 6.6			

Science Focus 4 Curriculum Correlation Grid for *PFA* and *Skills* outcomes

Outcomes	*Science Focus 3*									*Science Focus 4*								
	Ch1	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**	**Ch1**	**Ch2**	**Ch3**	**Ch4**	**Ch5**	**Ch6**	**Ch7**	**Ch8**	**Ch9**
5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team										1.2	2.2 2.3 2.4 2.5	3.1			6.1 6.5 6.6	7.1		
5.22.2g) monitor progress of the team towards completion of a task											SF	3.1		5.2	6.1 6.5 6.6	7.1		
5.22.2h) evaluate the process used by the team and effectiveness of the team in completing the task										1.2		3.1	4.4		6.1 6.5 6.6			

Stage 4

Science Focus 1 and Science Focus 2

Outcome 4.6 identifies and describes energy changes and the action of forces in common situations			
Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.6.1 the law of conservation of energy	a) identify situations or phenomena in which different forms of energy are evident b) use models to describe different forms of energy c) identify objects that possess energy because of their motion (kinetic) or because of other properties (potential) d) qualitatively account for the total energy involved in energy transfers and transformations		
4.6.2 forces	a) identify changes that take place when particular forces are acting b) use the term 'field' in describing forces acting at a distance		
4.6.3 electrical energy	a) associate electricity with energy transfer in a simple circuit b) construct and draw circuits to show transfer of energy		
4.6.4 sound energy	a) describe sound as a form of energy requiring a medium for propagation		
4.6.5 light energy	a) describe light as a form of energy not requiring a medium for propagation		
4.6.6 heat energy	a) identify processes of heat transfer by conduction, convection and radiation		

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.6.7 frictional force	a) describe friction as a contact force which opposes motion b) identify everyday situations where friction acts		
4.6.8 electrostatic force	a) describe ways in which objects acquire an electrostatic charge b) identify everyday situations where the effects of electrostatic forces can be observed c) describe the behaviour of charges when they are brought close to each other		
4.6.9 magnetic force	a) describe the behaviour of magnetic poles when they are brought close to each other b) identify everyday situations in which magnets and electromagnets are used		
4.6.10 gravitational force	a) identify that all objects exert a force of gravity on all other objects in the universe		

Syllabus map for *Science Focus* series NSW Stages 4 and 5

Outcome 4.7 describes observed properties of substances using scientific models and theories			
Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.7.1 the particle model of matter	a) describe the behaviour of matter in terms of particles that are continuously moving and interacting b) describe expansion and contraction of materials in terms of a simple particle model c) relate an increase or decrease in the amount of energy possessed by particles to changes in particle movement		
4.7.2 properties of solids, liquids and gases	a) relate properties of solids, liquids and gases to the particle model of matter b) describe the physical changes that occur during observations of evaporation, condensation, boiling, melting and freezing c) explain density in terms of a simple particle model d) explain changes in pressure in terms of increases or decreases in the frequency of particle collisions		
4.7.3 change of state	a) relate changes of state to the motion of particles as energy is removed or added b) relate energy transfers in melting and freezing, condensation, evaporation and boiling to the particle model		

Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.7.4 elements	a) classify elements as metals or non-metals according to their common characteristics b) identify internationally recognised symbols for common elements		
4.7.5 mixtures	a) identify some common mixtures b) identify, using examples, the importance of water as a solvent c) describe aqueous mixtures in terms of solute, solvent and solution d) identify situations where the processes of filtration, sedimentation, sieving, distillation, chromatography, evaporation, condensation, crystallisation and magnetic attraction are appropriate to separate components of a mixture		

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.7.6 compounds and reactions	a) distinguish between elements and compounds b) identify when a chemical reaction is taking place by observing changes in temperature, the appearance of a new substance or the disappearance of an original substance c) distinguish between compounds and mixtures		

Outcome 4.8 describes features of living things

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.8.1 cell theory	a) identify that living things are made of cells b) identify and describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, chloroplast c) identify that substances move into and out of cells d) distinguish between unicellular and multicellular organisms		

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.8.2 classification	a) classify living things according to structural features and identify that they have patterns of similarities and differences b) identify a range of plants and animals using simple keys		

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.8.3 unicellular organisms	a) identify the beneficial and harmful effects that microorganisms have on living things and the environment b) explain that reproduction in unicellular organisms takes place by cell division		

Syllabus map for *Science Focus* series NSW Stages 4 and 5

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.8.4 multicellular organisms	a) identify that there is a wide range of multicellular organisms b) identify that tissues, organs and organ systems in multicellular organisms consist of different types of cells c) explain why multicellular organisms require specialised organs and systems d) identify the materials required by multicellular organisms for the processes of respiration and photosynthesis e) describe the role of the root, stem and leaf in maintaining flowering plants as functioning organisms		

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.8.5 humans	a) describe the role of the digestive, circulatory, excretory, skeletal and respiratory systems in maintaining humans as functioning organisms		

Outcome 4.9 describes the dynamic structure of Earth and its relationship to other parts of our Solar System and universe

Students learn about:	Students learn to:	Science Focus 1	Science Focus 2
4.9.1 the Newtonian model of the Solar System	a) describe qualitatively relative sizes, distances and movements of components of our Solar System b) describe relative movements of the planets, moons and Sun c) explain night and day in terms of Earth's rotation d) explain the seasons in terms of the tilt of Earth's axis and its revolution around the Sun		
4.9.2 components of the universe	a) describe some major features of the universe, including galaxies, stars, nebulae and solar systems b) use appropriate scales to describe differences in sizes of, and distances between, structures making up the universe		

Syllabus map for *Science Focus* series NSW Stages 4 and 5

Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.9.3 the structure of Earth	a) describe the inner structure of Earth in terms of core, mantle, crust and lithosphere		
4.9.4 the atmosphere	a) identify gases that comprise the greater percentage of air and explain the difference between Earth's atmosphere and space b) describe the importance of atmospheric gases, including ozone and greenhouse gases, to life on Earth		
4.9.5 the hydrosphere	a) describe the water cycle in terms of the physical processes involved b) describe the effect of the forces of the Sun and Moon on the hydrosphere		
4.9.6 the lithosphere	a) identify that rocks are composed of minerals b) explain the breaking down of rocks in terms of physical and/or chemical changes c) relate the formation of landforms to weathering, erosion and deposition d) describe the origins of sedimentary, igneous and metamorphic rocks		

Outcome 4.10 identifies the factors affecting survival of organisms in an ecosystem			
Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.10 ecosystems	a) describe some adaptations of living things to factors in their environment b) describe, using examples of food chains and food webs from Australian ecosystems, how producers, consumers and decomposers are related c) describe the roles of photosynthesis and respiration in ecosystems d) discuss some effects of bushfires, drought and flood on Australian ecosystems		

Syllabus map for *Science Focus* series NSW Stages 4 and 5

Outcome 4.11 identifies resources used by humans and where they are found, and describes ways in which they are exploited			
Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.11 natural resources	a) distinguish between natural and made resources b) give examples of resources from living things and resources extracted from the air, earth and oceans c) identify fossil fuels and describe some of their uses d) identify renewable and non-renewable sources of energy		

Outcome 4.12 identifies, using examples, common simple devices and explains why they are used			
Students learn about:	**Students learn to:**	**Science Focus 1**	**Science Focus 2**
4.12 technology	a) identify that technologies make tasks easier or more convenient b) identify a variety of energy transformations in everyday devices involving either electrical, sound, light and/or heat energy		

Stage 5

Science Focus 3 and Science Focus 4

Outcome 5.6 applies basic physical models, theories and laws to situations involving energy, force and motion

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.6.1 the wave model	a) identify waves as carriers of energy		7.3
	b) qualitatively describe features of waves including frequency, wavelength and speed		7.3
	c) give examples of different types of radiation that make up the electromagnetic spectrum and identify some of their uses		7.2

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.6.2 Newton's laws – motion	a) describe qualitatively the relationship between force, mass and acceleration		6.3, 6.4, 6.5
	b) explain qualitatively the relationship between distance, speed and time		6.1
	c) relate qualitatively acceleration to a change in speed and/or direction as a result of a net force		6.2
	d) analyse qualitatively common situations involving motion in terms of Newton's laws		6.3, 6.4, 6.5, 6.7

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.6.3 electrical energy	a) design, construct and draw circuits containing a number of components		7.1
	b) describe voltage, resistance and current using analogies		7.1
	c) describe qualitatively the relationship between voltage, resistance and current		7.1
	d) compare the characteristics and applications of series and parallel circuits		7.1

Syllabus map for *Science Focus* series NSW Stages 4 and 5

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.6.4 light energy	a) distinguish between the absorption, reflection and refraction of light and identify everyday situations where each occurs		

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.6.5 nuclear energy	a) identify that energy and particles may be released from the nuclei of atoms		1.3

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.6.6 gravitational force	a) distinguish between the terms 'mass' and 'weight'		6.6

Outcome 5.7 relates properties of elements, compounds and mixtures to scientific models, theories and laws			
Students learn about:	**Students learn to:**	**Science Focus 3**	**Science Focus 4**
5.7.1 atomic theory	a) describe features of and the location of protons, neutrons and electrons in the atom b) distinguish between elements, using information about the numbers of protons, neutrons and electrons c) describe an appropriate model that has been developed to describe atomic structure		1.3
5.7.2 elements	a) identify the atom as the smallest unit of an element and distinguish between atoms and molecules b) describe some relationships between elements using the periodic table		

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.7.3 compounds and reactions	a) identify that a new compound is formed by rearranging atoms rather than by creating matter b) classify compounds into groups based on common chemical characteristics c) construct word equations from observations and written descriptions of a range of chemical reactions d) identify a range of common compounds using their common names and chemical formulae e) qualitatively describe reactants and products in the following chemical reactions: i) combustion ii) corrosion iii) precipitation iv) acids on metals and carbonates v) neutralisation vi) decomposition f) describe the role of indicators		1.1, 2.1, 2.3, 2.4, 2.5 2.1, 2.2, 2.3, 2.4, 2SF 1.1, 2.5, 2SF 1.1, 2.1, 2.3, 2.4, 2SF 1.2

Outcome 5.8 relates the structure and function of living things to models, theories and laws			
Students learn about:	**Students learn to:**	**Science Focus 3**	**Science Focus 4**
5.8.1 cell theory	a) explain that systems in multicellular organisms serve the needs of cells b) identify the role of cell division in growth, repair and reproduction in multicellular organisms		
5.8.2 the Watson-Crick model of DNA	a) explain the advantages of DNA replicating exactly b) explain the advantages and disadvantages of DNA mutating c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves d) identify that genes are part of DNA e) identify the role of genes and environmental factors in determining the features of an organism		3.2 3.4 3.2 3.1, 3.3 3.4

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.8.3 the theory of evolution and natural selection	a) discuss evidence that present-day organisms have developed from organisms in the distant past b) relate natural selection to the theory of evolution		5.1 to 5.4, SF 5.1 to 5.4, SF

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.8.4 humans	a) describe the role of, and interaction between, coordination systems in maintaining humans as functioning organisms b) describe some responses of body systems to infectious and non-infectious diseases c) relate the organs involved in human reproductive systems to their function		4.2 to 4.5, SF 4.1 to 4.5, SF

Outcome 5.9 relates the development of the universe and the dynamic structure of Earth to models, theories and laws and the influence of time			
Students learn about:	**Students learn to:**	**Science Focus 3**	**Science Focus 4**
5.9.1 the Big Bang theory	a) discuss current scientific thinking about the origin of the universe b) identify that some types of electromagnetic radiation are used to provide information about the universe c) describe some of the difficulties in obtaining information about the universe		
5.9.3 components of the universe	a) relate some major features of the universe to theories about the formation of the universe b) describe some changes that are likely to take place during the life of a star		

Syllabus map for *Science Focus* series NSW Stages 4 and 5

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.9.2 the theory of plate tectonics	a) discuss evidence that suggests crustal plates move over time		
5.9.4 natural events	a) identify that geological history can be interpreted from the formation, by sediments, of horizontal layers in which the oldest are at the base and the youngest are at the top b) describe conditions under which fossils form c) relate the fossil record to the age of Earth and the time over which life has been evolving d) relate movements of Earth's plates to convection currents in the mantle and to gravitational forces e) explain how interactions at plate boundaries may result in earthquakes, volcanic activity and new landforms f) explain some impacts of natural events including cyclones, volcanic eruptions and earthquakes on the atmosphere, hydrosphere, lithosphere and/or biosphere		

Outcome 5.10 assesses human impacts on the interaction of biotic and abiotic features of the environment

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.10 ecosystems	a) distinguish between biotic and abiotic features of the local environment b) describe the importance of cycles of materials in ecosystems c) describe some impacts of human activities on ecosystems		2.2, 8.1, 8.2, 8.3, 8.4, 8.5

Outcome 5.11 analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources

Students learn about:	Students learn to:	Science Focus 3	Science Focus 4
5.11.1 energy resources	a) discuss the importance of energy as a resource b) identify properties that make some natural resources economically important and describe their uses		2.2

5.11.2 waste from resource use	a) relate pollution to contamination by unwanted substances b) identify excessive use of fossil fuels as a contributing factor to a greenhouse effect c) discuss strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality of the environment		8.1, 8.2, 8.3 8.1, 8.2, 8.3 2.2

Outcome 5.12 describes scientific principles underlying some common technologies			
Students learn about:	**Students learn to:**	**Science Focus 3**	**Science Focus 4**
5.12 technology	a) describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy c) describe some benefits and problems of using biotechnology d) describe ways in which technology has increased the variety of made resources		7.2, 7.3 8.1, 8.3 1.3, 8.4, 8.5 2.3, 2.4, 2.5, 7.2, 8.4, 8.5

Science Focus Teaching Program Introduction

The main teaching features of each unit are highlighted in these teaching programs. The skills from the syllabus that are identified in each unit are those that form a major component of skill development for that unit. Where possible, additional content has been provided in each chapter.

It is suggested that these programs be used only as a scaffold for developing individual school-based programs.
When modifying the programs please include:

- relevant guidelines and directives from your educational sector
- school-based curriculum development policies
- occupational health and safety standards
- chemical safety in schools
- animal welfare guidelines.

When modifying the programs consider:

- what teaching and learning approach your faculty uses
- students' learning styles, cultural backgrounds and specific learning needs
- school resources and resource priorities.

The Teacher Edition wraparound notes provide extra activities that are useful in teaching the program. Choose which suit your school's teaching practices and your students' learning styles according to the Multiple Intelligences.

Refer to the Science Year 7–10 syllabus support document, *Advice on Programming and Assessment* and the *Quality Science* CD for information and guidance on program development and evaluation.

The document *Advice on Programming and Assessment* is an invaluable resource. It provides advice about constructing a program, maps a process for planning and sequencing of units, and offers advice on how to develop teaching and learning activities.
It provides scaffolds for:

- stage scope and sequence plans
- sample lesson sequences
- building a teaching and learning program
- developing units of work to ensure coverage of the scope of the syllabus.

1: Chemical and nuclear reactions

Prescribed focus area	**Applications and uses of science** 5.3a) identify and describe examples of scientific concepts and principles that have been used in technological developments (including Australian examples) 5.3b) discuss, using examples, the positive and negative impacts of applications of recent developments in science 5.3c) identify and describe examples where technological advances have impacted on science 5.3d) give reasons why society should support scientific research.

Domain outcomes	
Knowledge and understanding	5.6.5 nuclear energy 5.6.5a) identify that energy and particles may be released from the nuclei of atoms 5.7.1 atomic theory 5.7.1b) distinguish between elements using information about the numbers of protons, neutrons and electrons 5.7.3 compounds and reactions 5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.7.3e) qualitatively describe reactants and products in the following chemical reaction i) combustion ii) corrosion 5.12b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy.
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately

	5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.
Values and attitudes	5.23 demonstrates confidence and willingness to make decisions and to take responsible actions 5.24 respects differing viewpoints on science issues and is honest, fair and ethical 5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them.

Unit 1.1 Chemical reactions

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions	5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.13.2a) identify variables that need to be	**Quick quiz**: Chapter 1 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Change** Remind students the difference between physical and chemical change. **Web destination**: Chemical reactions (*Science Focus 4 Second Edition LiveText*) **Chemical change** occurs when there is a chemical reaction. **Video**: Catalysis (*Science Focus 4 Second Edition LiveText*,	Quick quiz Web destination Video	

	kept held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data-collection strategies and technologies, such as data loggers 5.16b) use a variety of techniques, such as key words, skimming and scanning, to identify appropriate information 5.17g) apply mathematical concepts and computer-based technologies to assist analysis of data and information 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, question being investigated or the proposed solution to a problem 5.19f) use models, including mathematical ones, to explain	*Science Focus 4 Second Edition Student Lounge*) **Prac 1**: Studying a reaction **Symbols and formulae** Recall that chemical equations take the form: reactants → products. Review elements, compounds, ions, metals and bonding. **Web destination**: The periodic table of elements (*Science Focus 4 Second Edition LiveText*) **Web destination**: Ten signs of chemical change (*Science Focus 4 Second Edition LiveText*) **Chemical equations** A chemical equation takes the general form: reactants → products. **Interactive:** Naming ionic compounds (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Worksheet 1.1**: Writing formulas **Balanced chemical equations** Define the role of subscript numbers in chemical formulae. Construct a step-by-step method for balancing a chemical equation. **Interactive:** Balancing equations (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) Define the Law of Conservation of Matter and Law of	Prac 1 Web destination Web destination Interactive Worksheet 1.1 Interactive	

	phenomena or make predictions 5.19g) use cause and effect relationships to explain ideas 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task	Conservation of Mass. **Prac 2**: Conservation of mass **The state of reactants and products** Define how scientists indicate the state of reactants and products. **Worksheet 1.2**: Chemical equations **Worksheet 1.3**: Chemical reactions **Interactive:** Representation of a chemical equation (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Controlling reaction rates** Consider temperature, concentration, changing surface area and catalysts. **Video**: Sodium and potassium in water (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 3**: Rates of reactions 1 **Prac 4**: Rates of reactions 2 (DYO) **Interactive:** Reaction rates (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 5**: Reaction rate—effect of catalysts and enzymes **Worksheet 1.4**: Rates of reaction **Drag and drop**: Writing chemical equations (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Prac 2 Worksheet 1.2 Worksheet 1.3 Interactive Video Prac 3 Prac 4 Interactive Prac 5 Worksheet 1.4 Drag and drop	

		Unit 1.1 questions **Web destination**: Chemistry tutorials (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Chemical compounds (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Balancing equations (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Creative chemistry (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Unit questions Web destination Web destination Web destination Web destination	

Unit 1.2 Corrosion and oxidation

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions	5.7.3e) qualitatively describe reactants and products in the following chemical reactions: i) combustion ii) corrosion 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct,	**Oxidation reactions** Introduce combustion and corrosion. **Combustion** Combustion that is incomplete or complete combustion. **Web destination**: Combustion reactions (*Science Focus 4 Second Edition LiveText*) **Prac 1**: Complete and incomplete combustion	Web destination Prac 1	

	assemble and manipulate identified equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19g) use cause and effect relationships to explain ideas 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for	**Corrosion** Describe the process of rusting and the compounds formed. **Prac 2**: Corrosion of iron **Prac 3**: Observing iron hydroxides **Corrosion protection** Compare the various methods used to protect metals from corrosion. Describe the process of protection for aluminium. **Worksheet 1.5**: Metal experiments **Prac 4**: Anodised aluminium **Drag and drop**: Corrosion protection (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Channel 4 video**: Investigating reactivity of metals (*Science Focus 4 Second Edition LiveText*) **Unit 1.2 questions**	 Prac 2 Prac 3 Worksheet 1.5 Prac 4 Drag and drop Video Unit questions	

	maintenance of a safe working environment for themselves and others 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team members according to the requirements of the task and the skills of the individual 5.22.2c) negotiate and allocate individual roles to members of the team 5.22.2d) accept specific roles in a team while planning and conducting investigations, communicating, information and understandings and solving problems 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team 5.22.2h) evaluate the process used by the group and effectiveness of the team in completing the task			

Unit 1.3 Nuclear reactions and radiation

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.5 nuclear energy 5.7.1 atomic theory 5.12 technology	5.6.5a) identify that energy and particles may be released from the nuclei of atoms 5.7.1b) distinguish between elements using information about the number of protons, neutrons and electrons 5.12b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.17g) apply mathematical concepts and computer-based technologies to assist analysis of data and information	**Radiation and radioactivity** Define what occurs when a radioactive element's nucleus breaks apart. **Atoms and isotopes** Define an isotope as atoms of the same element with different numbers of neutrons in the nucleus. Describe the isotopes of hydrogen. **Three types of nuclear radiation** Describe the three main types of radioactive decay: alpha, beta and gamma radiation. **Worksheet 1.6**: Uranium decay series **Web destination**: The power of radiation (*Science Focus 4 Second Edition LiveText*) **Half-life** Define the half-life of various isotopes. **Prac 1**: Half-life is sweet **Interactive:** Radioactive decay (*Science Focus 4 Second Edition LiveText*) **Sources of nuclear radiation** Describe both natural and artificial sources of radiation.	Worksheet 1.6 Web destination Prac 1 Interactive	

	5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19f) use models, including mathematical ones, to explain phenomena or make predictions	**Effects of radiation** Describe the biological effects of excess nuclear radiation. Describe how radiation is measured and the units used. **Uses of nuclear radiation** Research various uses for nuclear radiation, including nuclear medicine, industrial applications and carbon dating. **Drag and drop**: Radiation (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Guide to the nuclear wall chart (*Science Focus 4 Second Edition LiveText*) **Unit 1.3 questions**	Drag and drop Web destination Unit questions	

Chapter review

Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
Complete chapter review questions at the end of the chapter **Worksheet 1.7**: Crossword **Worksheet 1.8**: Sci-words **Chapter Review Questions** (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Test**	Chapter review questions Worksheet 1.7 Worksheet 1.8 Chapter Review Questions Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

2: Materials

Prescribed focus area	**The implications of science for society and the environment** 5.4a) discuss viewpoints about some issues with a major scientific component 5.4b) give examples to show that different societal groups may use or weight criteria differently to make a decision about an issue involving a major scientific component 5.4c) identify choices that need to be or have been made when considering whether to use particular scientific advances 5.4d) analyse the reasons why different cultures or groups within a society, including Aboriginal people, may have different views in relation to scientific issues 5.4e) discuss the place of ethical considerations in scientific practice and in applications of science.

Domain outcomes	
Knowledge and understanding	5.7.3 compounds and reactions 5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3b) classify compounds into groups based on common chemical characteristics 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.10 ecosystems 5.10c) describe some impacts of human activities on ecosystems 5.11.1 energy resources 5.11.1b) identify properties that make some natural resources economically important and describe their uses 5.11.2 waste from resource use 5.11.2c) discuss strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality and sustainability of the environment 5.12 technology 5.12d) describe ways in which technology has increased the variety of made resources.

2: Materials

Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.
Values and attitudes	5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them 5.27 acknowledges their responsibility to conserve, protect and maintain the environment for the future.

Unit 2.1 Pure metals and alloys

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions	5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3b) classify compounds into groups based on common chemical characteristics 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.14a) follow the planned procedure when performing an investigation 5.14d) record data using the appropriate units 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams,	**Quick quiz**: Chapter 2 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Composite materials (*Science Focus 4 Second Edition LiveText*) **Metallic bonding/Properties of metals** Recall the properties of metals. **Pure metals** Define pure metals and list their properties and uses. **Drag and drop**: Pure metals (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 1**: Metallic crystals **Alloys** Define an alloy and the advantages they possess over the base metal. **Prac 2**: How much is it worth? **Worksheet 2.1**: Toothache! **Worksheet 2.2**: Media analysis 1 **Drag and drop**: Pure metals and alloys (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Quick quiz Web destination Drag and drop Prac 1 Prac 2 Worksheet 2.1 Worksheet 2.2 Drag and drop	

	other texts and audio-visual resources 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.22.1b) set and work to realistic timelines and goals	**Unit 2.1 questions**	Unit questions	

Unit 2.2 Mining and extracting metals

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions 5.10 ecosystems 5.11.1 energy resources 5.11.2 waste from resource use	5.7.3b) classify compounds into groups based on common chemical characteristics 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions 5.10c) describe some impacts of human activities on ecosystems 5.11.1b) identify properties that make some natural resources economically important and describe their uses 5.11.2c) discuss strategies used to balance human activities and needs in ecosystems with conserving, protecting and maintaining the quality and sustainability of the environment 5.16a) use a range of sources including databases, CD-ROM and the Internet, to assess information 5.16c) extract information from column graphs, histograms, divided bar and	**Metals in the crust** Use a pie graph to show the percentage of various elements in the Earth's crust. **Pure metals in nature** Describe how some elements can exist as pure elements in nature. **Drag and drop**: Elements in the Earth's crust (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Metals in minerals and ores** Define minerals and ores. List some common ores and the metal extracted. **Is it worth mining?** Analyse the factors that need to be examined before mining of ores can start. **Web destination**: Mining maps (*Science Focus 4 Second Edition LiveText*) **The mining process** Compare and contrast mining methods. **Prac 1**: Chocolate chip mining **Prac 2**: Froth flotation **Extraction methods** Describe the methods for extracting different metals. Define the activity series and how it determines the extraction	Drag and drop Web destination Prac 1 Prac 2	

	sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.21d) propose ideas that demonstrate coherence and logical progression 5.21f) formulate cause and effect	methods. Extraction by electrolysis: Describe the process and what metals are extracted by this method. **Prac 3**: Extracting copper by electrolysis Extraction by heat: Define smelting and follow the chemical processes involved in steel making. **Prac 4**: Extracting copper by roasting **Channel 4 video**: Smelting copper and tin (*Science Focus 4 Second Edition LiveText*) **Recycling versus mining** Compare recycling of various metals. **Worksheet 2.3**: Extraction of metals **Worksheet 2.4**: Media analysis 2 **Web destination**: Minerals council of Australia (*Science Focus 4 Second Edition LiveText*) **Unit 2.2 questions** **Web destination**: Virtual mineral processing plant (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Prac 3 Prac 4 Video Worksheet 2.3 Worksheet 2.4 Web destination Unit questions Web destination	

	relationships 5.22.2a) identify the specific roles needed when working in a team 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team			

Unit 2.3 Plastics

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions 5.12 technology	5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3b) classify compounds into groups based on common chemical characteristics 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.12d) describe ways in which technology has increased the variety of made resources 5.13.1c) identify what type of information or data needs to be collected	**Plastic: carbon-based compounds** List properties that make plastics so versatile in their application. Predict uses related to the properties of various plastics. **Prac 1**: Identifying plastics **Drag and drop**: How plastics are used (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Channel 4 video**: How is plastic made? (*Science Focus 4 Second Edition LiveText*) **Monomers and polymers** Contrast monomers with polymers. **Prac 2**: Making casein plastic **Heating plastics** Describe the difference between	 Prac 1 Drag and drop Video Prac 2	

	5.13.1d) justify why particular types of data or information are to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental	thermosetting plastics and thermoplastics **Thermosetting plastics/Thermoplastics** Compare and contrast the properties of thermoplastic and thermosetting plastics. **Working with plastic** Examine the various methods used to mould shapes from plastic. **Recycling plastics** Because plastics are not biodegradable, it is important that some are recyclable. **Worksheet 2.5**: Recycling **Unit 2.3 questions** **Web destination**: Recycling (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Worksheet 2.5 Unit questions Web destination	

	procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately over a number of trials 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly			

	and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19f) use models, including mathematical ones, to explain phenomena or make predictions 5.19g) use cause and effect relationships to explain ideas 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for			

	maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team			

Unit 2.4 Fibres

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions 5.12 technology	5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3b) classify compounds into groups based on common chemical characteristics 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.12d) describe ways in which technology has increased the	**Natural and synthetic fibres** Compare and contrast natural and synthetic fibres. Examine how Australian Aboriginals use natural fibres. **Prac 1**: Making nylon: teacher demonstration **Web destination**: Advanced fibrous materials (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Length and strength** Define monofilaments.	 Prac 1 Web destination	

	variety of made resources 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct, assemble and manipulate identified	**Prac 2**: Identifying fibres **Prac 3**: Investigating fibres (DYO) **Other fibres** Describe the formation of carbon and glass. **Unit 2.4 questions**	Prac 2 Prac 3 Unit questions	

	equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information			

	5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19f) use models, including mathematical ones, to explain phenomena or make predictions 5.19g) use cause and effect relationships to explain ideas 5.22.1a) independently plan and conduct investigations, communicate information and understandings			

	and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team			

Science Focus: Organic chemistry

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions	5.7.3b) classify compounds into groups based on common chemical characteristics 5.7.3c) construct word equations from observations and written descriptions of a range of chemical	Organic chemistry: Define the unique properties of carbon in bonding to make millions of stable compounds. Define single, double and triple bonds and how they form. **Prac 1**: Making molecules	Prac 1	

	reactions 5.7.3d) identify a range of common compounds using their common names and chemical formulae 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.15a) make and record observations and measurements accurately 5.18b) select and use an appropriate medium to present data and information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.22.2a) identify the specific roles needed when working in a team 5.22.2g) monitor progress of the group towards completion of a task	Hydrocarbons: Define and use the general formula for alkanes, alkenes and alkynes. Introduce the prefix for the number of carbon atoms. Describe the industrial process of fractional distillation. **Drag and drop**: Fractional distillation of crude oil (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Fractional distillation (*Science Focus 4 Second Edition LiveText*) Using hydrocarbons: Describe a hydrocarbon Making plastics and polymers: Define alcohol as a group of organic chemicals having the functional group –OH. Investigate the combustion of hydrocarbons and alcohols. **Student activities** **Worksheet 2.6**: Organic chemistry	Drag and drop Web destination Student activities Worksheet 2.6	

Unit 2.5 Soap

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.7.3 compounds and reactions 5.12 technology	5.7.3a) identify that a new compound is formed by rearranging atoms rather than by creating matter 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions 5.12d) describe ways in which technology has increased the variety of made resources 5.13.1d) justify why particular types of data or information are to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.3b) select appropriate equipment (including appropriate safety	**Washing in water** How to wash in water. Grease doesn't dissolve by itself. **Making grease soluble** Define surfactants. **Prac 1**: Make soap **Hard and soft water** Describe the difference between hard and soft water. **Prac 2**: How hard is it? (DYO) **Web destination**: Hard and soft water (*Science Focus 4 Second Edition LiveText*) **How soap is made** Describe the process of saponification. **Prac 3**: Powder and liquid laundry detergents (DYO) **Unit 2.5 questions** **Web destination**: Detergents and soaps (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Soaps (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Fun with flat fluids (*Science Focus 4 Second*	 Prac 1 Prac 2 Web destination Prac 3 Unit questions Web destination Web destination Web destination	

	equipment) and/or resources to perform the task 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and	*Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)		

	information 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19g) use cause and effect relationships to explain ideas 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1d) evaluate the effectiveness of			

	their performance in completing the task 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team			

Chapter review

Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
Complete chapter review questions at the end of the chapter **Worksheet 2.7**: Crossword **Worksheet 2.8**: Sci-words **Interactive**: Materials crossword (Science Focus 4 Second Edition LiveText, Science Focus 4 Second Edition Student Lounge) **Chapter Review Questions** (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Test**	Chapter review questions Worksheet 2.7 Worksheet 2.8 Interactive Chapter Review Questions Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

3: Genetics

Prescribed focus area	**Current issues, research and development in science** 5.5a) describe some recent scientific contributions made by male and female scientists, including Australians, and discuss the effect of their contributions 5.5b) evaluate the potential impact of some issues raised in the mass media that require some scientific understanding 5.5c) identify scientific skills that can be useful in a broad range of careers 5.5d) identify possible career paths in science. **The history of science** 5.1 a) identify some of the scientific ideas that different cultures have contributed to science throughout history 5.1b) describe, using examples, including those developed by Aboriginal peoples, ideas developed by different cultures to explain the world around us 5.1c) describe some models and theories that have been considered in science and then been modified or rejected as a result of available evidence 5.1d) discuss examples of where societal, religious or ethical values have had an impact on scientific developments 5.1e) describe historical cases where developments in science have led to the development of new technologies 5.1f) describe historical cases where developments or improvements in technology have transformed science.

Domain outcomes	
Knowledge and understanding	5.8.1 cell theory 5.8.1b) identify the role of cell division in growth, repair and reproduction in multicellular organisms 5.8.2 the Watson-Crick model of DNA 5.8.2a) explain the advantages of DNA replicating exactly 5.8.2b) explain the advantages and disadvantages of DNA mutating 5.8.2c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves 5.8.2d) identify that genes are part of DNA

	5.8.2e) identify the role of genes and environmental factors in determining the features of an organism 5.12 technology 5.12c) describe some benefits and problems of using biotechnology.
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.20 selects and uses appropriate strategies to solve problems 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.
Values and attitudes	5.23 demonstrates confidence and a willingness to make decisions and to take responsible actions 5.24 respects different viewpoints and is honest and fair in dealing with others 5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them.

Unit 3.1 Inheritance

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.1 cell theory 5.8.2 the Watson-Crick model of DNA	5.8.1b) identify the role of cell division in growth, repair and reproduction in multicellular organisms 5.8.2d) identify that genes are part of DNA 5.8.2e) identify the role of genes and environmental factors in determining the features of an organism 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data collection strategies and technologies such as data loggers 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such	**Quick quiz**: Chapter 3 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Heredity and environment** Introduce the terms 'genetics', 'heredity' and 'environment' that affect characteristics of living things. **Mendel: father of genetics** Examine the history of genetics showing Mendel's cross-breeding experiments. Define 'true breeding', 'F_1 and F_2 generations'. Define dominating genetics including 'dominant traits' and 'recessive traits'. **Genes** Define the term 'gene' and where genes are located. **Chromosomes** Define 'chromosomes' and show the number of pairs for various organisms. Describe homologous pairs and their importance. **Web destination**: Genetics basics (*Science Focus 4 Second Edition LiveText*) **Cell reproduction** Define 'mitosis' and 'meiosis' and show the stages in each.	Quick quiz Web destination	

	as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.17c) check reliability of gathered data and information by comparing with observations or information from other sources 5.17d) organise data using a variety of methods including graphs, diagrams, tables, spreadsheets and databases 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.18d) use symbols to express	**Prac 1**: Observing mitosis **Channel 4 video**: Cell division: mitosis (*Science Focus 4 Second Edition LiveText*) **Prac 2**: Modelling meiosis **Drag and drop**: Meiosis (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Channel 4 video**: Formation of sex cells: meiosis (*Science Focus 4 Second Edition LiveText*) **Animation**: Cell division—meiosis and mitosis (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Worksheet 3.1**: Cell division **Simple inheritance** Define the terms associated with inheritance. Describe the effect of dominant and recessive genes. Relate this back to Mendel's pea experiments. Define the terms 'genotype' and 'phenotype'. **Prac 3**: Modelling inheritance Describe and use Punnett squares. **Worksheet 3.2**: Heterozygous or homozygous? **Other types of inheritance** Define the terms 'codominance' and 'incomplete dominance'. Construct Punnett squares to show these. Describe how inheritance appears simple but a single gene rarely controls a characteristic. **Web destination**: Drag and drop genetics (*Science Focus 4*	Prac 1 Video Prac 2 Drag and drop Video Animation Worksheet 3.1 Prac 3 Worksheet 3.2 Web destination	

	relationships, including mathematical ones, and appropriate units for physical quantities 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19a) justify inferences in light of gathered information 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19e) anticipate and/or respond to problems as they arise in practical situations 5.19f) use models, including mathematical ones, to explain phenomena or make predictions 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team	*Second Edition LiveText*) **Drag and drop**: Inheritance (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Interactive**: Genetics (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Career profile**: Geneticist **Unit 3.1 questions** **Web destination**: Pea soup—The story of Mendel (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Drag and drop Interactive Career profile Unit questions Web destination	

	members according to the requirements of the task and the skills of the individual 5.22.2c) negotiate and allocate individual roles to members of the team 5.22.2d) accept specific roles in a team while planning and conducting investigations, communicating information and understandings and solving problems 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team 5.22.2g) monitor progress of the group towards completion of a task 5.22.2h) evaluate the process used by the group and effectiveness of the team in completing the task			

Unit 3.2 Human inheritance

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.2 the Watson-Crick model of DNA	5.8.2a) explain the advantages of DNA replicating exactly 5.8.2c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves 5.8.2e) identify the role of genes and environmental factors in determining the features of an organism 5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to	**Simple human inheritance** Examine some traits in humans that are controlled by one gene. Construct a Punnett square for one of these characteristics. **Prac 1**: Dominant or recessive? **Blood groups** Describe the various blood groups. (NB: This may be used as extension material, as some students will find it difficult.) **Other types of human inheritance** Examine eye colour as an example of human inheritance. **Prac 2**: Continuous variation **Pedigrees** Describe how to construct, use and analyse pedigrees. **Drag and drop**: Pedigree symbols (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Drag and drop**: Pedigrees (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Worksheet 3.3**: Pedigree analysis **Web destination**: Drag and drop pedigrees (*Science Focus 4*	Prac 1 Prac 2 Drag and drop Drag and drop Worksheet 3.3 Web destination	

	be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.14a) follow the planned procedure when performing an investigation 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental	*Second Edition LiveText*) **Boy or girl?** Describe the XY and XX genotypes that determine sex. **Prac 3**: Vegetable babies **Sex-linked disorders** Define the importance of the X and Y chromosomes in humans. Describe and research some sex-linked diseases. **Career profile:** Medical laboratory technician **Unit 3.2 questions** **Web destination**: Centre for genetics education (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Genetics disease information (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Prac 3 Career profile Unit questions Web destination Web destination	

	procedures 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.17a) collate information from a number of sources 5.17c) check reliability of gathered data and information by comparing with observations or information from other sources 5.17d) organise data using a variety of methods including graphs, diagrams, tables, spreadsheets and databases 5.17e) critically analyse the accuracy of scientific information presented in popular media 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.17g) apply mathematical concepts and computer-based technologies to			

	assist analysis of data and information 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19f) use models, including mathematical ones, to explain phenomena or make predictions 5.21a) seek evidence to support claims 5.21b) evaluate evidence for reliability and validity			

	5.21c) produce creative solutions for problems 5.21d) propose ideas that demonstrate coherence and logical progression 5.21e) apply critical thinking in the consideration of proposals 5.21f) formulate cause and effect relationships 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task			

Unit 3.3 The molecule of life

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.2 the Watson-Crick model of DNA	5.8.2a) explain the advantages of DNA replicating exactly 5.8.2b) explain the advantages and disadvantages of DNA mutating 5.8.2c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves 5.8.2d) identify that genes are part of DNA 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment	**Deoxyribonucleic acid (DNA)** Define the four different nitrogen base molecules. Describe the structure of DNA. **Worksheet 3.4**: Model DNA **Web destination**: DNA from the beginning (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 1**: Modelling DNA (DYO) **Prac 2**: Extracting DNA **How DNA is copied** Define the process of replication. **Drag and drop**: The molecule of life (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **The genetic code/Determining characteristics** Define amino acids and their effect on determining human characteristics. **Gene expression** Define the term 'gene expression'. **Mutations** Define 'mutation' and explain how mutations may form. Include examples of environmental mutagens and single-cell and whole-chromosome mutations. Describe where	Worksheet 3.4 Web destination Prac 1 Prac 2 Drag and drop	

	5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources including databases, CD-ROM and the Internet, to assess information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.17e) critically analyse the accuracy of scientific information presented in popular media 5.18b) select and use an appropriate medium to present data and information 5.20a) identify the nature of a presented	mutations have been helpful, giving examples. **Unit 3.3 questions** **Web destination**: DNA extraction virtual lab (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Unit questions Web destination	

	problem 5.20b) describe different strategies that could be employed to solve an identified problem 5.20c) use identified strategies to develop a range of possible solutions to a particular problem 5.20d) evaluate the appropriateness of different strategies for solving an identified problem 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task			

Unit 3.4 Controlling genetics

Students learn about	**Students learn to**	**Suggested teaching and learning strategies**	***Science Focus 4* Resources**	**Register**
5.8.2 the Watson-Crick model of DNA 5.12 technology	5.8.2e) identify the role of genes and environmental factors in determining the features of an organism 5.12c) describe some benefits and problems of using biotechnology 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.17c) check reliability of gathered data and information by comparing with observations or information from other sources 5.17e) critically analyse the accuracy of scientific information presented in popular media 5.18a) select and use appropriately from	**Selective breeding** Define 'selective breeding', giving examples. **Using gene technology to improve an organism** Describe genetic engineering and what it allows scientists to achieve. Outline the methods used to achieve genetic modifications. Examine the advantages and disadvantages of genetic technology. **Web destination**: Biotechnology Australia (*Science Focus 4 Second Edition LiveText*) **How gene technology works** Define enzymes, bacteria and transgenics. **Using gene technology for testing** Discuss gene technology testing for diseases and defects, including prenatal testing, and gene technology testing in forensics. **Using gene technology for cloning D**iscuss cloning procedures and research in both humans and animals. **Worksheet 3.5**: Genetic modification	 Web destination Worksheet 3.5	

	discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.19g) use cause and effect relationships to explain ideas 5.20a) identify the nature of a presented problem 5.20b) describe different strategies that could be employed to solve an identified problem 5.21a) seek evidence to support claims 5.21b) evaluate evidence for reliability and validity 5.21c) produce creative solutions for problems 5.21d) propose ideas that demonstrate coherence and logical progression 5.21e) apply critical thinking in the consideration of proposals 5.21f) formulate cause and effect relationships	**Human genome** Discuss the Human Genome Project and what its results have revealed about the human genome. **Web destination**: Gene technology in Australia (*Science Focus 4 Second Edition LiveText*) **Unit 3.4 questions** **Web destination**: The Human Genome Project (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Web destination Unit questions Web destination	

Science Focus: DNA fingerprinting

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.2 the Watson-Crick model of DNA 5.12 technology	5.8.2d) identify that genes are part of DNA 5.12c) describe some benefits and problems of using biotechnology 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records	Biotechnology**:** Define 'biotechnology' and describe how it has been developed to enable DNA fingerprinting and resolve parental disputes. **Student activities**	 Student activities	

	for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.18d) use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately			

Chapter review

Suggested teaching and learning strategies	***Science Focus 4* Resources**	**Register**
Complete chapter review questions at the end of the chapter **Worksheet 3.6**: Crossword **Worksheet 3.7**: Sci-words **Interactive**: Genetics crossword (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Review Questions** (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Test**	Chapter review questions Worksheet 3.6 Worksheet 3.7 Interactive Chapter Review Questions Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

4: Health and disease

Prescribed focus area	**The implications of science for society and the environment** 5.4 a) discuss viewpoints about some issues with a major scientific component 5.4 b) give examples to show that different cultures or groups within a society (including Aboriginal and other Indigenous people) may use or weight criteria differently to make a decision about an issue involving a major scientific component 5.4 c) identify choices that need to be or have been made when considering whether to use particular scientific advances 5.4 d) discuss the place of social and ethical considerations in scientific practice and in applications of science.

Domain outcomes	
Knowledge and understanding	5.8.4 humans 5.8.4a) describe the role of, and interaction between, coordination systems in maintaining humans as functioning organisms 5.8.4b) describe some responses of body systems to infectious and non-infectious diseases.
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.20 selects and uses appropriate strategies to solve problems 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.

Values and attitudes	5.23 demonstrates confidence and a willingness to make decisions and to take responsible actions 5.25 recognises the relevance and importance of life-long learning and acknowledges the continued impact of science in many aspects of everyday life 5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them.

Unit 4.1 Health

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.4 humans	5.8.4a) describe the role of, and interaction between, coordination systems in maintaining humans as functioning organisms 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14f) demonstrate the use of safe and hygienic work practices, including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including	**Quick quiz**: Chapter 4 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Requirements for good health** Discuss the term 'good health'. Relate health to diet. Discuss the term 'balanced diet'. Describe how food supplies energy and that there is a daily energy requirement based on age and activity levels. **Prac 1**: Orange juice and vitamin C **Worksheet 4.1**: The glycemic index and load **Web destination**: Kids' health (*Science Focus 4 Second Edition LiveText*) **Unit 4.1 questions** **Web destination**: Nutrition cafe (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Quick quiz Prac 1 Worksheet 4.1 Web destination Unit questions Web destination	

	databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19e) anticipate and/or respond to problems as they arise in practical situations 5.20a) identify the nature of a presented problem 5.20b) describe different strategies that could be employed to solve an identified problem 5.20c) use identified strategies to develop a range of possible solutions to a particular problem 5.20d) evaluate the appropriateness of different strategies for solving an identified problem 5.21c) produce creative solutions for problems	**Web destination**: Better health channel (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Web destination	

Science Focus: Aboriginal health

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.4 humans	5.8.4a) describe the role of, and interaction between, coordination systems in maintaining humans as functioning organisms 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources	Aboriginal diet: Research and discuss the traditional Australian Aboriginal diet. Examine the effect of introduced new foods. Traditional medicine: Discuss how many medicines used by Aboriginal people have effective medical benefits. **Web destination**: Development of medicine (*Science Focus 4 Second Edition LiveText*) **Student activities**	 Web destination Student activities	

Unit 4.2 Disease

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.4 humans	5.8.4b) describe some responses of body systems to infectious and non-infectious diseases 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.18a) select and use appropriately from discussion, explanation, procedure,	**Pathology** Define the terms used when discussing disease. Recall microbes. Distinguish between a host and an agent. **Causes of disease** Describe the various causes of disease. **Worksheet 4.2**: Outbreak! **Prac 1**: Survey of diseases **Unit 4.2 questions** **Web destination**: Disease fact sheets (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Worksheet 4.2 Prac 1 Unit questions Web destination	

	exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.18d) use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly			

Unit 4.3 Infectious diseases

Students learn about	**Students learn to**	**Suggested teaching and learning strategies**	***Science Focus 4* Resources**	**Register**
5.8.4 humans	5.8.4b) describe some responses of body systems to infectious and non-infectious diseases 5.13.2d) establish an appropriate timeline for an investigation 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14f) demonstrate the use of safe and hygienic work practices, including the correct use of safety equipment 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate	**Diseases caused by some micro-organisms** Define the term 'communicable disease'. Recall the various microbes that can cause disease. Define these as pathogens. Describe in detail the types and effects of bacteria, viruses, protozoa and fungi. **Prac 1**: Making yoghurt **Channel 4 video**: Types of microbes (*Science Focus 4 Second Edition LiveText*) **Web destination**: The virtual museum of bacteria (*Science Focus 4 Second Edition LiveText*) **Prac 2**: Micro-organisms around you **Web destination**: Bird flu (*Science Focus 4 Second Edition LiveText*) **Diseases caused by macroscopic parasites** Describe the effects of macroscopic parasites, such as flukes and tapeworms. **Worksheet 4.3**: Infections **Drag and drop**: Agents and disease (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Prac 1 Video Web destination Prac 2 Web destination Worksheet 4.3 Drag and drop	

	information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.18b) select and use an appropriate medium to present data and information	**Unit 4.3 questions** **Web destination**: Infection, detection, protection (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Unit questions Web destination	

Unit 4.4 Transmission and control of infectious diseases

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.4 humans	5.8.4b) describe some responses of body systems to infectious and non-infectious diseases 5.14a) follow the planned procedure when performing an investigation 5.16a) use a range of sources, including databases, CD-ROM and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.17b) distinguish between relevant and irrelevant information 5.17c) check reliability of gathered data	**Pass it on** Examine how infectious diseases may be passed on. Define 'vector'. **Prac 1**: Modelling the transmission of disease **Web destination**: The economic costs of infectious diseases (*Science Focus 4 Second Edition LiveText*) **Natural control** Define the three lines of defence against disease. Define the terms 'antibodies', 'immunity' and 'antigen'. **Artificial control** Discuss the options when our body systems can't control a disease. Describe vaccinations and antibiotics. Research the work of Edward Jenner. **Prac 2**: Effectiveness of antiseptics **Drag and drop**: Infection (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Channel 4 video**: Meningitis story (*Science Focus 4 Second Edition LiveText*) **Case study:** HIV/AIDS: Research the history and effects of the HIV virus. **Worksheet 4.4**: AIDS	 Prac 1 Web destination Prac 2 Drag and drop Video Worksheet 4.4	

	and information by comparing with observations or information from other sources 5.19a) justify inferences in light of gathered information 5.19g) use cause and effect relationships to explain ideas 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.2a) identify the specific roles needed when working in a team 5.22.2d) accept specific roles in a team while planning and conducting investigations, communicating information and understandings and solving problems	**Unit 4.4 questions** **Web destination**: Childhood diseases (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Communicable disease fact sheets (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Unit questions Web destination Web destination	

Unit 4.5 Non-infectious diseases

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.4 humans	5.8.4b) describe some responses of body systems to infectious and non-infectious diseases 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices, including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information	**Genetic diseases** Define 'mutagens' and give examples of genetic diseases. **Web destination**: Genetic diseases and disorders (*Science Focus 4 Second Edition LiveText*) **Diseases caused by diet** Examine various diseases caused by diet: malnutrition, obesity, eating disorders and diabetes. **Diseases of the circulatory system** Examine diseases of the circulatory system: embolisms, varicose veins, hypertension and heart disease. **Cancer** Define tumours and the two types: benign and malignant. Examine various forms of cancer treatment. **Web destination**: Cancer as a genetic disease (*Science Focus 4 Second Edition LiveText*) **Illegal drugs** Present short- and long-term effects of psychoactive drug use. **Alcohol and smoking** Examine in detail the effects of alcohol and smoking. **Worksheet 4.5**: Blood alcohol concentration	Web destination Web destination Worksheet 4.5	

		Environmental hazards Describe the diseases that may occur due to environmental hazards, such as asbestos, lead, radiation and heavy metals. **Mental illness** Examine the effects of mental illness. **Drag and drop**: Non-infectious diseases (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Unit 4.5 questions** **Web destination**: Health and nutrition (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Drag and drop Unit questions Web destination	

Chapter review

Suggested teaching and learning strategies	***Science Focus 4*** **Resources**	Register
Complete chapter review questions at the end of the chapter	Chapter review questions	
Worksheet 4.6: Crossword	Worksheet 4.6	
Worksheet 4.7: Sci-words	Worksheet 4.7	
Interactive: Health and disease crossword (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Interactive	
Drag and drop: Health and disease (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Drag and drop	
Chapter Review Questions (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Chapter Review Questions	
Chapter Test	Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

5: Evolution

Prescribed focus area	**The history of science** 5.l a) identify some of the scientific ideas that different cultures have contributed to science throughout history 5.1b) describe, using examples, including those developed by Aboriginal peoples, ideas developed by different cultures to explain the world around us 5.1c) describe some models and theories that have been considered in science and then been modified or rejected as a result of available evidence 5.1d) discuss examples of where societal, religious or ethical values have had an impact on scientific developments 5.1e) describe historical cases where developments in science have led to the development of new technologies 5.1f) describe historical cases where developments or improvements in technology have transformed science.

Domain outcomes	
Knowledge and understanding	5.8.3 the theory of evolution and natural selection 5.8.3a) discuss evidence that present-day organisms have developed from organisms in the distant past 5.8.3b) relate natural selection to the theory of evolution.
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.

Values and attitudes	5.24 respects different viewpoints and is honest and fair in dealing with others 5.25 recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life 5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them.

Unit 5.1 Being suited to your environment

Students learn about	Students learn to	Suggested teaching and learning strategies	***Science Focus 4*** **Resources**	Register
5.8.3 the theory of evolution and natural selection	5.8.3b) relate natural selection to the theory of evolution 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written	**Quick quiz**: Chapter 5 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Adaptations** Discuss structural and functional adaptations. **Interactive**: Penguin adaptations (*Science Focus 4 Second Edition LiveText*) **Channel 4 video**: Adaptations of rhododendrons (*Science Focus 4 Second Edition LiveText*) **Variation** Define the term 'speciation' and explain the effect of geographical and reproductive isolation. **Unit 5.1 questions**	Quick quiz Interactive Video Unit questions	

	secondary sources 5.17d) organise data using a variety of methods including graphs, diagrams, tables, spreadsheets and databases 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem			

Unit 5.2 Evolution through natural selection

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.3 the theory of evolution and natural selection	5.8.3b) relate natural selection to the theory of evolution 5.14a) follow the planned procedure when performing an investigation 5.15a) make and record observations and measurements accurately over a	**Natural selection** Define the term 'natural selection' and examine how it worked in peppered moths in England. Compare this to rabbit control in Australia. **Prac 1**: Natural selection	Prac 1	

	number of trials 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.17d) organise data using a variety of methods including graphs, diagrams, tables, spreadsheets and databases 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed	**Observing evolution** Describe how selection in peppered moths and rabbits allows scientists to observe changes in generations. **Web destination**: Evolution (*Science Focus 4 Second Edition LiveText*) **Web destination**: Australia's magafauna (*Science Focus 4 Second Edition LiveText*) **Worksheet 5.1**: Natural selection **Interactive**: Natural selection (*Science Focus 4 Second Edition LiveText*) **Speciation** Define the term 'speciation' and explain the effect of geographical and reproductive isolation. **Types of evolution** Compare and contrast the three types of evolution: divergent, convergent and parallel evolution. Define the term 'adaptive radiation'. **Drag and drop**: The origin of species (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Unit 5.2 questions** **Web destination**: Peppered moth simulation (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Web destination Web destination Worksheet 5.1 Interactive Drag and drop Unit questions Web destination	

	solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19g) use cause and effect relationships to explain ideas 5.21e) apply critical thinking in the consideration of proposals 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team members according to the requirements of the task and the skills of the individual 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2g) monitor progress of the group towards completion of a task			

Unit 5.3 Evidence for evolution

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.3 the theory of evolution and natural selection	5.8.3a) discuss evidence that present-day organisms have developed from organisms in the distant past 5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected	**The fossil record** Recall how fossils are formed and what they represent. Define the geological time scale. Describe how to use the fossil record. Present the experiment carried out by Miller and Urey and discuss the results. Examine the evolution of life on Earth. **Drag and drop**: A history of life on Earth (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Web destination**: Geological time scale (*Science Focus 4 Second Edition LiveText*) **Using the fossil record/A changing record** Discuss the fossil record, outlining that it is incomplete and the gaps have yet to be filled. In some records, transitional forms of life exist. **Prac 1**: Studying fossils **Worksheet 5.2**: Evolution of the horse **Prac 2**: Constructing fossils **Evidence from other studies** Discuss that evidence appears in other studies, including anatomical, embryonic and the distribution of plants and animals. Examine each in depth; particularly note the errors by Ernst Haeckel in drawing embryonic development.	 Drag and drop Web destination Prac 1 Worksheet 5.2 Prac 2	

	5.13.2a) identify variables that need to be kept held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.19a) justify inferences in light of gathered information	Discuss gene duplication and organism biochemistry as evidence for evolution. **Unit 5.3 questions** **Web destination**: Evolution of a horse (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Unit questions Web destination	

Unit 5.4 Human evolution

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.3 the theory of evolution and natural selection	5.8.3a) discuss evidence that present-day organisms have developed from organisms in the distant past 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation	**Primates** Define the characteristics of primates. Compare Old and New World monkeys. **Web destination**: Introduction to human evolution (*Science Focus 4 Second Edition LiveText*) **Evolution of humans** Discuss the evolution of humans from distant relatives of the southern ape and more recent ancestors. Discuss the anatomical changes that have occurred between our ape-like ancestors and *Homo sapiens.* **Drag and drop**: Family tree (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Anatomical changes** There are some specific changes in the evolution of humans that scientists believe are unclear. **Drag and drop**: Human form (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Cultural evolution** Describe the changes that have occurred culturally in humans. **Worksheet 5.3**: The 'Hobbit' **Unit 5.4 questions**	Web destination Drag and drop Drag and drop Worksheet 5.3 Unit questions	

Science Focus: Evolution of a theory

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.8.3 the theory of evolution and natural selection	5.8.3a) discuss evidence that present-day organisms have developed from organisms in the distant past 5.8.3b) relate natural selection to the theory of evolution 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.19a) justify inferences in light of gathered information 5.21a) seek evidence to support claims 5.21b) evaluate evidence for reliability and validity 5.21c) produce creative solutions for	Theories in science: Theories in science are based on current evidence. Scientists are constantly developing and testing all theories. Evolution of the theory of evolution: Define the theory of biological evolution. Present early theories of evolution by Buffon and Lamarck. Define the term 'acquired characteristics'. **Web destination**: Timeline of evolutionary thought (*Science Focus 4 Second Edition LiveText*) Darwin's theory of natural selection: Describe the history of Darwin's theory of evolution, particularly his work on the finches of the Galapagos Islands. Contrast Lamarck's and Darwin's theories. Describe the parallel work of Alfred Russel Wallace and his work in Malaysia. **Web destination**: The voyage of the *Beagle*: Charles Darwin (*Science Focus 4 Second Edition LiveText*) **Alternatives to evolution** Present alternatives to the current theory of evolution.	 Web destination Web destination	

	problems 5.21d) propose ideas that demonstrate coherence and logical progression 5.21e) apply critical thinking in the consideration of proposals	**Web destination**: Theories of evolution (*Science Focus 4 Second Edition LiveText*) **Student activities**	Web destination Student activities	

Chapter review

Suggested teaching and learning strategies	***Science Focus 4* Resources**	**Register**
Complete chapter review questions at the end of the chapter	Chapter review questions	
Worksheet 5.4: Crossword 1	Worksheet 5.4	
Worksheet 5.5: Crossword 2	Worksheet 5.5	
Worksheet 5.6: Sci-words	Worksheet 5.6	
Interactive: Evolution crossword (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Interactive	
Drag and drop: Evolutionary theory (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Drag and drop	
Chapter Review Questions (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Chapter Review Questions	
Chapter Test	Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

6: Motion

Prescribed focus area	**The applications and uses of science** 5.3a) identify and describe examples of scientific concepts and principles that have been used in technological development (including Australian examples) 5.3b) discuss, using examples, the positive and negative impacts of applications of recent developments in science 5.3c) identify and describe examples where technological advances have impacted on science 5.3d) give reasons why society should support scientific research.

Domain outcomes	
Knowledge and understanding	5.6.2 Newton's Laws 5.6.2a) describe qualitatively the relationship between force, mass and acceleration 5.6.2b) explain, qualitatively, the relationship between distance, speed and time 5.6.2c) relate, qualitatively, acceleration to a change in speed and/or direction as a result of a net force 5.6.2d) analyse, qualitatively, common situations involving motion in terms of Newton's laws 5.6.6 gravitational force 5.6.6a) distinguish between the term 'mass' and 'weight' of an object.
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.20 selects and uses appropriate strategies to solve problems

	5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.
Values and attitudes	5.25 recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life 5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them.

Unit 6.1 Describing motion

Students learn about	**Students learn to**	**Suggested teaching and learning strategies**	***Science Focus 4* Resources**	**Register**
5.6.2 Newton's laws – motion	5.6.2b) explain, qualitatively, the relationship between distance, speed and time 5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected	**Quick quiz**: Chapter 6 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Distance and displacement** Define and contrast the two quantities 'distance' and 'displacement'. **Speed and velocity** Define the term 'speed'—both instantaneous and average. Contrast speed and velocity. Describe and model the method to convert from km/h to m/s and the reverse. **Prac 1**: They've got the runs! (DYO) **Measuring motion** Introduce the different ways of measuring motion, including the ticker-timer, and explain their operation.	Quick quiz Prac 1	

	5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk	**Prac 2**: Ticker-timer experiment **Graphing motion** Describe the two graphs that can be generated. These are the distance–time and the speed–time graphs. Explain how the slope of the distance–time graph represents the object's average speed. Explain how the area under a speed–time graph is the distance travelled by an object. **Prac 3**: Measuring speed (DYO) **Calculating distance** Use the formula $s = vt$ to calculate distance. Define 'reaction time' and calculate its effects. **Worksheet 6.1**: Distance–time graphs **Drag and drop**: Describing movement (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 4**: Chain reaction **Prac 5**: Driving reaction times **Unit 6.1 questions**	Prac 2 Prac 3 Worksheet 6.1 Drag and drop Prac 4 Prac 5 Unit questions	

	to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data collection strategies and technologies such as data loggers 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column			

	graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.17a) collate information from a number of sources 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.17g) apply mathematical concepts and computer-based technologies to assist analysis of data and information 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team members according to the			

	requirements of the task and the skills of the individual 5.22.2c) negotiate and allocate individual roles to members of the team 5.22.2d) accept specific roles in a team while planning and conducting investigations, communicating, information and understandings and solving problems 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team 5.22.2g) monitor progress of the group towards completion of a task 5.22.2h) evaluate the process used by the group and effectiveness of the team in completing the task			

Unit 6.2 Acceleration

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.2 Newton's laws – motion	5.6.2c) relate, qualitatively, acceleration to a change in speed and/or direction as a result of a net force 5.14d) record data using the appropriate units 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data collection strategies and technologies such as dataloggers 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from	**Acceleration** Define the term 'acceleration'. Define 'deceleration' as negative acceleration. **Calculating acceleration** Calculate acceleration using a mathematical formula. **Prac 1**: Braking distances **Channel 4 video**: Acceleration (*Science Focus 4 Second Edition LiveText*) **Calculating speed** Calculate the final speed of an object using a mathematical formula. **Web destination**: Rollercoaster! (*Science Focus 4 Second Edition LiveText*) **Acceleration and graphs** Present the various shapes of speed–time graphs, explaining how they represent various accelerations. **Worksheet 6.2**: Car performance data **Interactive**: Motion graphs (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 2**: Acceleration and datalogging (DYO)	Prac 1 Video Web destination Worksheet 6.2 Interactive Prac 2	

	identified oral and written secondary sources 5.17a) collate information from a number of sources 5.17b) distinguish between relevant and irrelevant information 5.17c) check reliability of gathered data and information by comparing with observations or information from other sources 5.17d) organise data using a variety of methods including graphs, diagrams, tables, spreadsheets and databases 5.17e) critically analyse the accuracy of scientific information presented in popular media 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18d) use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities	**Prac 3**: Construct an accelerometer (DYO) **Unit 6.2 questions**	Prac 3 Unit questions	

	5.20a) identify the nature of a presented problem 5.20b) describe different strategies that could be employed to solve an identified problem 5.21e) apply critical thinking in the consideration of proposals 5.21f) formulate cause and effect relationships			

Unit 6.3 Newton's First Law

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.2 Newton's laws – motion	5.6.2a) describe, qualitatively, the relationship between force, mass and acceleration 5.6.2d) analyse, qualitatively, common situations involving motion in terms of Newton's laws 5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering	**What is a force?** Recall what a force is and the various types, giving examples. **Web destination**: Sport science (*Science Focus 4 Second Edition LiveText*) **Newton's First Law** Define Newton's First Law. **Prac 1**: Crash test dummies **Interactive**: Video analysis of motion: Braking (*Science Focus 4 Second Edition LiveText*) **Feeling lighter, feeling heavier** Discuss the term 'inertia'. Discuss the figures showing inertia in action. **Worksheet 6.3**: Safety features **Prac 2**: Inertial eggs **Prac 3**: The yolk's on you! (DYO) **Web destination**: Aircraft safety (*Science Focus 4 Second Edition LiveText*) **Web destination**: Fatal impact (*Science Focus 4 Second Edition LiveText*) **Unit 6.3 questions**	 Web destination Prac 1 Interactive Worksheet 6.3 Prac 2 Prac 3 Web destination Web destination Unit questions	

	information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct,	**Web destination**: Newton's First Law (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Web destination	

	assemble and manipulate identified equipment 5.14e) evaluate and modify experimental procedures 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.19a) justify inferences in light of gathered information			

	5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19e) anticipate and/or respond to problems as they arise in practical situations 5.19f) use models, including mathematical ones, to explain phenomena or make predictions 5.19g) use cause and effect relationships to explain ideas 5.21e) apply critical thinking in the consideration of proposals 5.21f) formulate cause and effect relationships			

Unit 6.4 Newton's Second Law

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.2 Newton's laws – motion	5.6.2a) describe, qualitatively, the relationship between force, mass and acceleration 5.6.2d) analyse, qualitatively, common situations involving motion in terms of Newton's laws 5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering	**Acceleration** Recall the term 'acceleration'. **Newton's Second Law** Define Newton's Second Law, in words and by the formula, $F = ma$ **Prac 1**: $F = ma$ **Worksheet 6.4** : Calculating force **Unit 6.4 questions** **Web destination**: Newton's Second Law (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Prac 1 Worksheet 6.4 Unit questions Web destination	

	information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14c) safely and efficiently construct,			

	assemble and manipulate identified equipment 5.14e) evaluate and modify experimental procedures 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.19a) justify inferences in light of gathered information			

	5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made			

Unit 6.5 Newton's Third Law

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.2 Newton's Laws – motion	5.6.2a) describe, qualitatively, the relationship between force, mass and acceleration 5.6.2d) analyse, qualitatively, common situations involving motion in terms of Newton's laws 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the	**Newton's Third Law** Explain the action–reaction relationship of forces. Define Newton's Third Law. In particular, note that an action–reaction pair of forces may mean that more than two individual forces are acting. Summarise all of Newton's laws. **Bats and balls** What is the relationship between a bat and a ball? **Drag and drop**: Newton's laws (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Interactive**: Newton's laws of motion (*Science Focus 4 Second Edition LiveText*) **Getting moving** Describe action–reaction pairs. **… 3, 2, 1 lift-off!** Examine the uses of action–reaction forces. Relate it to rockets as examples of reaction engines. Discuss rockets, having students understand that it is the *acceleration* of the mass of exhaust gas, not its *speed*, that lifts the rocket. **Worksheet 6.5**: The history of forces **Prac 1**: Water rockets **Prac 2**: A two-stage rocket	Drag and drop Interactive Worksheet 6.5 Prac 1 Prac 2	

	Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.19e) anticipate and/or respond to problems as they arise in practical situations 5.19f) use models, including mathematical ones, to explain phenomena or make predictions	**Unit 6.5 questions** **Web destination**: Newton's Third Law (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Unit questions Web destination	

	5.20a) identify the nature of a presented problem 5.20b) describe different strategies that could be employed to solve an identified problem 5.20c) use identified strategies to develop a range of possible solutions to a particular problem 5.20d) evaluate the appropriateness of different strategies for solving an identified problem 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team members according to the requirements of the task and the skills of the individual 5.22.2c) negotiate and allocate individual roles to members of the team 5.22.2d) accept specific roles in a team while planning and conducting investigations, communicating, information and understandings and solving problems 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team			

	5.22.2g) monitor progress of the group towards completion of a task 5.22.2h) evaluate the process used by the group and effectiveness of the team in completing the task			

Unit 6.6 Gravity

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.6 gravitational force	5.6.6a) distinguish between the term 'mass' and 'weight' of an object 5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected	**Gravity/Falling objects** Recall the definition of gravity and weight. Introduce the term 'air resistance'. **Prac 1**: Finding *g* using a ticker-timer **Prac 2**: Measuring height with a stopwatch! **Terminal velocity** Examine the effect of air resistance on falling objects. Define the term 'terminal velocity'. **Worksheet 6.6**: Weight **Web destination**: Dynamics of flight (*Science Focus 4 Second Edition LiveText*) **Unit 6.6 questions** **Web destination**: Terminal velocity (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Prac 1 Prac 2 Worksheet 6.6 Web destination Unit questions Web destination	

	5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data collection strategies and technologies such as data loggers 5.16a) use a range of sources, including databases, CD-ROMs and the			

	Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16d) summarise information from identified oral and written secondary sources 5.17a) collate information from a number of sources 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18c) select and use an appropriate method to acknowledge sources of information 5.21a) seek evidence to support claims 5.21b) evaluate evidence for reliability and validity 5.21c) produce creative solutions for problems 5.21d) propose ideas that demonstrate coherence and logical progression			

	5.21e) apply critical thinking in the consideration of proposals 5.21f) formulate cause and effect relationships 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team members according to the requirements of the task and the skills of the individual 5.22.2c) negotiate and allocate individual roles to members of the team 5.22.2d) accept specific roles in a team while planning and conducting investigations, communicating information and understandings and solving problems 5.22.2e) set and work to realistic timelines and goals as a group 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team 5.22.2g) monitor progress of the group towards completion of a task 5.22.2h) evaluate the process used by the group and effectiveness of the team in completing the task			

Unit 6.7 Work and energy

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
	5.6.2d) analyse, qualitatively, common situations involving motion in terms of Newton's laws 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14d) record data using the appropriate units 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.17g) apply mathematical concepts and computer-based technologies to assist analysis of data and information 5.18f) select and draw the appropriate type of graph or diagram to convey	**Work** Define 'work' and how it relates to forces. Recall the definition for energy. **Kinetic energy** Define 'kinetic energy' as energy due to motion. Describe it using a mathematical formula. Use the formula to show the effect of speed on energy. **Gravitational potential energy** Define 'gravitational potential energy' as stored energy due to height. Describe it using a mathematical formula. **Elastic potential energy** Define 'elastic potential energy' and spring constant. Describe it using a mathematical formula. **Prac 1**: Extension of an elastic band **Efficiency** Define 'efficiency'. **Prac 2**: Efficiency of a roller coaster **Prac 3**: Ball bounce (DYO) **Worksheet 6.7**: Work and energy **Unit 6.7 questions**	Prac 1 Prac 2 Prac 3 Worksheet 6. 7 Unit questions	

	information and relationships clearly and accurately 5.19g) use cause and effect relationships to explain ideas 5.21c) produce creative solutions for problems			

Chapter review

Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
Complete chapter review questions at the end of the chapter	Chapter review questions	
Worksheet 6.8: Crossword	Worksheet 6.8	
Worksheet 6.9: Sci-words	Worksheet 6.9	
Interactive: Motion crossword (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Interactive	
Drag and drop: Revising formulas (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Drag and drop	
Chapter Review Questions (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Chapter Review Questions	
Chapter Test	Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

7: Electricity, electromagnetism and communications technology

Prescribed focus area	**The applications and uses of science** 5.3a) identify and describe examples of scientific concepts and principles that have been used in technological development (including Australian examples) 5.3b) discuss, using examples, the positive and negative impacts of applications of recent developments in science 5.3c) identify and describe examples where technological advances have impacted on science 5.3d) give reasons why society should support scientific research.

Domain outcomes	
Knowledge and understanding	5.6.1 wave energy 5.6.1a) identify waves as carriers of energy 5.6.1 b) qualitatively describe features of waves including frequency, wavelength and speed 5.6.1 c) give examples of different types of radiation that make up the electromagnetic spectrum and identify some of their uses 5.6.3 electrical energy 5.6.3a) design, construct and draw circuits containing a number of components 5.6.3b) describe voltage, resistance and current using analogies 5.6.3c) qualitatively describe the relationship between voltage, resistance and current 5.6.3d) compare the characteristics and applications of series and parallel circuits 5.12 technology 5.12a) describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology 5.12d) describe ways in which technology has increased the variety of made resources.
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence

	5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions 5.20 selects and uses appropriate strategies to solve problems 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.
Values and attitudes	5.25 recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life.

Unit 7.1 Electricity

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.3 electrical energy	5.6.3a) design, construct and draw circuits containing a number of components 5.6.3b) describe voltage, resistance and current using analogies 5.6.3c) qualitatively describe the relationship between voltage, resistance and current 5.6.3d) compare the characteristics and applications of series and parallel	**Quick quiz**: Chapter 7 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **A simple circuit** Recall the components of a simple circuit and the symbols used to represent them. **Drag and drop**: Circuit components (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Quick quiz Drag and drop	

	circuits 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2 planning first-hand investigations 5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental	**Measuring electricity/Using a water analogy** Define the terms 'current', 'voltage' and 'resistance'. Describe voltage, resistance and current using a water pump analogy. **Web destination**: Resistor colour codes—interactive tutorial (*Science Focus 4 Second Edition LiveText*) **Types of circuits** Recall series and parallel circuits. Compare the characteristics and applications of series and parallel circuits. **Prac 1**: Simple series and parallel circuits **Prac 2**: Measuring voltage and current in circuits **Web destination**: Series *vs* parallel (*Science Focus 4 Second Edition LiveText*) **Ohm's law** Describe the relationship between voltage, resistance and current in a circuit. State Ohm's law. **Worksheet 7.1**: Ohm's law **Prac 3**: Ohm's law **Web destination**: Ohm's law (*Science Focus 4 Second Edition LiveText*) **AC/DC** Define the two types of current that are available and give common uses. **Unit 7.1 questions**	 Web destination Prac 1 Prac 2 Web destination Worksheet 7.1 Prac 3 Web destination Unit questions	

	procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data collection strategies and technologies such as data loggers 5.17d) organise data using a variety of methods including graphs, diagrams, tables, spreadsheets and databases 5.17f) identify trends, patterns, relationships and contradictions in data and information 5.17g) apply mathematical concepts and computer-based technologies to assist analysis of data and information 5.18d) use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed			

	solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to a relevant set of observations or experimental results 5.22.2a) identify the specific roles needed when working in a team 5.22.2b) match the tasks to the team members according to the requirements of the task and the skills of the individual 5.22.2f) accept personal responsibility for maintenance of a safe working environment for the team 5.22.2g) monitor progress of the group towards completion of a task			

Unit 7.2 Electromagnetism

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.1 the wave model 5.12 technology	5.6.1 c) give examples of different types of radiation that make up the electromagnetic spectrum and identify some of their uses 5.12a) describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology 5.12d) describe ways in which technology has increased the variety of made resources 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental	**Magnetic fields** Describe the relationship between an electric current and magnetism. **Electromagnets/Using electromagnets** Describe the application of electromagnets in everyday use. **Prac 1**: Oersted's experiment and the electromagnet **Web destination**: Magnetic fields and wires (*Science Focus 4 Second Edition LiveText*) **Worksheet 7.2**: Inside MLX01 **Currents in a magnetic field** Examine how a magnetic field can produce an electric current. **Prac 2**: Force on a wire **Prac 3**: A simple electric motor (DYO) **Electric generators/Other uses of generators** Give examples of the application of generators. **Prac 4**: A simple generator **Web destination**: Electromagnets (*Science Focus 4 Second Edition LiveText*) **Transformers** Define a transformer and its importance to	Prac 1 Web destination Worksheet 7.2 Prac 2 Prac 3 Prac 4 Web destination	

	procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.17e) critically analyse the accuracy of scientific information presented in popular media 5.18b) select and use an appropriate medium to present data and information 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.19c) predict outcomes and generate plausible explanations directly related to observations made 5.19d) make generalisations in relation to	household electricity. **Drag and drop**: Electromagnetism (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Unit 7.2 questions** **Web destination**: Japan's Maglev train (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	 Drag and drop Unit questions Web destination	

	a relevant set of observations or experimental results 5.19e) anticipate and/or respond to problems as they arise in practical situations 5.19f) use models, including mathematical ones, to explain phenomena or make predictions 5.19g) use cause and effect relationships to explain ideas 5.20a) identify the nature of a presented problem 5.20b) describe different strategies that could be employed to solve an identified problem 5.20c) use identified strategies to develop a range of possible solutions to a particular problem 5.20d) evaluate the appropriateness of different strategies for solving an identified problem 5.21c) produce creative solutions for problems 5.21f) formulate cause and effect relationships			

Unit 7.3 Waves in communication

Students learn about	**Students learn to**	**Suggested teaching and learning strategies**	***Science Focus 4* Resources**	**Register**
5.6.1 the wave model	5.6.1a) identify waves as carriers of energy	**Two kinds of waves** Recall the two types of waves: transverse and longitudinal.		
5.12 technology	5.6.1 b) qualitatively describe features of waves including frequency, wavelength and speed	**Drag and drop**: Two kinds of waves (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Drag and drop	
	5.12a) describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology	**Prac 1**: Waves in a slinky **Properties of waves** Define the terms 'frequency', 'wavelength' and 'amplitude'. Students should be able to distinguish the features of waves.	Prac 1	
	5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments	**Light waves** Recall the properties of sound waves as requiring a medium to travel through. Contrast this with light waves. Define the electromagnetic spectrum.		
	5.13.2c) describe a logical procedure for undertaking a simple or controlled experiment	**Prac 2**: Other waves on the slinky **Interactive**: Waves in ropes (*Science Focus 4 Second Edition LiveText*)	Prac 2 Interactive	
	5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific	**The visible spectrum/The electromagnetic spectrum** Describe the full electromagnetic spectrum and indicate some applications of various sections. Define gamma rays, X-rays, UV radiation, visible light, IR rays, microwaves and radio		

	task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14c) safely and efficiently construct, assemble and manipulate identified equipment 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and	waves. Compare and contrast AM and FM radio transmission. **Animation**: Electromagnetic spectrum (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Interactive**: Good vibrations (*Science Focus 4 Second Edition LiveText*) **Prac 3**: Polarised! **Worksheet 7.3**: Electromagnetic spectrum **Channel 4 video**: Types of waves (*Science Focus 4 Second Edition LiveText*) **Unit 7.3 questions** **Web destination**: The electromagnetic spectrum (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Animation Interactive Prac 3 Worksheet 7.3 Video Unit questions Web destination	

	scanning to identify appropriate information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task			

Unit 7.4 The communications network

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.12 technology	5.12a) describe some everyday uses and effects of electromagnetic radiation, including applications in communication technology 5.12d) describe ways in which technology has increased the variety of made resources 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18c) select and use an appropriate method to acknowledge sources of information	**The telegraph/The telephone/Mobile phones** Investigate the history of the development of the communications network from telegraph to telephone. **Interactive**: Morse code (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Prac 1**: Locating another mobile phone (DYO) **Today's communications network** Analogue and digital. Compare our current network with past networks. Describe how coaxial cables, optic fibres and microwave networks operate. Research the operation of the mobile phone and examine future possibilities. **Components in the communication network** Describe how copper wire, coaxial cable, fibre-optic cable, radio waves and microwaves provide links in the communication network. **Worksheet 7.4**: Digital communication **Unit 7.4 questions** **Web destination**: Telecommunications timeline (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Interactive Prac 1 Worksheet 7.4 Unit questions Web destination	

Chapter review

Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
Complete chapter review questions at the end of the chapter	Chapter review questions	
Worksheet 7.5: Crossword	Worksheet 7.5	
Worksheet 7.6: Sci-words	Worksheet 7.6	
Interactive: Electricity and communications crossword (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Interactive	
Chapter Review Questions (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Chapter Review Questions	
Chapter Test	Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

8: Global issues

Prescribed focus area	**The implications of science for society and the environment** 5.4a) discuss viewpoints about some issues with a major scientific component 5.4b) give examples to show that different societal groups may use or weight criteria differently to make a decision about an issue involving a major scientific component 5.4c) identify choices that need to be or have been made when considering whether to use particular scientific advances 5.4d) analyse the reasons why different cultures or groups within a society, including Aboriginal people, may have different views in relation to scientific issues 5.4e) discuss the place of ethical considerations on scientific practice and in applications of science.

Domain outcomes	
Knowledge and understanding	5.6.5 nuclear energy 5.6.5a) identify that energy and particles may be released from the nuclei of atoms 5.7.1 atomic theory 5.7.1b) distinguish between elements using information about the number of protons, neutrons and electrons 5.10 ecosystems 5.10c) describe some impacts of human activities on ecosystems 5.11.1 energy resources 5.11.1a) discuss the importance of energy as a resource 5.11.1b) identify properties that make some natural resources economically important and describe their uses 5.11.2 waste from resource use 5.11.2a) relate pollution to contamination by unwanted substances 5.11.2b) identify excessive use of fossil fuels as a contributing factor to the greenhouse effect 5.11.1 energy resources 5.11.1a) discuss the importance of energy as a resource

	5.11.1b) identify properties that make some natural resources economically important and describe their uses 5.12 technology 5.12b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy.
Skills	5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions.
Values and attitudes	5.23 demonstrates confidence and a willingness to make decisions and to take responsible actions 5.25 recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life 5.26 recognises the role of science in providing information about issues being considered and in increasing understanding of the world around them 5.27 acknowledges their responsibility to conserve, protect and maintain the environment for the future.

8: Global issues

Unit 8.1 Debates in science and society

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.5 nuclear energy 5.12 technology	5.6.5a) identify that energy and particles may be released from the nuclei of atoms 5.10c) describe some impacts of human activities on ecosystems 5.11.2a) relate pollution to contamination by unwanted substances 5.11.2b) identify excessive use of fossil fuels as a contributing factor to the greenhouse effect 5.12b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy	**Quick quiz**: Chapter 8 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Debates in society** Use this chapter to discuss issues in science and how they affect progress and society. Define the triple bottom line and how costs affect decision-making. **Web destination**: Science ethics (*Science Focus 4 Second Edition LiveText*) **Nuclear power in Australia** Briefly introduce how nuclear power has been used in Australia. **Unit 8.1 questions**	Quick quiz Web destination Unit questions	

Unit 8.2 Global warming

Students learn about	**Students learn to**	**Suggested teaching and learning strategies**	***Science Focus 4* Resources**	**Register**
5.10 ecosystems 5.11.2 waste from resource use	5.10c) describe some impacts of human activities on ecosystems 5.11.2a) relate pollution to contamination by unwanted substances 5.11.2b) identify excessive use of fossil fuels as a contributing factor to the greenhouse effect 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental procedures 5.14f) demonstrate the use of safe and hygienic work practices including the correct use of safety equipment 5.15a) make and record observations and measurements accurately 5.15b) use independently a range of data collection strategies and technologies such as data loggers 5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information	**The greenhouse effect** Describe how the greenhouse effect operates and compare it to the inside of a car with closed windows in summer. **The enhanced greenhouse effect** Contrast the greenhouse effect with the enhanced greenhouse effect. **Prac 1**: The greenhouse effect **Greenhouse gases** Describe the history of the rise in greenhouse gases. Explain that the main gas is carbon dioxide but others also contribute. **Video clip**: Stratospheric ozone (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Video clip**: Catalytic destruction of ozone (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Evidence of global climate change** Describe how graphs showing carbon dioxide levels have been able to go back 420 000 years. **Channel 4 video**: Polar bears special report (*Science Focus 4*	 Prac 1 Video Video Video	

	5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information 5.18e) use drawings, diagrams, graphs, tables, databases, spreadsheets and flow charts to show relationships and present information clearly and/or succinctly 5.18f) select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.19d) make generalisations in relation to a relevant set of observations or experimental results	*Second Edition LiveText*) **The future** Examine what may happen to world surface temperatures and sea level. Use the detailed predictions to examine local effects. **Worksheet 8.1**: Temperature change **Web destination**: Earth's sunscreen (*Science Focus 4 Second Edition LiveText*) **Web destination**: The ozone layer (*Science Focus 4 Second Edition LiveText*) **Worksheet 8.2**: Global warming **Worksheet 8.3**: Analysing ozone **Prac 2**: Icebergs **Drag and drop**: Global warming (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **El Niño** Define the El Niño effect. **Unit 8.2 questions** **Web destination**: Greenhouse gas calculator (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*)	Worksheet 8.1 Web destination Web destination Worksheet 8.2 Worksheet 8.3 Prac 2 Drag and drop Unit questions Web destination	

Unit 8.3 Nuclear power

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.6.5 nuclear energy 5.12 technology	5.6.5a) identify that energy and particles may be released from the nuclei of atoms 5.10c) describe some impacts of human activities on ecosystems 5.11.2a) relate pollution to contamination by unwanted substances 5.11.2b) identify excessive use of fossil fuels as a contributing factor to the greenhouse effect 5.12b) discuss the benefits and problems associated with medical and industrial uses of nuclear energy 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources	**Why nuclear?** Discuss how Australia contributes to the use of nuclear power around the world. **Generating nuclear energy** Define ‘fission’ and ‘chain reaction’ and discuss nuclear bombs. **Web destination**: Nuclear radiation (*Science Focus 4 Second Edition LiveText*) **Web destination**: Nuclear science in society (*Science Focus 4 Second Edition LiveText*) **Nuclear reactors** What is a nuclear reactor? Where is Australia’s own nuclear reactor? **Nuclear dangers** Focus on the issues and dangers of nuclear energy use. Explain waste issues and have students investigate the accidents that have occurred in the past, such as Chernobyl. **Interactive**: Nuclear reactors (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Worksheet 8.4**: Nuclear devastation **Alternative energy sources** What can be used instead of nuclear energy for more effective and safe energy production? **Web destination**: Nuclear power (*Science Focus 4 Second Edition LiveText*) **Unit 8.3 questions**	Web destination Web destination Interactive Worksheet 8.4 Web destination Unit 8.3 questions	

Unit 8.4 Fiddling with food

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.12 technology	5.4e) discuss the place of ethical considerations on scientific practice and in applications of science 5.10c) describe some impacts of human activities on ecosystems 5.12c) describe some benefits and problems of using biotechnology 5.12 d) describe ways in which technology has increased the variety of made resources. 5.14a) follow the planned procedure when performing an investigation 5.14b) use time and resources effectively 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report, response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information	**Bioaccumulation** Discuss what being at the top of the food chain means in terms of ingesting toxins and poisons through our food. Describe mercury, lead and dioxins. **Herbicides and pesticides** Clarify how herbicides and pesticides work. Describe DDT and discuss some of the effects it created. **Prac 1**: Bioaccumulation **Genetic modification of food** Why is genetic modification of food useful and what risks are involved? **Web destination**: GM food (*Science Focus 4 Second Edition LiveText*) **Channel 4 video**: Genetically modified foods (*Science Focus 4 Second Edition LiveText*) **Reducing the food supply** Describe the quandary of food supply versus fuel supply. **Unit 8.4 questions**	Prac 1 Web destination Video Unit 8.4 questions	

Unit 8.5 Biotechnology

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
5.4 implications of science	5.4a) discuss viewpoints about some issues with a major scientific component 5.4b) give examples to show that different societal groups may use or weight criteria differently to make a decision about an issue involving a major scientific component 5.4c) identify choices that need to be or have been made when considering whether to use particular scientific advances 5.4e) discuss the place of ethical considerations on scientific practice and in applications of science 5.10c) describe some impacts of human activities on ecosystems 5.12c) describe some benefits and problems of using biotechnology 5.12 d) describe ways in which technology has increased the variety of made resources	**Stem cells** Introduce students to stem cells, the issues, the problems and how stem cells can be used. **Stem cell research** Discuss the research into stem cells and the implications involved with stem cell research. **Cloning** Discuss animal cloning and human cloning. Discuss how animal cloning has been possible, using examples, such as Dolly the sheep. **Drag and drop**: Therapeutic cloning (*Science Focus 4 Second Edition LiveText*) **Worksheet 8.5**: Human cloning **Drag and drop**: Biotechnology (*Science Focus 4 Second Edition LiveText*) **Web destination**: Biotechnology timeline (*Science Focus 4 Second Edition LiveText*) **Unit 8.5 questions**	Drag and drop Worksheet 8.5 Drag and drop Web destination Unit 8.5 questions	

Chapter review

Suggested teaching and learning strategies	***Science Focus 4* Resources**	**Register**
Complete chapter review questions at the end of the chapter **Worksheet 8.6**: Crossword **Worksheet 8.7**: Sci-words **Interactive**: Global issues crossword (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Review Questions** (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Test**	Chapter review questions Worksheet 8.6 Worksheet 8.7 Interactive Chapter Review Questions Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
Assessment for learning strategies
Projects undertaken
Websites

9: Individual research project

Prescribed focus area	**The nature and practice of science** 5.2a) evaluate the importance of using creativity, curiosity, objectivity and logical reasoning in describing phenomena in their surroundings, stimulating investigations about phenomena and devising and testing hypotheses 5.2b) distinguish between scientific argument and economic or legal argument 5.2c) apply scientific processes to test the validity of ideas and theories 5.2d) describe how an idea can gain acceptance in the scientific community as either theory or law 5.2e) use examples which show that scientists isolate a set of observations, identify trends and patterns and construct hypotheses or models to explain these 5.2f) give examples that demonstrate the benefits and limitations of using models 5.2g) identify that the nature of observations made depends upon the understanding that the observer brings to the situation. **Current issues, research and development in science** 5.5a) describe some recent scientific contributions made by male and female scientists, including Australians, and discuss the effect of their contributions 5.5c) identify scientific skills that can be useful in a broad range of careers 5.5d) identify possible career paths in science.

Domain outcomes	
Skills	5.13 identifies a problem and independently produces an appropriate investigation plan 5.14 undertakes first-hand investigations independently with safety and competence 5.15 gathers first-hand data accurately 5.16 accesses information from a wide variety of secondary sources 5.17 explains trends, patterns and relationships in data and/or information from a variety of sources 5.18 selects and uses appropriate forms of communication to present information to an audience 5.19 uses critical thinking skills in evaluating information and drawing conclusions

	5.20 selects and uses appropriate strategies to solve problems 5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions 5.22 plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member.
Values and attitudes	5.23 demonstrates confidence and a willingness to make decisions and to take responsible actions 5.26 recognises the role of science in providing information about issues being considered and in increasing their understanding of the world around them.

Unit 9.1 Being an individual

Students learn about	Students learn to	Suggested teaching and learning strategies	***Science Focus 4*** **Resources**	Register
	5.22.1a) independently plan and conduct investigations, communicate information and understandings and solve problems 5.22.1b) set and work to realistic timelines and goals 5.22.1c) accept responsibility for maintenance of a safe working environment for themselves and others 5.22.1d) evaluate the effectiveness of their performance in completing the task	**Quick quiz**: Chapter 9 (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Independent work skills** Recall the skills that were used in the team research project in *Science Focus 2*. Compare these skills to those needed in an individual project. **Surviving on your own** Brainstorm some characteristics that may be needed when working alone. Include creativity, organisation, resourcefulness, dedication and self-motivation. **Career profile**: Science teacher **Web destination**: Dr Karl (*Science Focus 4 Second Edition LiveText*) **Unit 9.1 questions**	Quick quiz Career profile Web destination Unit questions	

Science Focus: Weird science!

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
	5.16a) use a range of sources, including databases, CD-ROMs and the Internet, to access information 5.16b) use a variety of techniques, such as key words, skimming and scanning to identify appropriate information 5.16c) extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio-visual resources 5.16d) summarise information from identified oral and written secondary sources 5.17g) apply mathematical concepts and computer-based technologies to assist analysis of data and information 5.18a) select and use appropriately from discussion, explanation, procedure, exposition, recount, report,	Oldies but goodies: Present this list of classic investigations that have been carried out by scientists. These may provide some novel ideas for students. The physics of dunking biscuits: This investigation looks at the art of successful dunking of biscuits. The perfect cheese sandwich: This investigation generated an equation for the optimal thickness of various cheeses on a sandwich. Wasted gravy: Another of Dr Fisher's investigations, this time into the percentage absorption of gravy by various foods. **Student activities**	Student activities	

	response and experimental records for oral or written presentation 5.18b) select and use an appropriate medium to present data and information			

Unit 9.2 My investigation

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
	5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering	**Types of investigation** Classify various investigations as either first-hand, demonstration of a scientific principle, or construction of a model. Suggest various examples of each. **Web destination**: DIY science activities (*Science Focus 4 Second Edition LiveText*)	Web destination	

	information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describes a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental			

	procedures 5.15a) make and record observations and measurements accurately over a number of trials			

Science Focus: Scientific method

Students learn about	Students learn to	Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
	5.13.1a) describe a problem, hypothesis or question that can be tested or researched 5.13.1b) propose possible sources of data and/or information relevant to the investigation 5.13.1c) identify what type of information or data needs to be collected 5.13.1d) justify why particular types of data or information are to be collected 5.13.1e) identify the appropriate units to be used in collecting data 5.13.1f) recommend the use of an appropriate technology or strategy for collecting data or gathering	Scientific method: Review the scientific method to assist students in designing, conducting and reporting an investigation. Communicating: Review the various methods of presenting and communicating the investigation. **Worksheet 9.1**: Proposing my big idea **Worksheet 9.2**: Planning my investigation **Career profile**: Science laboratory assistant **Unit 9.2 questions**	Worksheet 9.1 Worksheet 9.2 Career profile Unit questions	

	information 5.13.1g) formulate a means of recording the data to be gathered or the information to be collected 5.13.2a) identify variables that need to be held constant if reliable first-hand data is to be collected 5.13.2b) specify the dependent and independent variables when planning controlled experiments 5.13.2c) describes a logical procedure for undertaking a simple or controlled experiment 5.13.2d) establish an appropriate timeline for an investigation 5.13.3a) identify advantages and limitations of using particular laboratory equipment for a specific task 5.13.3b) select appropriate equipment (including appropriate safety equipment) and/or resources to perform the task 5.13.3c) describe ways to reduce the risk to themselves and others when working in the laboratory or field 5.14d) record data using the appropriate units 5.14e) evaluate and modify experimental			

	procedures 5.15a) make and record observations and measurements accurately over a number of trials 5.19a) justify inferences in light of gathered information 5.19b) identify data which supports or discounts a hypothesis, a question being investigated or the proposed solution to a problem 5.20b) describe different strategies that could be employed to solve an identified problem			

Chapter review

Suggested teaching and learning strategies	*Science Focus 4* Resources	Register
Complete chapter review questions at the end of the chapter **Worksheet 9.3**: Sci-words **Chapter Review Questions** (*Science Focus 4 Second Edition LiveText*, *Science Focus 4 Second Edition Student Lounge*) **Chapter Test**	Chapter review questions Worksheet 9.3 Chapter Review Questions Chapter Test	

Program review and evaluation

Topic
Modifications required in program
Additional practicals and skill development
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Projects undertaken
Websites

1.1 Answers

Remembering

1 **a** carbon dioxide
b water
c sodium chloride
d lithium carbonate
e nitrogen
f calcium oxide
g argon

2 (s), (l), (g), (aq)

3 **a** fireworks, explosion, vinegar and sodium bicarbonate
b rusting, fermenting, ripening

4 increase the temperature, increase the concentration of reactants, change the surface area, add a catalyst

Understanding

5 **a** the chemicals that are used up in a chemical reaction
b the chemicals that are produced during a chemical reaction

6 NaCl is a lattice compound, so 'NaCl' represents the ratio of the number of sodium and chloride ions in a crystal of table salt. However, the molecular formula 'CO_2' explains exactly how many carbon and oxygen atoms are contained in a molecule of carbon dioxide.

7 A balanced equation shows exactly how many of each type of atom are used up in the reaction and how many of each type of atom are formed in the products. A balanced equation is consistent with the Law of Conservation of Mass.

8 $NaCl_{(s)}$ is sodium chloride as a solid crystal, whereas $NaCl_{(aq)}$ is dissolved sodium chloride.

9 Fe: 12, S: 36, O: 54

Applying

10 C

11 **a** neither (metallic bonding)
b ionic
c covalent
d ionic

12 **a** O
b H, O
c H, N, O
d Pb, O
e C, H, O
f Al, O

Analysing

13 B

14 A

15 **a** 2

b 2

c 2

d 6

16 **a** **i** Reactants: 2 hydrogen, 2 oxygen.
Products: 2 hydrogen, 1 oxygen.

ii,iii $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$

b **i** Reactants: 1 sodium, 2 chlorine.
Products: 1 sodium, 1 chlorine.

ii,iii $2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$

c **i** Reactants: 1 calcium, 1 carbon, 3 oxygen.
Products: 1 calcium, 3 oxygen.

ii,iii $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

d **i** Reactants: 1 carbon, 4 hydrogen, 2 oxygen.
Products: 1 carbon, 2 hydrogen, 3 oxygen.

ii,iii $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

Evaluating

17 **a** hydrochloric acid + sodium hydroxide → water + sodium chloride

b hydrogen + nitrogen → ammonia

c carbon monoxide + oxygen → carbon dioxide

d iron + chlorine → iron(III) chloride

e sodium hydroxide + sulfuric acid → sodium sulfate + water

f calcium + hydrochloric acid → calcium chloride + hydrogen

18 **a** Reactants: copper(II) nitrate. Products: copper(II) oxide, nitrogen dioxide, oxygen.

b copper(II) nitrate → copper(II) oxide + nitrogen dioxide + oxygen

c $2Cu(NO_3)_{2(s)} \rightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

19 **a** sodium + oxygen → sodium oxide

b Unbalanced equation: $Na + O_2 \rightarrow Na_2O$
Balanced equation: $4Na + O_2 \rightarrow 2Na_2O$

c $4Na_{(s)} + O_{2(g)} \rightarrow 2Na_2O_{(s)}$

d The mass of the products is equal to the total mass of all reactants.

1.1 Practical activities

Prac 1: Studying a reaction

Common mistakes

Carefully invert the measuring cylinder on top of the filter funnel to avoid air bubbles forming inside the measuring cylinder.

Ensure that students do not use too much magnesium or the volume of gas will be too large to measure.

Possible results

The volume of hydrogen gas produced is measured when magnesium is reacted with sulfuric acid.

Suggested answers

1 *magnesium + sulfuric acid → magnesium sulfate + hydrogen gas*

$Mg_{(s)} + H_2SO_{4\,(aq)} \rightarrow MgSO_{4\,(aq)} + H_{2\,(g)}$

2 **a** *An 8 cm strip should produce twice the volume of hydrogen gas.*

b *A 1 cm strip should produce one-quarter of the volume of hydrogen gas.*

Prac 2: Conservation of mass

Common mistakes

Instruct students to place the balloon onto the conical flask as quickly as possible to avoid the escape of gas. Allow the calcium carbonate from the balloon to drop into the flask. Reweigh. This method ensures a 'closed system' from the beginning of the reaction.

Possible results

The mass of the reactants, calcium carbonate and hydrochloric acid, will equal the mass of the products, calcium chloride, water and carbon dioxide.

Suggested answers

1 *calcium carbonate + hydrochloric acid → calcium chloride + carbon dioxide + water*

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

2 *Answers will vary.*

3 *It would be possible that some gas has escaped.*

Prac 3: Rates of reactions 1

Common mistakes

The controlled variables must be kept the same in each trial to ensure a fair test.

Possible results

An increase in temperature, concentration and surface area will result in an increase in the rate of reaction.

A decrease in temperature, concentration and surface area will result in a decrease in the rate of reaction.

Suggested answers

1 *temperature, concentration and surface area*

2 *reactions proceeded faster*

3 *catalyst*

Prac 4: Rates of reactions 2

Common mistakes

The mass of the calcium carbonate and the level and temperature of the acid must be kept the same across both trials to ensure a fair test.

Possible results

An increase in the surface area that is exposed will result in an increase in the rate of reaction.

Suggested answers

1 *The powdered calcium carbonate reacted with the acid faster than the marble chips because there is a larger surface area exposed to react with the acid.*

The smaller marble chips reacted faster than the larger marble chips because there is a larger surface area exposed to react with the acid.

2 *Answers will vary.*

Prac 5: Reaction rate—effect of catalysts and enzymes

Common mistakes

The sizes of the liver, potato and apple pieces must be similar so comparisons are valid.

Possible results

The order of vigour of the test tubes is: manganese dioxide, liver, potato, apple.

Suggested answers

1 *The test tube containing the manganese dioxide.*

2 *The manganese dioxide and the liver would remain in the test tube because both are catalysts and are never used up in a reaction.*

3 *The potato and apple bubbled less vigorously than the manganese dioxide.*

4 *No, because the enzyme catalyst, catalase, will be denatured by the cooking process.*

1.2 Answers

Remembering

1 corrosion, combustion

2 **a** $2C_2H_{6(g)} + 7O_{2(g)} \rightarrow 4CO_{2(g)} + 6H_2O_{(g)}$

b Reaction 1: $2C_2H_{6(g)} + 5O_{2(g)} \rightarrow 4CO_{(g)} + 6H_2O_{(g)}$

Reaction 2: $2C_2H_{6(g)} + 3O_{2(g)} \rightarrow 4C_{(s)} + 6H_2O_{(g)}$

3 **a** oxygen

b magnesium oxide

c ethane

- **d** iron(II) oxide
- **e** iron(II) hydroxide

4 iron, water, oxygen

5 salt and heat

6 **a** $2Fe + 2H_2O + O_2 \rightarrow 2Fe(OH)_{2(s)}$

b $4Fe(OH)_2 + O_2 \rightarrow 2Fe_2O_{3(s)} + 4H_2O$

c $2Al + 3H_2O \rightarrow Al_2O_{3(s)} + 3H_2$

7 coating, making alloys, galvanising, sacrificial protection

8 **a** sodium

b gold

c zinc

d tin

9 aluminium oxide

Understanding

10 **a** A more reactive metal is attached to another metal so that the reactive metal corrodes first.

b A form of sacrificial protection where iron is protected by a coating of zinc.

c A process used to increase the thickness of the natural, oxide layer.

11 The salt and humidity will increase the rate of corrosion.

12 Galvanisation works even if the coating layer is chipped, cracked or scratched.

13 Iron oxide is flaky so allows oxygen and water to penetrate and react with the iron metal underneath.

14 The aluminium forms a grey-white oxide layer that does not allow oxygen to penetrate, protecting the aluminium metal underneath.

15 The word rust only refers to iron(III) oxide. However, zinc can oxidise in air to form zinc oxide and therefore it corrodes.

Applying

16 oxygen

17 **a** Complete combustion: blue flame, incomplete combustion: yellow flame.

b Hold a glass over a yellow flame and you will see back carbon deposits, indicating incomplete combustion.

c Blue flame requires an open airhole. The yellow flame does not.

18 **a** methane + oxygen → carbon dioxide + water

b $CH_4 + O_2 \rightarrow CO_2 + H_2O$

c $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

19 **a** glucose + oxygen → carbon dioxide + water

b $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

c $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

20 **a** cutlery, nails, metal beams

b made into a stainless steel alloy, galvanised, painted

21 Copper: the copper will corrode preferentially.
Magnesium: the magnesium will corrode preferentially.
Tin: the iron will corrode preferentially.

Analysing

22 **a** blow in more oxygen, chop the wood into smaller pieces

b reduce the flow of oxygen, make the pieces of wood bigger

c place it in a closed, air-tight container

Evaluating

23 Magnesium, because calcium, sodium and potassium are too dangerous and aluminium forms its own protective layer.

24 **a** Gold is the most valuable because it is rare.

b Iron is the most valuable because it is the most useful.

Creating

25 **a** $2H_2 + O_2 \rightarrow 2H_2O$

b $2Zn + O_2 \rightarrow 2ZnO$

c $2Mg + O_2 \rightarrow 2MgO$

1.2 Practical activities

Prac 1: Complete and incomplete combustion

Common mistakes

One or two drops of ethanol won't produce a significant flame for observation.

A well-lit room is not ideal for this prac, as it may not allow students to see the initial colour of the flame clearly. A darkened room will assist this exercise.

Possible results

Several different products are possible when carbon compounds are burned. The products formed are dependent on the oxygen supply.

Suggested answers

1 *a* *Complete combustion is usually indicated by blue flames, and both products (carbon dioxide and water vapour) are invisible.*

b *Incomplete combustion is usually indicated by a yellow, sooty flame, and black carbon (soot) may be seen in the smoke.*

2 *Kerosene contains much larger molecules with much lower boiling points than ethanol, so it is difficult for the kerosene to vaporise. It is also difficult to get enough oxygen to the flame to react with the many hydrogen and carbon atoms released.*

3 *In a well-tuned and well-maintained car, complete combustion occurs. If a car is poorly tuned ('running rich') incomplete combustion can occur.*

Prac 2: Corrosion of iron

Common mistakes

The size and type of nails must be kept the same across all test tubes to ensure a fair test. Do not use bent nails, as rust will occur at the site of the bend.

Possible results

Salt water will encourage rusting and heat will increase the rate at which rusting will occur. The sacrificed metal must be more reactive than the metal being protected from corrosion.

Suggested answers

1 *Salt water should encourage the most rusting.*

2 *Heat increased the rate of rusting.*

3 *Most reactive to least reactive: magnesium, iron (steel), copper.*

4 *Sacrificial protection was demonstrated in the test tube with the magnesium ribbon.*

5 *Only a more reactive metal will sacrifice itself. Magnesium is more reactive than iron, but copper is not.*

Prac 3: Observing iron hydroxides

Common mistakes

To ensure a fair test, ensure that the level of each solution and the drops of sodium hydroxide are the same for both test tubes.

Possible results

When combined, iron(II) chloride solution and sodium hydroxide solution will form a green precipitate, iron(II) hydroxide.

When combined, iron(III) chloride solution and sodium hydroxide solution will form a reddish brown precipitate, iron(III) hydroxide.

Suggested answers

1 *A green precipitate formed.*

2 *A reddish brown precipitate formed, which is rust.*

3 $2NaOH_{(aq)} + FeCl_{2(aq)} \rightarrow Fe(OH)_{2(s)} + 2NaCl_{(aq)}$

$3NaOH_{(aq)} + FeCl_{3(aq)} \rightarrow Fe(OH)_{3(s)} + 3NaCl_{(aq)}$

Prac 4: Anodised aluminium

Common mistakes

Do not touch the aluminium with bare hands, as aluminium is very reactive and touching it with fingers could corrode the surface.

Possible results

The process of anodising will cause the surface of the aluminium to oxidise and create a more stable surface.

Suggested answers

1 *Aluminium is very reactive and touching it with fingers could corrode the surface.*

2 *Aluminium forms a thin layer of aluminium oxide that protects it from the air and from further corrosion.*

3 *Anodising is intentionally creating a thicker and more permanent oxide layer on the surface.*

4 *Aluminium's oxide forms a solid layer, tightly stuck to the surface. Iron's oxide (rust) is scaly and flaky and falls away from the surface.*

1.3 Answers

Remembering

1 alpha particles, beta particles, gamma rays

2 **a** nuclear (strong) force

b electrostatic force

3 uranium, actinium, astatine, carbon etc.

4 solar and cosmic rays, terrestrial radioisotopes

5 1700 microsieverts

6 check for leaks in pipes, measure the thickness of a metal

Understanding

7 **a** an isotope of an element that undergoes radioactive decay

b the time it takes for half the atoms in a quantity of radioactive isotope to decay

8 Their nuclei are less stable because there are a large number of protons. Nuclear force is only effective over a very short distance.

9 Ions are chemically reactive and can cause unwanted chemical reactions in cells.

10 Geiger counter, photographic plate, dosimeter

11 Food irradiation kills bacteria but may destroy vitamins.

12 by adding a neutron to the nucleus of a natural gold atom

Applying

13 Z

14 **a** alpha radiation

b beta radiation

c gamma radiation

d beta radiation

e alpha particle

Analysing

15

	Particle size	Speed	Penetration
Alpha particle	Same size as a helium nucleus	One-tenth the speed of light	Cannot penetrate paper or skin
Beta particle	Same size as an electron	Nine-tenths the speed of light	Can penetrate a sheet of paper, but not aluminium
Gamma ray	No size	Speed of light	Can penetrate several centimetres of lead and concrete

16 **a** 1 kg
b 0.5 kg
c 0.25 kg

17 **a** ${}^{218}_{84}\text{Po} \rightarrow {}^{214}_{82}\text{Pb} + {}^{4}_{2}\alpha$
b ${}^{24}_{11}\text{Na} \rightarrow {}^{24}_{12}\text{Mg} + {}^{0}_{-1}\beta$
c ${}^{133}_{54}\text{Xe} \rightarrow {}^{133}_{54}\text{Xe} + \gamma$
d ${}^{59}_{26}\text{Fe} \rightarrow {}^{59}_{27}\text{Co} + {}^{0}_{-1}\beta + \gamma$

Evaluating

18 Radon gas and alpha particles can be breathed in, causing internal damage.

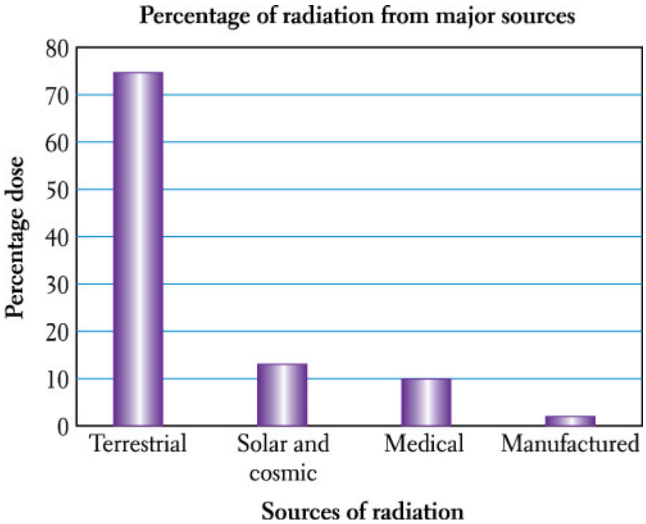
19 They do not penetrate deeply, so could not be detected for medical diagnosis. They could cause damage to cells once inside the body.

20 Radiation therapy attacks all cells, but affects cells that reproduce more quickly. Hair cells divide more often than most cells, which is why our hair keeps growing.

21 **a** Little to no danger.
b This is much less than the normal yearly dose, so little to no danger.
c Causes cell damage and increased risk of cancer.

Creating

22



1.3 Practical activity

Prac 1: Half-life is sweet

Common mistakes

To eliminate the temptation for students to eat the M&Ms, use double-sided items, such as 5-cent coins instead.

Possible results

Students' graphs should demonstrate an exponential decay curve. Initially, there should be a rapid decrease, then a gradual decrease.

Suggested answers

1 *Students' answers.*

2 *Students' answers.*

3 *The graph of the M&Ms mimics the graph of radioactive decay. First, there is a rapid decrease in the number of particles in the radioactive material, then the rate of decay decreases.*

Chapter answers

Remembering

1 solid (s), liquid (l), gas (g), aqueous (aq)

2 Students' answers may vary; an example is given below.
$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$
Reactants: hydrogen, oxygen.
Product: water.

3 Students may list one of the following: increase the temperature, increase the concentration of reactants, increase the surface area.

Understanding

4 To efficiently communicate what happens during a chemical reaction. The equations explain what chemicals are used, what chemicals are produced, the type and number of each atom involved and the states of each of the chemicals.

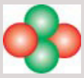
5 SO_2 is a molecular formula, because it shows the exact number of sulfur and oxygen atoms in each molecule of sulfur dioxide. Na_2SO_4 is not a molecular formula because sodium sulfate is a lattice compound, so the formula shows only the ratio of sodium ions to sulfate ions in a crystal of sodium sulfate.

6 **a** When sodium metal is reacted with water, the products are hydrogen and sodium hydroxide.

b When copper oxide reacts with nitric acid, the products are copper nitrate and water.

7 Complete combustion occurs when there is an excess of oxygen and the products are carbon dioxide and water. Incomplete combustion occurs when there is only limited oxygen and it may produce carbon, carbon monoxide and water.

8

	Alpha particles	**Beta particles**	**Gamma rays**
Sketch			
Charge	+2	–1	0
Mass	7200 × the mass of an electron	mass of an electron	zero mass
Speed	0.1 × speed of light	0.9 × speed of light	speed of light
Penetration ability (high, medium, low)	low	medium	high
Stopped by ionising ability	high	medium	low

9 Radiotherapy affects cells that divide rapidly more so than other cells. Cancer cells divide rapidly and therefore are more susceptible to radiotherapy.

10 The patient is injected with a radioactive isotope and the radiation of the isotope is detected and converted to images of the internal organs.

11 Radiation affects cells that are growing, developing and changing more than it affects other cells. Therefore, children are more affected by radiation.

12 Radon gas is produced when uranium in the ground undergoes radioactive decay.

Applying

13 **a** lithium chloride (LiCl)

b lithium carbonate + hydrochloric acid → lithium chloride + carbon dioxide + water

c $Li_2CO_{3(s)} + 2HCl_{(l)} \rightarrow 2LiCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$

Analysing

14 **a** $Al(OH)_3 + 3HNO_3 \rightarrow 3H_2O + Al(NO_3)_3$

b $2H_2O + 2K \rightarrow H_2 + 2KOH$

15 **i** **a** hydrochloric acid + potassium hydroxide → water + potassium chloride

b $HCl_{(aq)} + KOH_{(s)} \rightarrow H_2O_{(l)} + KCl_{(aq)}$

ii **a** sulfur dioxide + oxygen → sulfur trioxide

b $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

iii **a** magnesium + chlorine → magnesium chloride

b $Mg_{(s)} + Cl_{2(g)} \rightarrow MgCl_{2(s)}$

iv **a** silver nitrate + sodium chloride → sodium nitrate + silver chloride

b $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow NaNO_{3(aq)} + AgCl_{(s)}$

16 0.125

17 22 920 years old

Evaluating

18 Aluminium creates its own protective layer and therefore will not oxidise preferentially even when attached to a less reactive metal.

19 No, alpha particles cannot penetrate cardboard, so there would be no way to distinguish between different thicknesses.

20 Particles from the ammunition will remain in the environment of the war zone and will remain radioactive for millions of years.

21 The radioactivity would not be very different. The half-life of plutonium is approximately 24 000 years. So, after 10 years, there would be almost the same amount of radioactive nuclei in the sample.

2.1 Answers

Remembering

1 **a** true

b true

2 dense, malleable, ductile, conduct heat, conduct electricity

3 **a** gold: jewellery; silver: jewellery; copper: wires; mercury: thermometers.

b brass: doorknobs; bronze: ornaments; cupronickel: 'silver' coins; solder: electrical joins in circuitry

4 24

5 mild steel, tool steel, cast iron

Understanding

6 **a** the main component of an alloy

b a mixture where the main component is a metal

7 Alloys can have different properties from the base metals, which may be more useful. For example, iron corrodes easily but when alloyed with chromium it makes stainless steel, which resists corrosion.

8 On a scale of 0 to 24, it measures the proportion of gold in a gold alloy.

9 Coins are alloys; e.g. 'silver' coins are an alloy of copper and nickel. To make actual gold and silver coins from pure metals would cost more than the coin itself.

10 Poor conductors, as metals need free electrons to conduct electricity.

Applying

11 ductile, good electrical conductors

12 The charred, grill marks on the fish indicate that the metal is hotter than the air.

13 **a** copper (but aluminium content is also high in some gold coins)

b mercury

c iron

d copper

e chromium

Analysing

14 **a** $\frac{1}{2}$, 50%

b $\frac{3}{8}$, 37.5%

c $\frac{11}{12}$, 91.7%

Evaluating

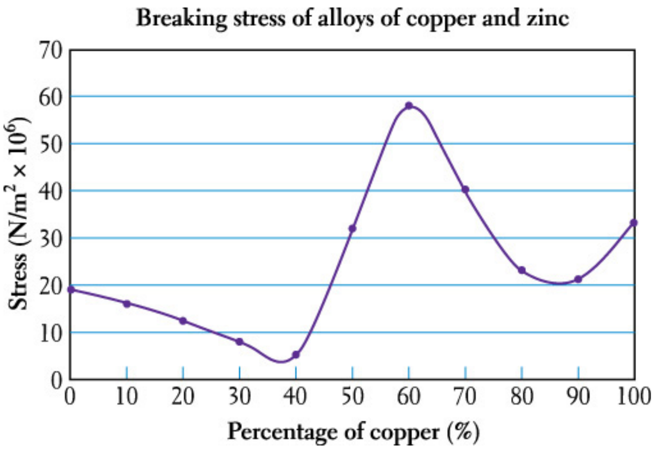
15 Mercury is a liquid over a large range of temperatures, expands and contracts a large amount with small changes in temperature, and is a good conductor of heat.

16 iron

17 Aluminium is very light so can be made into thick wires to carry a lot of electrical current.

Creating

18



a **i** 32×10^6 N/m^2

ii 12×10^6 N/m^2

iii 5×10^6 N/m^2

iv 33×10^6 N/m^2

v 19×10^6 N/m^2

b 52–72%

c 1–45%

d 60% copper

e 48%, 78% and 94%

2.1 Practical activities

Prac 1: Metallic crystals

Common mistakes

Soiled or coated copper wire may inhibit crystal growth. If soiled or coated, clean with a piece of sandpaper or steel wool.

Possible results

Silver crystals will grow on the copper wire while the copper is being dissolved. The colourless solution becomes blue.

Suggested answers

1 *Chemical change. Copper wire dissolves and silver is deposited. Clear silver nitrate becomes a blue solution.*

2 *From the silver nitrate solution: copper$_{(s)}$ + silver nitrate$_{(aq)}$ → silver$_{(s)}$ + copper nitrate$_{(aq)}$*

3 *The copper wire left in the silver nitrate solution is thinner than the original wire, as it reacted with silver nitrate to produce copper nitrate solution.*

4 *The solution turned blue. Copper had replaced the silver in the solution to produce copper nitrate.*

Prac 2: How much is it worth?

Common mistakes

Answers will vary depending on the accuracy in weighing.

Possible results

Mass of \$1 coin = 8.978 g

Mass of copper in coin = 92% of 8.978 = 8.259 76 g

Mass of aluminium in coin = 6% of 8.978 = 0.538 68 g

Mass of nickel in coin = 2% of 8.978 = 0.179 56 g

Mass of \$2 coin= 6.631g

Answers will vary depending on current metal prices.

Mass of copper in coin = 92% of 6.631 = 6.100 52 g

Mass of aluminium in coin = 6% of 6.631 = 0.397 86 g

Mass of nickel in coin = 2% of 6.631 = 0.132 62 g

Exchange rates vary and the rest of the answers will vary.

Suggested answers

1 *No. All coins cost less to produce than their face value.*

2 *Silver has become too expensive, making the coins worth more than their face value.*

3 *Answers will vary depending on current metal prices.*

2.2 Answers

Remembering

1 silicon dioxide

2 oxygen, silicon, aluminium, iron, calcium, sodium, magnesium, potassium

3 bauxite: aluminium; galena: lead; haematite: iron

4 **a** copper

b gold, silver

c potassium, sodium, calcium

d iron, zinc, nickel, tin

5 water penetration, collapse, venting poisonous gases, explosive gases, provision of fresh air

6 **i** $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

ii $CaCO_3 \rightarrow CaO_{(s)} + CO_{2(g)}$

iii $CO_{2(g)} + C_{(s)} \rightarrow 2CO_{(g)}$

iv $Fe_2O_3 + 3CO_{(g)} \rightarrow 2Fe + 3CO_{2(g)}$

v $CaO_{(s)} + SiO_{2(s)} \rightarrow CaSiO_{3(l)}$

7 Advantage: helps conserve limited metal resources.
Disadvantage: is too expensive for some metals.

8 **a** false

b false

c true

9 **a** aluminium

b iron

Understanding

10 **a** There is not enough metal in the ore, the ore is not easily accessible, the overall cost to the environment is too high, the overall cost to local communities is too high.

b There is a large quantity of ore, the ore can be accessed easily, there is a high percentage of metal in the ore.

11 **a** Smelting is a technique for extracting metals from ore that involves using heat with chemical processes.

b A non-renewable resource is a useful material of which there is limited supply in the Earth and which cannot be replenished.

12 very expensive and requires a lot of energy

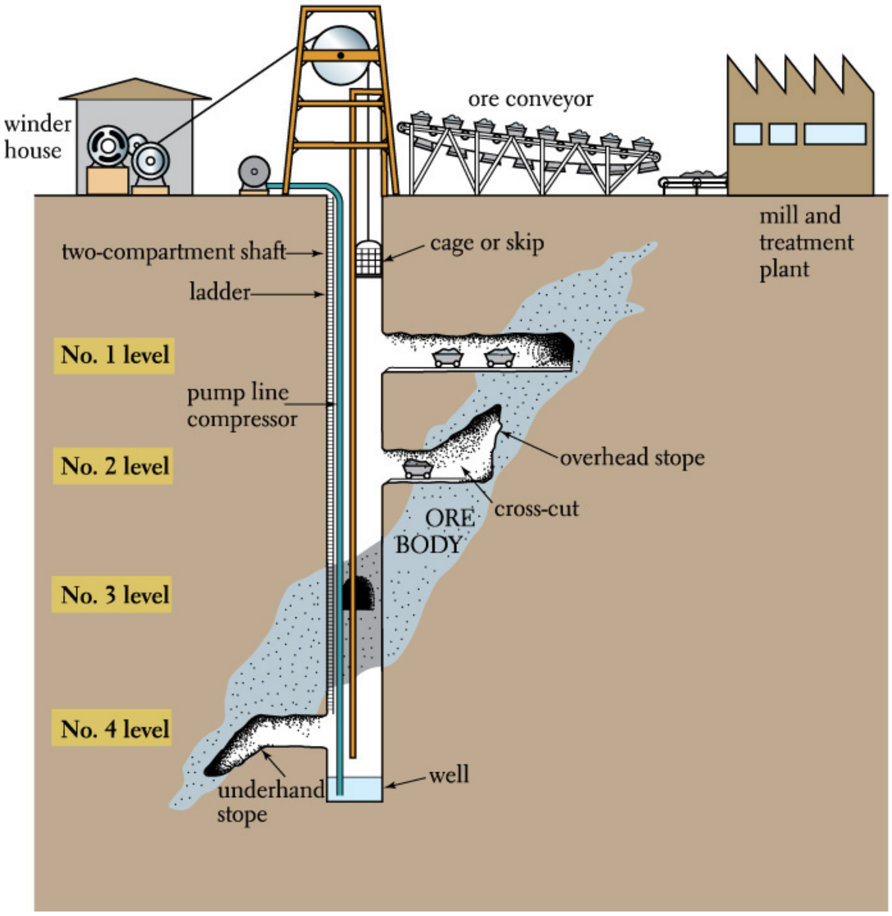
Applying

13

Students to list any three of each of the following sites. Many other sites are possible.

Ore	Sites
Bauxite	Tomago, Gladstone, Pinjarra, Able, Nabalco
Chalcopyrite	Scuddles, Telfer, Gecko, Balcooma, Kurri Kurri
Galena	Paraburdoo, Whyalla, Century, Goongewa, Plenty River
Haematite	Mt Tom Price, Jimblebar, Newcastle, Yarrie, Port Kembla
Pitchblende	Angela, Beverly, Radium Hill, Manyingee, Jabiluka
Sphalerite	Blendevale, Plenty River, Elura, Scuddles, Balcooma

14 a



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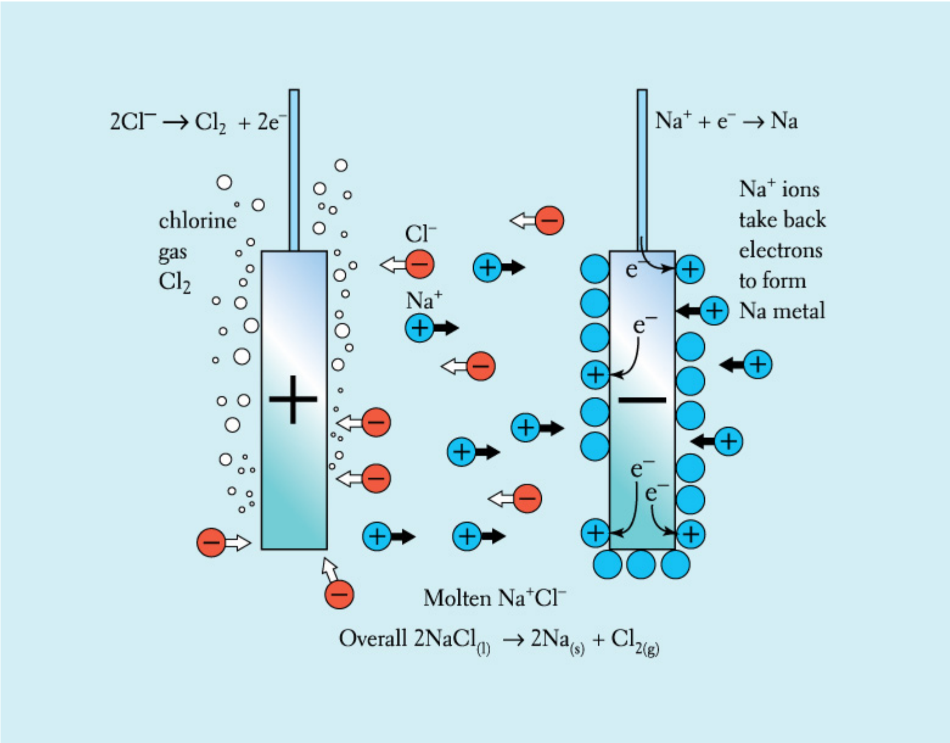
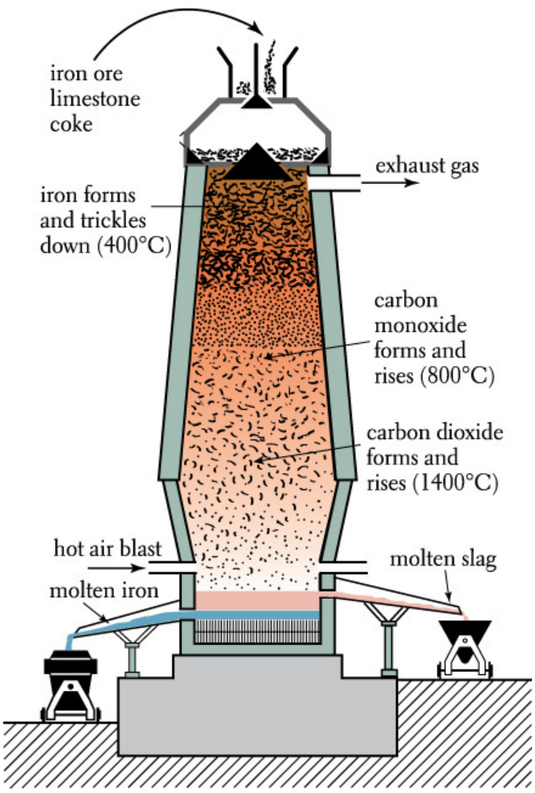
b



$2Cl^- \rightarrow Cl_2 + 2e^-$
$Na^+ + e^- \rightarrow Na$
chlorine gas Cl_2
Cl^-
Na^+
Na^+ ions take back electrons to form Na metal
e^-
Molten Na^+Cl^-
Overall $2NaCl_{(l)} \rightarrow 2Na_{(s)} + Cl_{2(g)}$

c



iron ore
limestone
coke
exhaust gas
iron forms and trickles down (400°C)
carbon monoxide forms and rises (800°C)
carbon dioxide forms and rises (1400°C)
hot air blast
molten iron
molten slag

15 Mined material is crushed by rollers or steel balls within a ball mill. Impurities known as gangue are separated by froth flotation. The remaining ore is now ready for extraction.

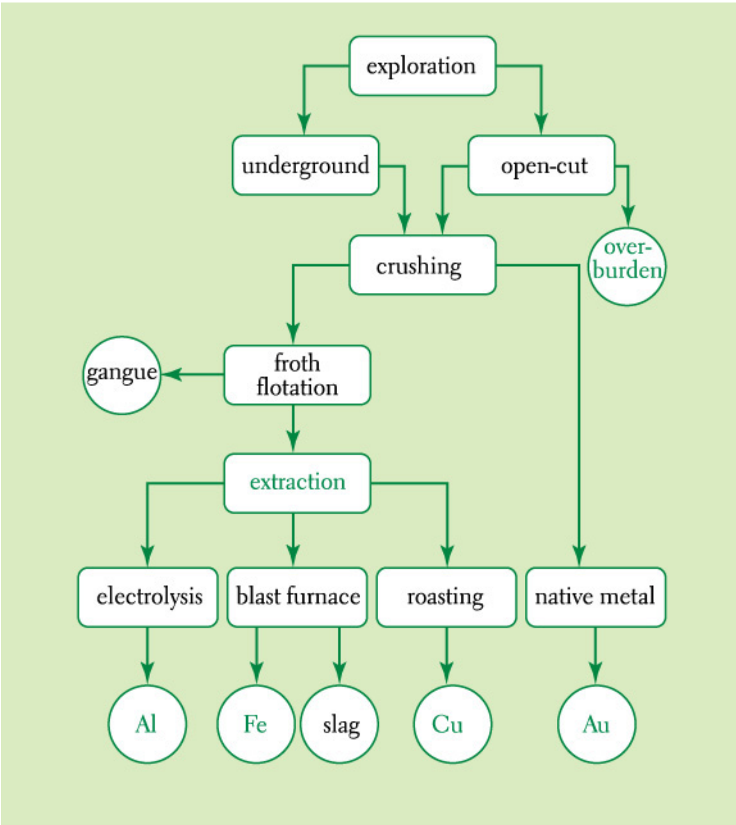
16 **a** sodium chloride

b Sodium ion: negative electrode.
Chloride ion: positive electrode.

c $2NaCl_{(l)} \rightarrow 2Na_{(s)} + Cl_{2(g)}$

d chlorine gas

17



Analysing

18 Investigation task.

19 **a** Minerals are rocks containing large amounts of a particular metal. If there is sufficient metal to make it worth mining, it is called an ore.

b A shaft is the main vertical hole bored down in an underground mine. Drive shafts come off horizontally from the shaft leading to the stope, which is an area where the ore has been excavated.

c Slag is the waste from a blast furnace, whereas gangue is the waste produced by froth flotation.

d Overburden is the dirt that has no value, which is removed from an open-cut mine in order to reach the ore, which has a high metal content.

Evaluating

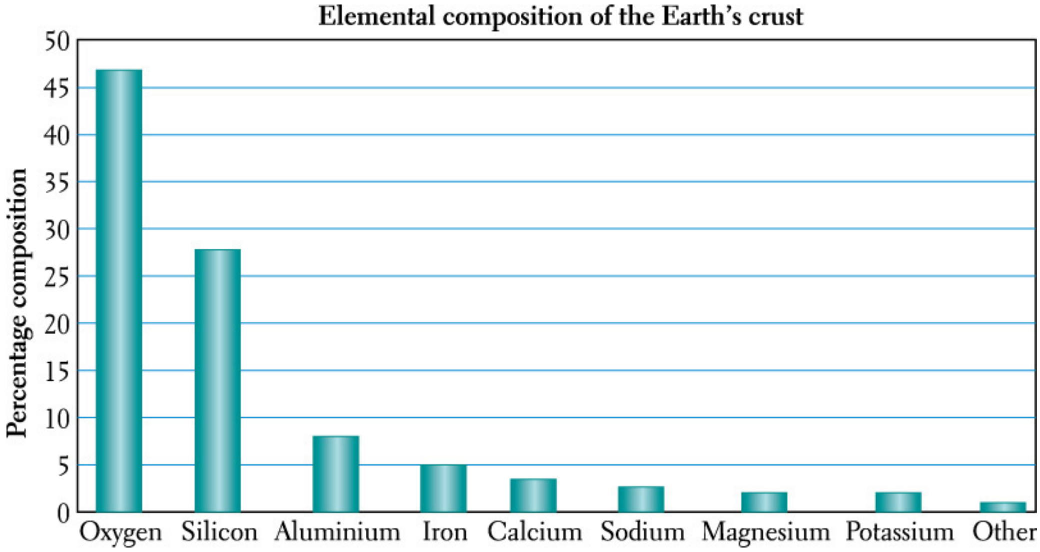
20 Answers will vary depending on personal opinion.

21 At the bottom, with gold and silver.

Creating

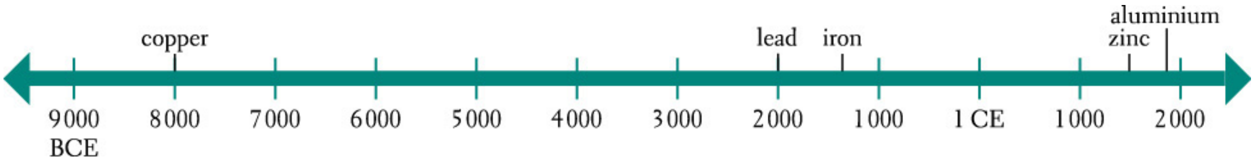
22 Creative task.

23



24 Creative investigation task.

25



2.2 Practical activities

Prac 1: Chocolate chip mining

Common mistakes

Ensure that the cookie crumbs are contained and easily retrievable for reweighing. Trays will assist in containing the cookie crumbs.

Possible results

Students compare the amount of 'valuable' material mined with the waste produced. As a general rule, the desired element is a small fraction of the material mined.

Suggested answers

1 *Results will differ across groups.*

2 *The composition of each biscuit should be roughly the same, although there will be variations.*

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3 *Chocolate chip biscuits usually only have a few choc-chips in each biscuit and so the amount of 'waste' (biscuit crumbs) would be close to the amount of material in the biscuit itself.*

4 *The waste material after 'extraction' would not completely fill the 'hole' dug.*

5 **a** *The ore is the chocolate chip biscuit.*

b *The mineral is the chocolate chips (extremely valuable).*

c *The gangue is the leftover waste (biscuit crumbs).*

Prac 2: Froth flotation

Common mistakes

Larger iron filings will be too heavy to float. Finely crushed iron filings will assist this activity.

Possible results

The kerosene coats the iron filings. The part of the detergent molecule that is hydrophobic attaches itself to the kerosene. The detergent then carries the iron filings to the surface.

Suggested answers

1 *The detergent creates the froth.*

2 *The metal ore (basically rock) has to float on top of the water (in the froth), so the particles need to be as small and light as possible.*

Prac 3: Extracting copper by electrolysis

Common mistakes

Ensure the voltage selected is suitable for the globe tolerance.

Possible results

Copper is formed at the negative electrode. The blue colouration of the solution will become less strong as the copper ions are converted into pure, metallic copper.

Suggested answers

1 *Copper was formed at the negative electrode.*

2 *The blue colouration of the solution will become less strong as the copper ions are converted into pure, metallic copper.*

3 *Copper is formed at the negative electrode and the blue colouration becomes weaker.*

4 $Cu^{2+}_{(aq)} + 2e^{-} \rightarrow Cu_{(s)}$

5 *Copper is sometimes found as a native metal. Otherwise, it is extracted from its ore by simply roasting it. These methods are far easier and cheaper than electrolysis.*

Prac 4: Extracting copper by roasting

Common mistakes

Students may confuse the copper oxide with the ground charcoal. Ensure that each substance is labelled clearly to avoid any confusion.

Possible results

Pieces of copper metal will appear in the mixture.

Suggested answers

1 *Copper metal will be produced.*

copper oxide$_{(s)}$ + carbon$_{(s)}$ → copper metal$_{(s)}$ + carbon dioxide$_{(g)}$

2 *Students' own answers required.*

3 *Students' own answers required.*

2.3 Answers

Remembering

1 **a** IV

b 4

c diamond, graphite

d carbon dioxide, methane

2 fossil fuels, drugs, plastics

3 **a** polythene, acrylic, nylon, polystyrene, melamine

b cellulose, resin, pitch

c asbestos

4 extrusion moulding, blow moulding, injection moulding

5 toys, bottle caps, outdoor furniture

6 blow moulding

7 hard, brittle, rigid

Understanding

8 Desirable: cheap, versatile, recyclable.
Undesirable: non-biodegradable, burn to form noxious gases, become brittle over time.

9 Thermoplastics are held together by long chains, but the chains are not cross-linked, so they can move and flow around each other when in liquid form. Because the chains are not cross-linked, these plastics will reset when cooled.

10 Cross-linking forms strong bonds across the polymer chains. Therefore, the chains are physically stuck to each other and cannot flow to form a liquid when heated.

Applying

11 **a** 6

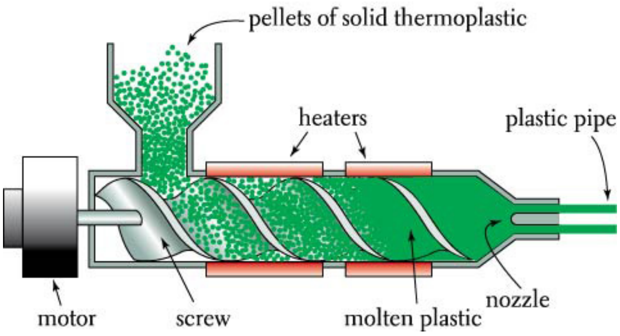
b 2

c 4

12 A small molecule capable of joining together in a long chain is called a monomer. When small molecules join together they form a polymer. Small molecules join together in a process known as polymerisation and result in the production of plastics.

13 one carriage

14



Analysing

15 Monomers are the individual building blocks that make up polymers.

16 Both are plastics that are shaped by heating. Thermosetting plastics cannot be remoulded; they are hard, brittle, rigid and cross-linked. Thermoplastics can be remoulded, tend to be soft, flexible and are not cross-linked.

17 Investigation task.

Evaluating

18 No, because a thermosetting powder could not be remoulded into useful objects.

19 Plastics provide a very useful, cheap and versatile material for our society. However, plastics are not good for the environment because they do not biodegrade. They also pose a risk to animals that may be caught in plastics or have plastics caught in their digestive systems after swallowing them.

20 They could perhaps be used as a form of insulation, made into new weatherproof materials etc.

21 We will have to start taking our own shopping bags to the supermarket (which we should be doing already) or pay a small fee for biodegradable bags.

22 If they are made of synthetic polymers, then the polymer chains might contract under heat and cause the clothes to shrink.

Creating

23 Practical task.

24 Investigation task.

25 Design task.

26 Design task.

2.3 Practical activities

Prac 1: Identifying plastics

Common mistakes

Encourage students to use very small samples of plastic to expose to a flame in order to reduce the fire hazard.

Possible results

Results will vary depending on the plastic samples used. All of the plastics used should be thermoplastic. Perspex and nylon will be heavier than water. Polythene will keep burning once removed from the flame.

Suggested answers

1 *Answers will vary depending on the plastic samples used.*

2 *Answers will vary depending on the plastic samples used.*

3 *Many plastics produce toxic fumes when burnt, so burning or heating them must be done in a fume hood. PVC produces hydrochloric acid fumes when it burns.*

4 *Dioxin, which is highly toxic.*

5 *None of these plastics sink in water or react with it.*

6 *Polythene will keep burning once removed from a flame.*

Prac 2: Making casein plastic

Common mistakes

Do not heat the milk over 50°C, as the protein casein will denature and will lose its potential to form a polymer.

Possible results

Students make a polymer called casein from milk. When milk is acidified with the vinegar, it is transformed into a solid component, called curd, and a liquid component, called whey. The curd contains the protein casein.

Suggested answers

1 *Casein plastic is thermoplastic (unless it is cross-linked using formaldehyde, which was not done in this experiment).*

2 *Casein was used as wood glue. The final test showed how the glue was made and how it worked.*

3 *As casein takes a long time to manufacture, it is not used much now. It was once used for things such as combs and handles.*

4 *Casein is hardened industrially using formaldehyde.*

5 *Junket (curds and whey) used to be a common dessert, but students will have a variety of reactions to junket. (Maybe, make some junket for them!)*

2.4 Answers

Remembering

1 **a** false
b false
c false

2 **a** cotton, silk, linen
b nylon, Kevlar, spandex
c viscose, acetate, rayon
d rhizomes, bark, leaves
e bullet-proof vests, sails, fuel tanks

3 spinneret

Understanding

4 The fibres have rough surfaces that trap and hold on to the water.

5 They are a monofilament, so breaking fishing line requires breaking many strong, chemical bonds between the polymer chains.

6 A monofilament is a long strand made up of a single fibre.

7 The longer the molecule, the stronger the fibre.

8 1 m

9 First, glass fibres are produced by running molten glass through a perforated steel bowl that spins very fast, sending out threads of liquid glass that cool in the air. The glass fibres are then mixed with resin to form fibreglass.

Applying

10 **a** clothes, fishing line
b spider webs, silkworm cocoons

11 **a** surfboards, thermal insulation, electrical insulation
b Surfboards: fibreglass is strong, water resistant and lightweight.
Thermal insulation: resists heat, high melting point.
Electrical insulation: non-conductive.

12 **a** carbon
b Carbon fibres are extremely strong and lightweight, Carbon, itself, is a black, soft and crumbly substance.
c Carbon fibres are used in sporting equipment such as tennis rackets, bike frames and rowing oars, whereas the soft form of carbon is used for sketching.

13 The fibres are not made directly from carbon. The fibres are first formed using polymer chains and then charred to create the carbon fibres.

Analysing

14 **a** Natural fibres tend to be better insulators because their rough surfaces trap air.

b Natural fibres tend to be more absorbent because their rough surfaces trap water.

c Natural fibres have rough surfaces that trap air and water, whereas synthetic fibres have smooth surfaces that do not trap air and water.

15 100 000 000

Evaluating

16 Applying heat could cause the synthetic polymer chains to contract, melt or char.

2.4 Practical activities

Prac 1: Making nylon: teacher demonstration

Common mistakes

The two solutions of 1,6-diaminohexane and sebacoyl chloride must not mix when poured into the beaker. Pouring the two solutions gently down a glass rod will assist in obtaining an interface between the two solutions.

Possible results

The two solutions of 1,6-diaminohexane and sebacoyl chloride contain substances called monomers. The monomers from one solution join the monomers of the other solution to form a long molecule called a polymer. The name of this polymer is called nylon.

Suggested answers

1 *The cartoon or diagram should summarise and repeat the steps described in the Method.*

2 *A mess! A mass of layers of plastic, a bit like scrambled eggs.*

3 *The fibre was of very variable thickness and strength due to the way it was manufactured.*

Prac 2: Identifying fibres

Common mistakes

Encourage students to use a very small sample of fabric to expose to the flame to reduce fire hazards.

Possible results

Rayon, nylon and polyester are synthetic fibres. Wool, cotton and linen are natural fibres. Synthetic fibres are formed by injection moulding through spinnerets, giving them a smooth surface and consistent thickness. Natural fibres grow on animals or in plants.

Suggested answers

1 *Answers will vary.*

2 *Rayon, nylon and polyester are synthetic fibres. Wool, cotton and linen are natural fibres.*

3 *Synthetic fibres are formed by injection moulding through spinnerets, giving them a smooth surface and consistent thickness. Natural fibres grow on animals or in plants. Their growth rate and thickness will therefore vary.*

4 *Natural fibres are typically more fire-safe (less flammable) than artificial fibres, but the precise order will vary.*

5 *Children are more likely to be less careful around fires than adults. Girls' flowing skirts or dresses are more likely to catch fire than boys' more fitted shorts or trousers.*

6 *Natural fibres would be better for clothing for babies and young children due to their fire resistance.*

Prac 3: Investigating fibres

Common mistakes

Student-designed experiments should be assessed by the teacher for any safety considerations before they are carried out.

Possible results

Students design their own experiment to investigate the strength, absorption and structure of different fabrics.

Suggested answers

1 *Students' responses will vary.*

2 *Students' responses will vary.*

Science Focus

Practical activity

Making molecules

Common mistakes

Soft malleable plasticine will assist this exercise. If the plasticine is too hard, place on paper towel and microwave for a very brief time (too long and it melts).

Possible results

Students build a model to demonstrate the orientation and number of carbon and hydrogen atoms that make up a variety of hydrocarbons belonging to the alkane group.

Suggested answer

The general formula for all alkanes is C_nH_{2n+2}*, where n is the number of carbon atoms in a molecule. The number of hydrogen atoms equals double the number of carbon atoms plus two.*

2.5 Answers

Remembering

1 polar

2 organic compound

3 **a** turpentine, methylated spirits, nail polish, soaps, shampoos, detergents

b dry cleaners, industrial cleaners, around the home

4 dissolved by surfactants, hot water, agitation, lather

5 soap lathers better, soap scum is not produced, washing requires less soap

6 soaps

7 solid calcium, magnesium salts of soap

8 fat, alkaline solution

9 fat + alkaline solution → soap + glycerol

Understanding

10 A polar molecule has a slight positive charge on one end and a slight negative charge on the other end.

11 Surfactants are long molecules with one organic part and one ionic part that can dissolve in both polar and non-polar solvents.

12 Soap is a long molecule with a polar end and a non-polar end, allowing it to dissolve in both water and grease.

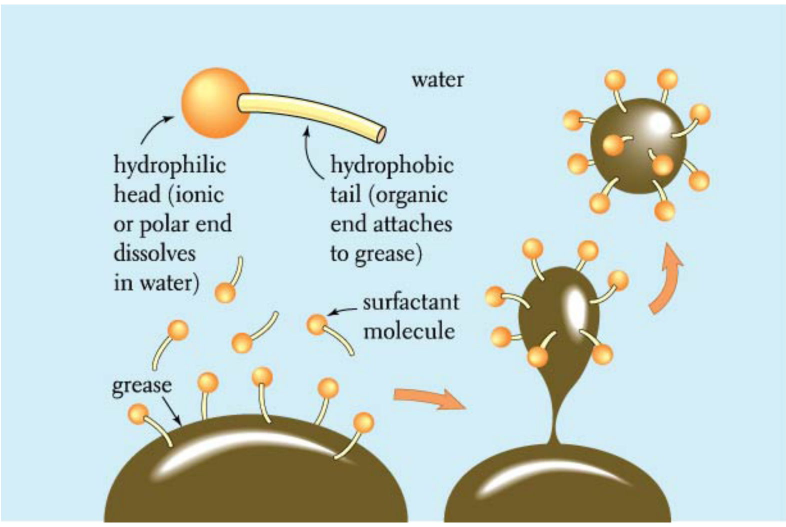
13 back on the skin or in the razor

Applying

14 **a** Like plastics, soap molecules are long molecules with a chain of many carbon atoms as their backbone.

b Like ionic compounds, soap molecules can dissolve in water and are charged when dissolved.

15



16 Lather uses air and bubbles to stop grease from redepositing on a surface, especially when using only a small amount of water.

17 palm oil, olive oil, sunflower oil

18 the amount and type of dirt, the amount and type of solvent, the type of fabric, temperature, level of agitation

Analysing

19 Both detergents and soaps are made up of long-chain molecules with a hydrophilic end and a hydrophobic end. However, soaps are made from natural fats and will precipitate out in hard water, whereas detergents are synthetic chemicals and will not precipitate in hard water.

Evaluating

20 boiled down carcasses of cattle

Creating

21 Creative task.

22 Investigation task.

2.5 Practical activities

Prac 1: Make soap

Common mistakes

Ensure enough time is allowed for the sodium hydroxide to react with the oil.

Possible results

Sodium hydroxide mixes with the fatty acids in the oil and produces soap and glycerine.

Suggested answers

1 *Students' answers will vary.*

2 *Kerosene and water do not mix.*

3 *Soap causes the kerosene and water to mix.*

4 *oil + sodium hydroxide → soap + glycerol*

Prac 2: How hard is it?

Common mistakes

The size of the soap chips and the temperature must be kept the same across all test tubes to ensure a fair test.

Possible results

Hard water contains dissolved calcium (or magnesium) salts that react with a soap solution to form an insoluble scum that should be seen as a white cloudiness in the test tubes. When all the calcium ions have precipitated out, the water will lather. Thus, the volume of soap lather measures the amount of hardness.

Suggested answers

1 *It does not lather as it should.*

2 *Calcium hydrogen carbonate will probably be the hardest. Calcium carbonate is too insoluble to be as hard.*

3 *Water will not show any hardness with shampoo and detergent.*

4 *Detergent does not form scum in hard water.*

5 *Students' answers will vary.*

Prac 3: Powder and liquid laundry detergents

Common mistakes

Student-designed experiments should be assessed by the teacher for any safety considerations before they are carried out.

Possible results

Students design their own experiment to identify variables or factors that could influence the effectiveness of laundry detergents in removing grease.

Suggested answers

1 *Students' responses will vary.*

2 *Students' responses will vary.*

Chapter answers

Remembering

1 stainless steel, iron

2 metals

3 **a** 2.5–4.5%

b 1%

c 0.5%

4 24 carats

5 75%

6 **a** sodium

b iron

c copper

7 iron oxide, calcium carbonate, coke (carbon)

8 cross-linked, hard, brittle, rigid

9 Natural fibres: cotton, linen.
Synthetic fibres: nylon, Kevlar.

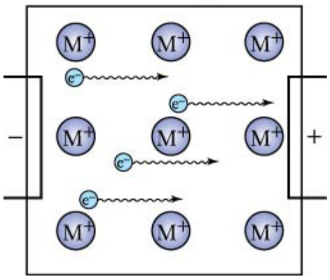
Understanding

10 These are unreactive metals.

11 non-biodegradable, trap wildlife

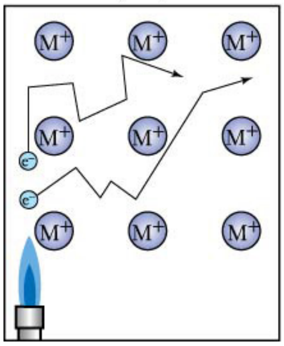
12 **a**

Electrons can carry current



b

Electrons rapidly transfer heat



Applying

13 aluminium: overhead power cables; Duralumin: aircraft frames; bauxite: aluminium ore; zinc: galvanised iron; bronze: statues; celluloid: film; cast iron: construction; haematite: iron ore; Kevlar: gaskets.

14 **a** bronze
b haematite
c stainless steel
d gold
e carbon
f cotton
g rayon
h mercury
i oxygen
j fishing line
k chromium
l aluminium
m soap
n methylated spirits

Analysing

15 **a** All organic compounds are carbon based.
b Alloys are pure metals with metallic and non-metallic elements.
c An ore is a non-metallic compound that has a high concentration of metal atoms.
d A carat is a measure of the purity of gold whereas a carrot is a tubular vegetable.

16 Both reach high temperatures. The carbon and calcium carbonate in a blast furnace are like fossil fuels and limestone inside the Earth.

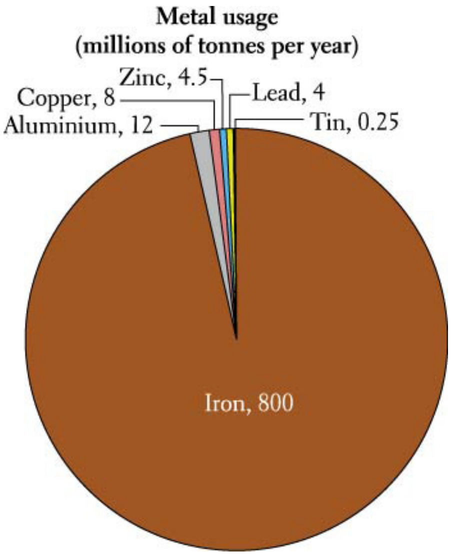
Evaluating

17 copper

18 Investigation task.

Creating

19 **a**



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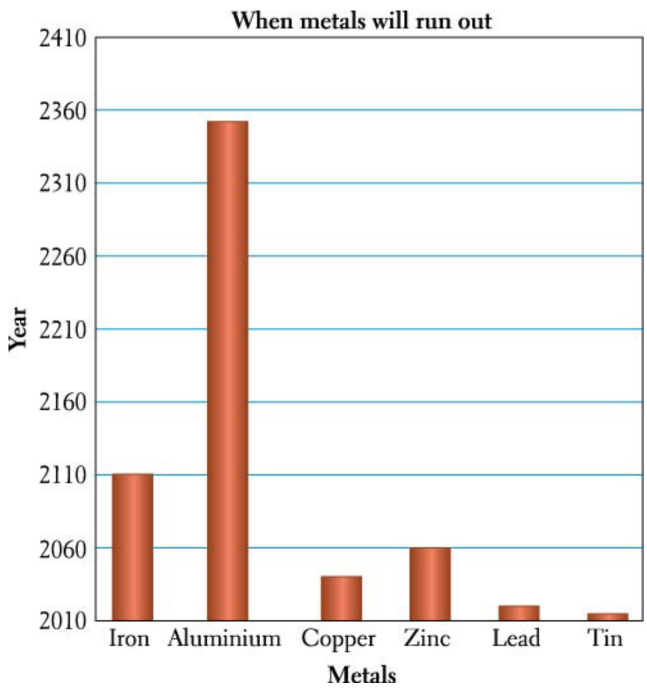

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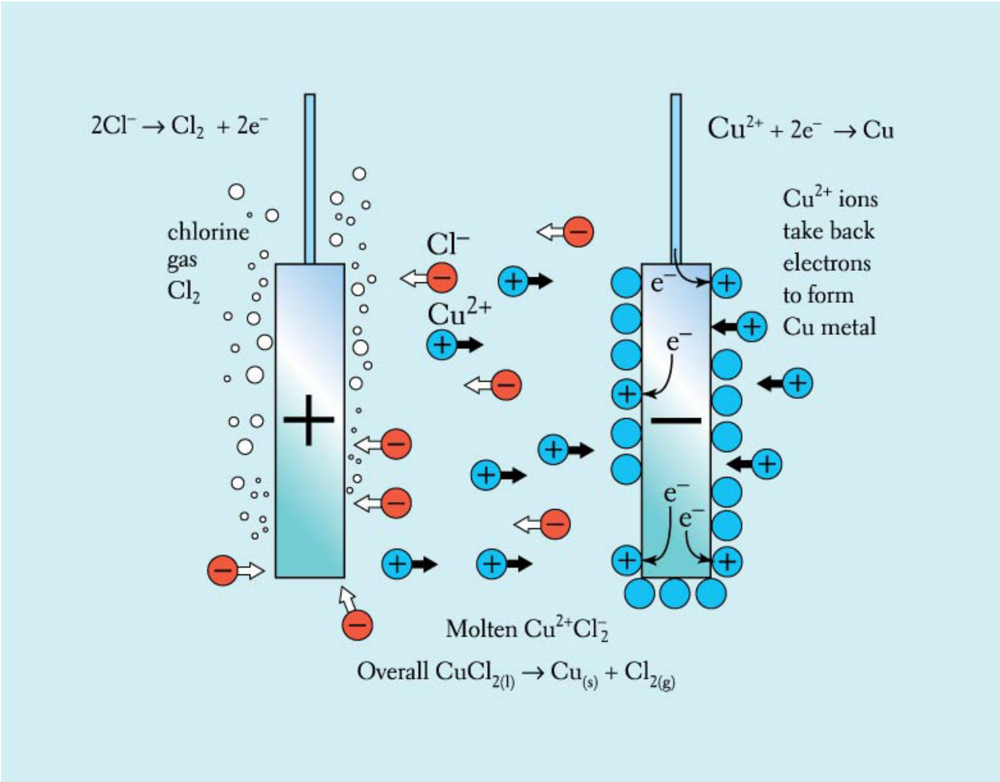

$2Cl^- \rightarrow Cl_2 + 2e^-$
chlorine gas Cl_2
Cl^-
Cu^{2+}
$Cu^{2+} + 2e^- \rightarrow Cu$
Cu^{2+} ions take back electrons to form Cu metal
e^-
Molten $Cu^{2+}Cl_2^-$
Overall $CuCl_{2(l)} \rightarrow Cu_{(s)} + Cl_{2(g)}$

3.1 Answers

Remembering

1 heredity (potential height), environment (nutrition)

2 characteristics inherited from parents

3 plants that consistently produce offspring the same as the parents

4 **a** recessive

b dominant

c dominant

d dominant

e recessive

5 deoxyribonucleic acid (DNA)

6 **a** 46 (23 pairs)

b 23

c 46

7

P1 / P2	***R***	***W***
R	*RR*	*RW*
W	*WR*	*WW*

Understanding

8 **a** A gene that is not 'masked', it appears in the F_1 generation. It is the gene that masks a recessive gene.

b When both alleles are the same; for example, gg or GG.

c The form different genes come in.

d The physical appearance produced by the genotype.

e The first new cell formed when sperm and ova join during fertilisation.

9 A gene is a hereditary unit that controls a particular characteristic. Genes determine the physical features of an organism.

10 Sperm and ova contain only one of each type of chromosome (only half of the necessary chromosomes); therefore, they cannot make a new organism by themselves.

11 When a dominant allele is present in a genotype (*GG* homozygous and Gg heterozygous) it will always be displayed in the phenotype.

12 **a** When the heterozygous genotype displays a patchwork of the homozygous parents. When a red (*RR*) cow mates with a white (*WW*) cow it produces a heterozygous (*RW*) roan (patches of red and white) cow.

b When heterozygous genes in an offspring blend to produce a different colour to the parents. In the case of snap dragons, a red and white parent will produce a pink offspring.

Applying

13 **a** haploid

b diploid

c diploid

d haploid

14 **a** meiosis

b mitosis

c mitosis

d mitosis

e meiosis

15

Symbol	Description
gg	Homozygous genotype
green pods	Phenotype
G	Dominant allele
Gg	Heterozygous genotype
g	Recessive allele

16 **a** black

b brown

c black

d black

17 **a** red

b white

c parent 2

d 50%

e 50%

18 **a** *Hh*

b *HH*, *Hh*, *hH*, *hh*

c long hair, short hair

d 75% long hair, 25% short hair

19 **a** incomplete dominance

b complete dominance

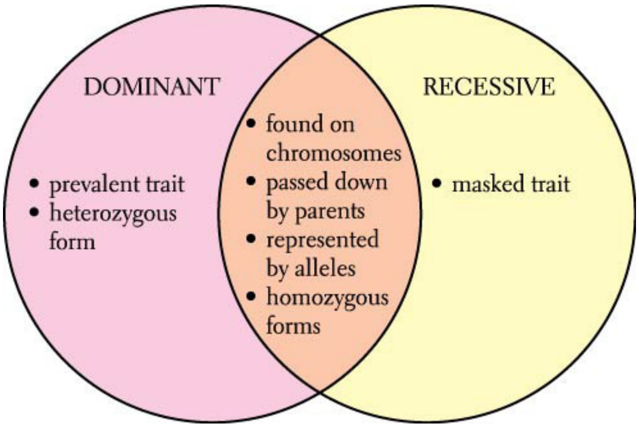
c complete dominance

Analysing

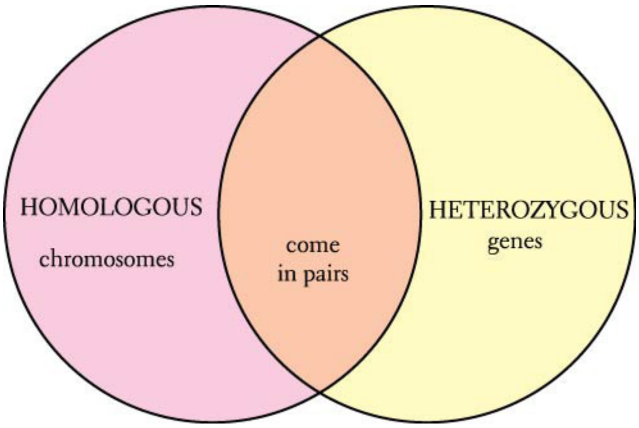
20 eight

Evaluating

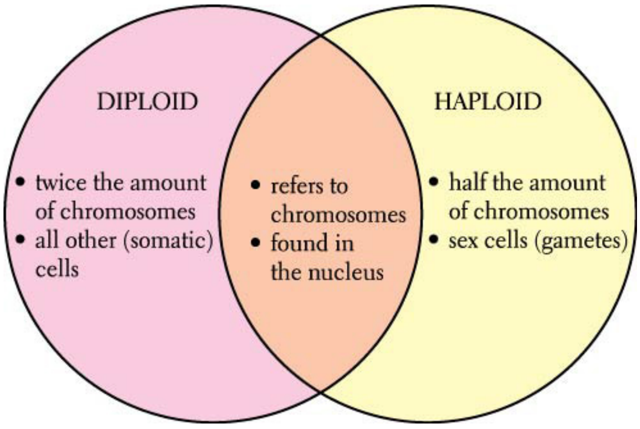
21 **a**



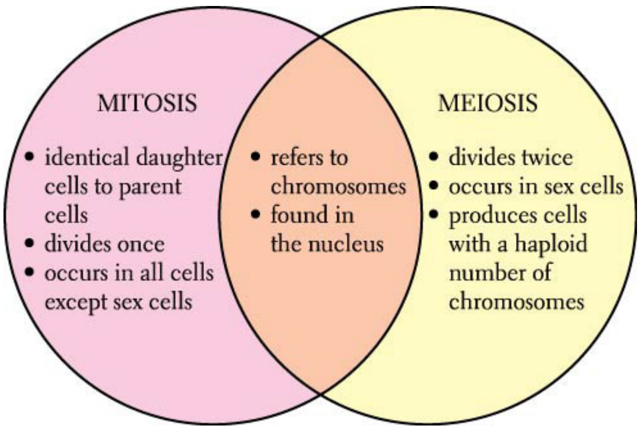
b



c



d



Creating

22 **a**

P1 / P2	***W***	***w***
w	*Ww*	*ww*
w	*Ww*	*ww*

b **i** *Ww* (heterozygous),
ww (homozygous recessive)

ii 50% heterozygous,
50% homozygous recessive

iii 50%

23 **a**

P2 \ P1	***L***	***L***
l	*Ll*	*Ll*
l	*Ll*	*Ll*

b

P2 \ P1	***L***	***l***
L	*LL*	*Ll*
l	*Ll*	*ll*

c 3:1

d Yes, because there is one homozygous dominant (*LL*) and two heterozygous dominant (*Ll*, *Ll*) to give offspring with the long-stem phenotype, and one homozygous recessive (*ll*) to give offspring with the short-stem phenotype. This means there are three chances out of four of producing an offspring with the long-stem phenotype.

24 **a** black (*BB*), white (*WW*), blue (*BW*)

b

P2 \ P1	***B***	***W***
B	*BB*	*BW*
W	*BW*	*WW*

c 25% black, 50% blue, 25% white

d The blue Andalusian fowl carries the alleles for both the white and the black, so whenever it is crossed with another blue fowl it has a 50% chance of producing a colour other than blue.

3.1 Practical activities

Prac 1: Observing mitosis

Common mistakes

Incorrect focusing techniques may result in broken cover slips and slides. Instruct students on the use and care of microscopes and slides.

A videoflex or a digital microscope camera would be useful for this activity.

Possible results

Using prepared slides and images of mitosis, students observe the sequence changes in the nucleus of an onion root tip cell undergoing mitosis.

Suggested answers

1 *Results will vary, but should be similar to Figure 3.1.6.*

2 *The second stage of cell division in mitosis does not involve chromosomes lining up in homologous pairs.*

Prac 2: Modelling meiosis

Common mistakes

Soft malleable plasticine will assist this exercise. If the plasticine is too hard, place on paper towel and microwave for a very brief time (too long and it melts).

Possible results

Students construct models to demonstrate the process of meiosis.

Suggested answers

1 *Meiosis produces four gametes in males and one in females. Eight combinations of chromosomes are possible.*

2 *When lining up in homologous pairs, the chromosomes from the mother do not gather together. Likewise, the chromosomes from the father do not gather together. This means that when the chromosomes separate and move to the ends of the cell, there is no way of predicting which chromosomes end up with which gamete; it is only certain that each chromosome will be represented.*

3 *Meiosis effectively produces cells with half the number of chromosomes.*

4 *The crossing over of homologous chromosomes was not demonstrated in this model.*

Prac 3: Modelling inheritance

Common mistakes

Ensure that the paper bag is large enough to avoid possible ripping when students place their hands inside.

Possible results

Students use beads, counters and jelly beans to model simple inheritance to show that it is a random process. The three genotypes that should be seen are 50% *RG*, 25% *RR* and 25% *GG*.

Suggested answers

1 *'Heterozygous' means that the genotype is made up of two different alleles.*

2 *The three genotypes that should be seen are 50%* RG*, 25%* RR *and 25%* GG*.*

3 *Statistical patterns become more obvious when the sample is large, so may not be seen after 20 selections.*

4 *Statistical patterns become more obvious when the sample is large, so should be seen after 100 selections.*

5 ***a*** *homozygous* × *homozygous* = RR × GG

b *homozygous* × *heterozygous* = RR × RG *or* GG × RG

3.2 Answers

Remembering

1 tongue rolling, right- or left- handed, hairline, ear lobe attached or free, albinism, cleft chin, colour blindness

2

Male / Female	X^H	Y
X^H	$X^H X^H$	$X^H Y$
X^h	$X^H X^h$	$X^h Y$

3 **a** *RR* or *Rr*

b *rr*

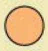
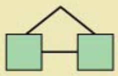
4 **a** green and grey

b hazel and black

5 **a** height, eye, hair or skin colour

b albinism, ear lobe attachment or left/right handed

6

	Symbol	Meaning
a		male with the inherited characteristic
b		mating of a male and female
c		female without the inherited characteristic
d		deceased male
e		identical twin boys

7 **a** *XY*
b *XX*

Understanding

8 **a** Two *X* chromosomes are responsible for female characteristics.
b Males have the genotype XY.
c The *X* chromosome carries more genetic coding than the *Y* chromosome.
d Sex-linked diseases occur because the *Y* chromosome doesn't have a matching gene on the *X* chromosome.
e Diseases such as haemophilia are inherited through females in a family.

9 Both parents carry a 'masked' gene, which is then passed onto their child.

10 Due to the presence of the dominant allele, a carrier 'hides' or masks the recessive gene, which requires two copies to cause the disorder.

11 Males have only one *X* chromosome, so it solely determines whether or not the disorder is present, unlike females who can mask a recessive gene causing a disorder with its dominant allele on the other *X* chromosome.

Applying

12 **a** A
b A
c AB
d B
e B
f O

13 If BB × AA, children are all AB.
If BO × AA, children are AB and AO.
If BO × AO, children are AB, BO, AO, OO.
If BB × AO, children are AB, BO.

14 **a** BO, BB, AB
b B or AB

15 **a** 25%
b 75%
c In each of the three affected children, the male gamete (sperm) carried the recessive trait and fertilised an ovum that also carried the recessive trait. Even though there is a 75% chance of having an unaffected offspring, fertilisation is random.

Analysing

16

Continuous	**Discontinuous**
Height, weight, skin colour, intelligence, baldness	Ability to roll tongue, sex or gender, albinism, blood group

17 See answers in Q18 below.

18 **a** *Rr*
b *Rr*
c *Rr*

Evaluating

19 **a** Males have one only *X* chromosome. This chromosome either doesn't have the gene or it does. In the case of when the gene is present, although the chromosome 'carries' the gene, the gene can never be 'masked' because there is no other *X* chromosome present to mask the gene with a dominant allele. The *Y* chromosome doesn't carry information about sex-linked disorders.
b Sperm are male. This statement is a bit of both. A sperm cell is haploid and may carry either a *Y* chromosome or an *X* chromosome.
c A person with *XXY* is a hermaphrodite who will display characteristics of both genders.

Creating

20

	Donor								
Recipient		A^+	A^-	B^+	B^-	AB^+	AB^-	O^+	O^-
	A^+	✓	✓	×	×	×	×	✓	✓
	A^-	×	✓	×	×	×	×	×	✓
	B^+	×	×	✓	✓	×	×	✓	✓
	B^-	×	×	×	✓	×	×	×	✓
	AB^+	✓	✓	✓	✓	✓	✓	✓	✓
	AB^-	×	✓	×	✓	×	✓	×	✓
	O^+	×	×	×	×	×	×	✓	✓
	O^-	×	×	×	×	×	×	×	✓

21 **a** R = tongue roller;
r = non-tongue roller

P1 / P2	*r*	*r*
r	*rr*	*rr*
r	*rr*	*rr*

b none

22 a

P1 / P2	***a***	***a***
a	*aa*	*aa*
a	*aa*	*aa*

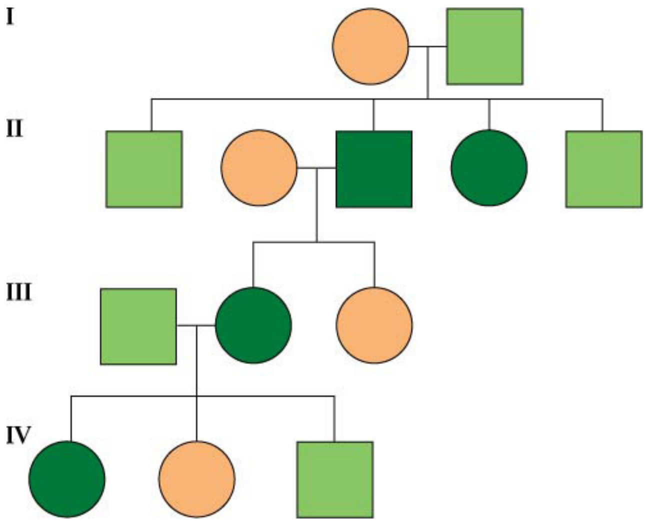
100%

b

P1 / P2	***a***	***a***
A	*Aa*	*Aa*
a	*aa*	*aa*

50%

23



3.2 Practical activities

Prac 1: Dominant or recessive?

Common mistakes

Students may mistakenly believe that just because a characteristic is more frequent in a population that it is the dominant characteristic.

Possible results

Dominant characteristics are usually free ear lobes, no bump on the outer rim of the ear, no gap between the front teeth and little finger bent inwards.

Suggested answers

1 *Answers will vary depending on whether the students themselves have these characteristics.*

2 *Answers will vary.*

Prac 2: Continuous variation

Common mistakes

Measurement errors.

Possible results

Results show that height is a continuous variation.

Suggested answers

1 *The results obtained should show continuous variation within the heights normal for this age group.*

2 *The results obtained are not representative of the entire population because they sample only a narrow band of ages. Depending on the school, they may also be representative of one particular gender or ethnicity only.*

3 *The average height of boys in Year 9 will generally be greater than that of girls. In Year 7, however, the results may be opposite, as girls tend to go through puberty before boys.*

Prac 3: Vegetable babies

Common mistakes

The vegetables in this activity will make better appendages if the vegetables are crisp. Cut the vegetables just before starting the activity.

Possible results

Students construct different phenotype vegetable babies based on dominant and recessive alleles.

Suggested answers

1

Feet	*F*	*f*
f	*Ff*	*ff*
f	*Ff*	*ff*

Arms	*a*	*a*
A	*Aa*	*Aa*
A	*Aa*	*Aa*

Eyes	*E*	*e*
e	*Ee*	*ee*
e	*Ee*	*ee*

2 *feet: 50% carrot, 50% parsnip;*
arms: 100% short celery stick;
eyes: 50% peas, 50% sultanas

3 *50%*

4 *Results will vary.*

5 *Results will vary.*

6 *Results will vary.*

3.3 Answers

Remembering

1 **a** double helix

b sugar, phosphate

c nitrogen bases (adenine, thymine, cytosine, guanine)

2 A: adenine, T: thymine, C: cytosine, G: guanine

3 **a** cytosine

b adenine

4 Watson and Crick (James Watson and Francis Crick) and they shared the Nobel Prize with Maurice Wilkins.

5 98.5%

6 When it produces a change in the gene or chromosome that leads to a new species, such as the Granny Smith apple.

7 **a** sickle-cell anaemia

b Down syndrome

Understanding

8 **a** A set of three bases is called a codon.

b A mutation is a spontaneous change in a gene or chromosome that may alter a characteristic for which it codes.

c A mutation-causing agent.

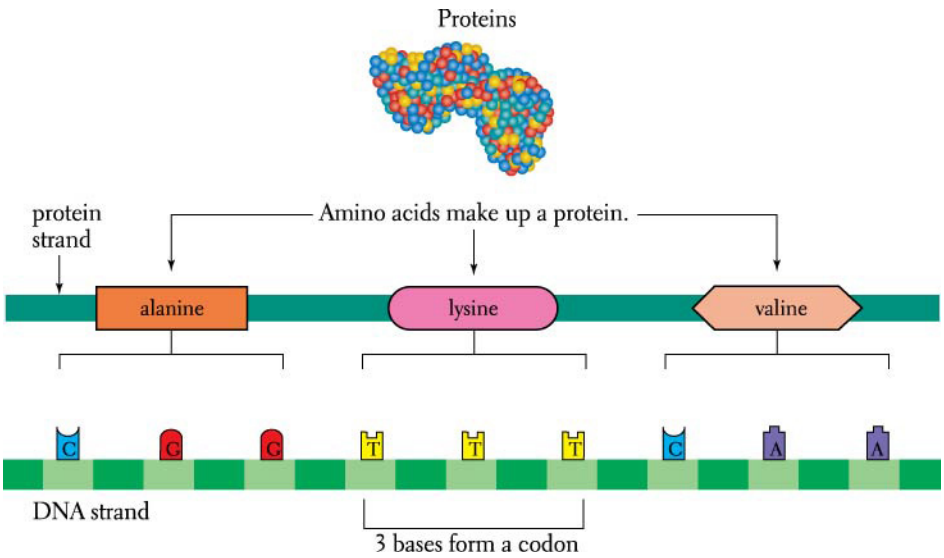
9 A codon is a set of three bases that contains the instructions to form an amino acid. These amino acids join to form chains that make proteins. These proteins, in turn, determine the characteristics of individuals.

10 nitrogen base, codon, DNA strand, cell

11 When genes become active and are expressed; that is, the characteristic they code for appears, it is referred to as gene expression.

12 The mutation must be present in the sex cells (gametes: ova and sperm) to be inherited by the next generation.

13



14 Mutations allow for genetic variation, which means that individuals may possess desirable traits that are advantageous. This increases their chances of survival.

Applying

15 UV radiation, benzene, asbestos

16 **a** GCCTATTCGAT

b Student responses will vary. An example is: GCCAATTCGAT

c It changes the amino acid produced and, in turn, the protein and the gene it codes for.

Analysing

17 $200 \times 3 = 600$ bases

18 **a** 21

b girl

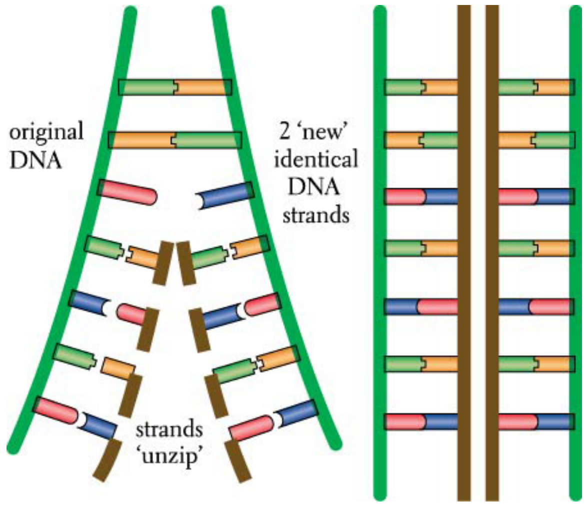
Evaluating

19 UV radiation is a mutagen. When cells, such as skin cells, are exposed to mutagens they cause a mutation (alteration) in the genetic make-up of an individual.

20 DNA needs to undergo replication so that it is able to make copies of cells undergoing mitosis during growth and repair. If DNA cannot replicate, the organism dies.

Creating

21



3.3 Practical activities

Prac 1: Modelling DNA

Common mistakes

Student-designed experiments should be assessed by the teacher for feasibility before they are carried out.

Possible results

Students construct a model of DNA.

Suggested answers

Student design.

Prac 2: Extracting DNA

Common mistakes

To achieve impressive strands of DNA it is essential to stir very gently.

Possible results

Thin strands of DNA are extracted from a sample of wheatgerm.

Suggested answers

1 *Answers will vary, but the DNA should appear as thin threads.*

2 ***a*** *Detergent breaks down cell walls and nuclear membranes to expose the DNA.*

b *Ethanol precipitates the DNA, making it visible.*

3 *Maintaining the temperature between 50 and 60°C and gentle stirring.*

3.4 Answers

Remembering

1 keeping the seeds from only the best plants for next year's crop; crossing with a related plant genus to produce a new plant that possesses desirable traits from both parent plants

2 The protein kills the major pest of cotton (*Heliothis* caterpillar) when the caterpillar eats the leaves.

3 enzymes

4 sickle-cell anaemia, cystic fibrosis

5 DNA fingerprinting to solve criminal cases; therapeutic cloning to grow cells for repair of damaged cells

6 **a** 99.9%

b 32 000 genes

c 26 000 proteins

Understanding

7 **a** Manipulating DNA to change the genes within an organism. For example, insulin for use by diabetics is produced in large quantities by bacteria. The DNA sequence of insulin is inserted into plasmids that have been removed from bacteria. The altered plasmids are then put back into the bacteria. On reproduction, these bacteria quickly produce multiple copies of the 'foreign' DNA that was spliced into them, in this case, insulin.

b The altering of a plant's gene sequence. For example, genetically modified cotton has the bacteria Bacillus thuringiensis inserted to help the cotton produce a protein that kills its major pest, Heliothis caterpillar.

c Insertion of modified genes directly into animal cells. For example, insertion of the jelly fish gene into mice to code for GFP (green fluorescent protein).

8 **a** Plasmids are circular pieces of DNA that occur naturally in bacterial cells.

b Enzymes are used to cut open a plasmid, foreign DNA is inserted into the plasmid and the plasmid is then rejoined to form recombinant DNA. The altered plasmids are then put back into bacteria. The bacteria quickly reproduce multiple copies of the 'foreign' DNA that was inserted. The bacteria act according to the new instructions of the inserted DNA and manufacture the proteins it codes for.

9 **a** A gene probe is a small piece of DNA with a base sequence identical to part of a gene.

b Prenatal testing to identify defects or diseases: Prenatal testing is carried out using gene probes containing a small piece of DNA with a base sequence identical to that of a gene associated with a genetic disorder. The probe sticks to the abnormal gene, allowing embryos to be tested for disorders, such as sickle-cell anaemia or cystic fibrosis.

DNA fingerprinting: DNA fingerprinting relies on the fact that everyone has a unique sequence of bases in their DNA found in every cell of their body. A suspect's DNA fingerprint can be compared to the DNA obtained from body fluids, fragments of skin or strands of hair found at a crime scene. DNA fingerprints can then be used in court to prove innocence (no DNA match) or guilt (DNA match).

10 DNA fingerprinting relies on the fact that everyone has a unique sequence of bases in their DNA found in every cell of their body.

Applying

11 Rice that produces more seeds; dairy cattle that produce more milk.

12 Students' responses will vary.

Analysing

13 Cloning is the process in which a single cell is grown to produce a new individual, whereas therapeutic cloning is the insertion of an individual's DNA into eggs to produce stem cells. These stem cells are then manipulated to produce any type of cell required by the patient to repair damaged tissue.

Evaluating

14 Stem cells have the same DNA as the rest of the cells in the body, so the heart will not be rejected and the patient may have a faster and easier recovery.

15 **a** plan a healthier lifestyle (food and exercise)

b If you are prone to illness, a prospective employer might not hire you or may not promote you. Your medical bills and insurance premiums could be higher or you could be refused medical insurance because you could become costly to the insurer.

c Students' responses will vary.

16 **a** Gene cell therapy involves removing the genetic material from some body cells, manipulating it and reinserting it into the same person.

b To overcome diseases, such as cancer, and to prevent the inheritance of diseases such as haemophilia.

17 The protein may kill other insects that feed on the cotton. Predators of the caterpillar may also be affected.

18

Some arguments against gene technology	Some arguments for gene technology
• Genetic modification is not natural. Interfering with a highly evolved and delicate system may upset it in unpredictable ways. • GM plants with inbuilt pesticides may kill insects that are not pests. • Pests will, in time, develop resistance to the inbuilt pesticides in GM plants. • GM herbicide-resistant plants may transfer their resistance to other plants, creating 'superweeds'. • GM herbicide-resistant plants may encourage the excessive use of herbicides. • GM crops will not necessarily solve the world's food problems. Food shortages have more to do with economics and politics than with agriculture. • Multinational companies own the rights to most GM plants. Farmers will incur costs to use the modified plants. • Some religious groups have specific arguments against the use of GM foods.	• Gene technology is faster and more efficient than conventional selective breeding techniques. • Food production will be increased due to better disease prevention and drought resistance in plants. • Animals will produce leaner meat, thicker wool and have increased productivity. • GM foods may be more nutritious, cheaper and keep better than conventional foods. • GM crops with pest resistance will reduce the use of harmful chemical pesticides. • GM crops may be produced that tolerate poor soils and salinity, allowing more areas to be farmed. • Gene technology can be used to locate and study genes causing human disease, and genes that predispose people to other diseases. • Gene technology can be used to create new, improved medical treatments, such as insulin.

Creating

19 Students' responses will vary.

20 **a** Students' responses will vary.

b Students' responses will vary.

Chapter answers

Remembering

1

Term	Description
Meiosis	Cell division producing gametes
Mitosis	Cell division producing daughter cells identical to the parent cell
Diploid	A cell having two of each type of chromosome
Haploid	A cell having one of each type of chromosome
Gene	A hereditary unit
DNA	The chemical that carries the genetic code.

2 double helix

3 uprights: alternating sugar and phosphate units
rungs: nitrogen bases (adenine, thymine, guanine, cytosine)

4

Term	**Description**
Codon	A sequence of three bases that codes for an amino acid
Genetic map	Shows positions of genes on chromosomes
Plasmid	A circular piece of DNA
Gene probe	A small piece of DNA that recognises a gene
Recombinant DNA	A molecule containing DNA from two organisms
Transgenic organism	An organism with a new gene
Mutagen	Causes a spontaneous change in a gene or chromosome

Understanding

5 Heredity: the set of characteristics inherited from your parents; the environment: a diverse set of factors that act on the organism throughout its life, such as pollutants and quality of food.

6 A gene is a hereditary unit that controls a particular characteristic. Genes are made of a chemical called DNA. Genes are located on chromosomes.

7 DNA unzips and makes an exact copy of each strand by matching each base with its complementary base.

8 **a** Mutations can cause cells to mutate, forming cancerous tumours in an individual, but have no effect on the species, unless they occur in the sex cells (sperm or egg cells) or in the zygote that forms on fertilisation.

b A change in the base sequence of DNA within sex cells (sperm or ova) will not affect the individual. However, if this change is passed onto their offspring, the new base sequence could code for a dysfunctional/harmful gene that could lead to a disease or a non-desirable trait.

c Sometimes, mutations can lead to the creation of a different species; e.g. Granny smith apples.

9 **a** Gene technology is the manipulation of DNA to change the genes within an organism.

b Cloning is the process in which a single cell is grown to produce a new individual without the need for fertilisation.

c Gene cell therapy involves removing the genetic material from some body cells, manipulating it and reinserting it into the same person.

Applying

10 Students' responses will vary.

11 **a** Genes come in different forms. In this example, there are two alleles for stem length—one allele codes for long stem (*L*) and the other codes for short stem (*l*).

b The possible combinations of two alleles together determine a genotype; e.g. two long stem alleles (*LL*), two short stem alleles (*ll*) or one of each allele (*Ll*).

c The appearance produced by the genotype is the phenotype; e.g. the plant will have long (*Ll* or *LL*) or short (*ll*) stems.

d Homozygous is when both alleles are the same; e.g. *LL* or *ll*.

e Heterozygous is when both alleles are different; e.g. (*Ll*).

Analysing

12 **a** both

b mitosis

c meiosis

d meiosis

e mitosis

13 **a** *Rr* × *rr*

b

	R	***r***
r	*Rr*	*rr*
r	*Rr*	*rr*

c 50% heterozygous, 50% homozygous recessive

d red eyes, white eyes

e 50% red eyes, 50% white eyes

14 Characteristics that are clearly defined, such as ear lobe attachment and albinism, are discontinuous. Continuous variation refers to characteristics that have a range of possible outcomes, such as eye colour and height.

15 **a** It is not possible for two non-tasters to have three children who are tasters, because both parents must each have a recessive gene.

b Both parents must be heterozygous (*Tt*) tasters for them to produce one non-taster and three taster children.

16

	A	**B**
O	AO	BO
O	AO	BO

The child will either be blood group A or B.

17 **a** **i** $X^M Y$

ii $X^m X^m$

iii $X^m Y$

b recessive

c

	X^M	X^m
X^M	$X^M X^M$	$X^m X^M$
Y	$X^M Y$	$X^m Y$

There is a 50% chance of the boy having the disease.

Evaluating

18 **a** 99.9 %

b Yes, identical twins come from the same fertilised egg and so will have the same total DNA base sequence.

19 **a** GM foods may be more nutritious and keep better than conventional foods, may be pest resistant and tolerate harsher environmental conditions.

b GM foods that contain pesticide-resistant genes don't necessarily solve the world's food shortage problems, they may pass on the resistant gene to other plants creating 'superweeds', and insects that are not pests may be killed.

Creating

20 a

	R	***W***
R	*RR*	*RW*
R	*RR*	*RW*

2 red: 0 white: 2 pink

b

	R	***W***
R	*RR*	*RW*
W	*RW*	*WW*

1 red: 1 white: 2 pink

21 a *Rr* × *rr*

b

	R	***r***
r	*Rr*	*rr*
r	*Rr*	*rr*

c *Rr*, *rr*

d 50% *Rr*, 50% *rr*

e tongue rolling and non-tongue rolling

f 50% tongue rolling and 50% non-tongue rolling

22 a No, they are not albino.

b

	A	***a***
A	*AA*	*Aa*
a	*Aa*	*aa*

c ¼

23 a

	X^n	X^n
X^N	$X^N X^n$	$X^N X^n$
Y	$X^n Y$	$X^n Y$

b The husband carries the dominant gene because he isn't colour blind, therefore 'masking' the colour-blind gene in the daughters who are carriers.

c All their sons will be affected.

4.1 Answers

Remembering

1 good nutrition, healthy mind, adequate exercise

2 fats, protein, carbohydrates

3
- **a** false
- **b** true
- **c** true
- **d** false
- **e** true

4
- **a** Vitamin A is important for healthy sight.
  Vitamin C helps form connective tissue.
- **b** Calcium is important for bone and tooth formation.
  Zinc reduces skin problems.

5 37°C

6 age, health, activity level

7 20 minutes of weight-bearing exercise at least three times a week.

8

Term	Definition
Psychosomatic	Caused by the mind but with very real symptoms
Nutrient	Substances taken in and used for energy or to build tissue
Organism	Any living thing
Calcium	A mineral used by the body

Understanding

9 Health means many different things to different people. It is a person's viewpoint; one person may think they are healthy even though they live in a slum in a developing country with contaminated water, whereas another individual in a developed country may find the stresses and pressures of work make them feel mentally and physically unhealthy.

10 Any energy not used up is stored as fat.

11 Exercise should aim to increase your heart rate for at least 20 minutes, at least three times a week. Age affects the type of exercise a person should do because as you get older your heart rate increases.

12 **a** Students' responses will vary.
b Students' responses will vary.
c depression, anorexia nervosa, bulimia nervosa

Applying

13 Students' responses will vary.
14 **a** breads and cereals
b fruits and vegetables
c indulgences or extras
15 **a** 1 KJ
b 2.5 KJ
c 3.3 KJ
d 0.5 KJ
e 0.88 KJ
f 16.7 KJ
g 10.5 KJ
16 bathtub
17 Students' responses will vary.

Analysing

18 baby, active teenager, NRL player, postie, inactive teenager
19 **a** 31 000
b 700
c 8368
d 75 312
e 167 360

Evaluating

20 Students' responses will vary.
21 Students' responses will vary.
22 Weight-bearing exercises would be difficult because there is no or little gravity in space; therefore no resistance.
23 First, his metabolism will slow down, then he will lack the energy to complete tasks and, finally, signs of malnutrition will appear.

Creating

24 Students' responses will vary.
25 Students' responses will vary.

4.1 Practical activity

Prac 1: Orange juice and vitamin C

Common mistakes

It is important to use the same size test tubes for all tests.

Possible results

Students determine which brand of orange juice has the highest content of vitamin C. Iodine solution will react with the starch suspension, resulting in a blue solution. When vitamin C is added, it reduces the iodine so that it no longer reacts with the cornstarch and so the solution becomes clear.

Suggested answers

1 *Depends on experimental results.*

2 *Depends on experimental results. Brands of orange juice should be on the x-axis and the number of drops of juice on the y-axis.*

3 *Answers will vary. Some examples are berries, broccoli, tomatoes, oranges, kiwi fruit.*

4.2 Answers

Remembering

1

Term	Description
Symptom	Outward sign of disease
Pathology	Study of disease
Microbe	Very small organism
Agent	Causes disease
Host	Organism being affected by agent
Parasite	Agent using host for food or shelter
Infectious	Can be passed on to another host

2 Students' responses will vary. Examples are listed below.

a humans, roses, cats

b Any three of bacteria, virus, protozoa, fungi.

c fleas, ticks, intestinal worms

3 **a** exposure to UV radiation

b Any one of drug abuse, overuse of alcohol, smoking.

c diabetes

4 endemic, epidemic, outbreak, pandemic

Understanding

5 **a** Diseased people can feel unable to function well in their environments.

b A host is used by a parasite for food and shelter.

c Not all diseases are infectious.

d Symptoms, such as blurred vision, are signs of disease.

6 Students' responses will vary.

Applying

7 Parasites obtain food from their host. A flea's food source is the blood of warm-blooded mammals, such as a dog or a cat.

8 **a** host: kitten; agent: threadworms

b parasite

9 lack of hygiene, sneezing, coughing

Analysing

10 Students' responses will vary, but examples are listed below.

a 10

b 1

c 5

11 **a** Endemic is when a disease regularly affects a small number of people in a population, whereas epidemics have higher than normal numbers of people affected by a disease in a certain population.

b Host is the organism that is affected by an agent, which is anything that causes disease.

12 Students' responses will vary.

Evaluating

13 **a** It kills so quickly that it doesn't have enough time to spread beyond the village it attacks.

b It would be able to survive long enough for a villager to survive and spread the disease to people in other villages.

14 They are not detected by the naked eye and so we are less aware of them. We may therefore unknowingly spread them when we sneeze or not wash our hands properly.

15 **a** Wash hands with warm soapy water after going to the toilet.

b Wash the plate with warm soapy water before placing the cooked meat on it.

c Keep fish in the refrigerator until ready to cook.

d Wash food that has fallen onto the floor or throw it out if washing is not possible.

e Pierce ears, nose or lips by professionals that use sterilised equipment.

16 **a** legionnaire's disease

b *Legionella* bacteria

c *Legionella* bacteria reproduce in warm stagnant water and air-conditioning units if they are not disinfected properly. Legionnaire's disease will therefore arise.

d Air conditioners were not widely used or available.

17 A disease that does not pass from host to host.

4.2 Practical activity

Prac 1: Survey of diseases

Common mistakes

Calculation errors.

Possible results

Students survey the range of childhood diseases and medical conditions experienced by the class.

Suggested answers

1 *Students' answers.*

2 *Students' answers.*

3 *Depends on experimental results. The disease should be listed on the x-axis and the percentage on the y-axis.*

4 *Prevention is cheaper than treatment.*

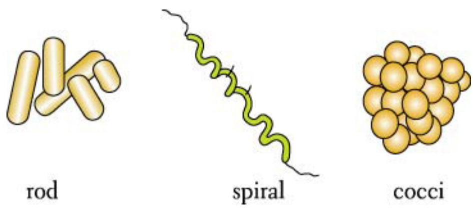
5 *There are over 200 types of virus that can cause the common cold, which is why it's not possible to be immunised against a cold.*

4.3 Answers

Remembering

1 bacteria, viruses, protozoa, fungi

2



3 **a** Rabies: paralysis, spasms, fever, overproduction of saliva

b Giardia: nausea, flatulence, diarrhoea

c Tinea: creamy mucus

 ISBN 978 1 4425 1541 3

4 flukes, tapeworms, flatworms

Understanding

5 A pathogen is a micro-organism that causes a disease.

6 Viruses don't self-reproduce, grow, feed or produce waste.

7 Viruses 'hijack' (invade) the cell, reprogramming it to make more virus particles.

8 Protozoa are single-celled organisms.

9 A pathogen, like a fungus, is usually associated with infection. It will infect a person whose immune system is weakened or if the conditions are ideal.

10 Macroscopic parasites are parasites that can be seen without a microscope.

11 If tapeworm eggs are swallowed by a human, tiny embryos will hatch from the eggs and move from the human's intestines to the human's bloodstream. Cysts then develop and have the ability to kill the host, particularly if they lodge in the brain.

12 **a** Spherical bacteria are called cocci.

b Viruses are smaller than bacteria.

c Many fungi don't cause disease in humans.

d Parasites usually don't kill their hosts.

13 Bacteria form thick-walled spores, and protozoa form cysts.

Applying

14

	Pathogen	Type of pathogen
a	*Yersinia pestis*	Bacteria
b	*Vibrio cholera*	Bacteria
c	*Giardia lamblia*	Protozoa
d	*Microsporum gypseum*	Fungi
e	*Staphylococcus aureus*	Bacteria
f	Avian influenza A	Virus
g	H3N2	Virus
h	*Plasmodium falciparum*	Protozoa

Analysing

15 • Fully grown fluke eggs pass out of human's faeces into water, where they hatch into immature flukes.
- Young flukes penetrate soft parts of snail to feed on it and reproduce.
- Individual flukes in their free-swimming stage leave the snail and swim until they reach and penetrate human skin.
- They find their way into human blood vessels.

Evaluating

16 An endemic disease regularly affects a small number of people in the population, whereas epidemic diseases affect a greater than usual number of people in the population.

17 A microscopic organism cannot be seen with the naked eye and a microscope is needed to view it, whereas a macroscopic organism can be seen without a microscope.

18 use insect repellent, wear long pants and sleeves, use mosquito nets

19 The tapeworms live in the intestines, so they would absorb any nutrients taken in by the host.

20 wear shoes and socks

21 **a** so that a correct diagnosis can be made

b greater amounts of mosquitoes in tropical areas

c There are more bacteria in our surroundings compared with fungi.

d so that you don't get flukes

e may contain pathogens that cause disease

Creating

22 Students' responses will vary.

4.3 Practical activities

Prac 1: Making yoghurt

Common mistakes

For optimum results, the culture should be allowed to incubate for several days.

Possible results

Students produce yoghurt using a bacterial culture from existing yoghurt.

Suggested answers

1 *The yoghurt contains the necessary bacterial cultures.*

2 *This is the optimum temperature for the growth of this particular bacterial culture.*

3 *The mixture should become thicker and develop a cheesy smell.*

Prac 2: Micro-organisms around you

Common mistakes

To avoid contamination of more than one source, instruct students to close the Petri dish lid immediately after inoculation.

Possible results

Students grow a variety of microbes on nutrient agar plates. The control plate should have no signs of bacterial growth after incubation.

Suggested answers

1 *A control is needed in case the agar is contaminated and contains microbes.*

2 *Answer depends on the experimental results.*

3 *An appropriate table would have the column headings, 'Colony types' (bacterial or fungal), 'Numbers of these colonies', 'Colour' and 'Sketch of colony'.*

4 *Answer depends on the experimental results.*

5 *Fungal colonies appear fuzzy, whereas bacterial colonies appear smooth.*

4.4 Answers

Remembering

1 **a** direct transmission (contagious)

b leucocytes

2 **a** measles, chickenpox, tuberculosis

b Any three of good nutrition, clean water, adequate sleep and exercise.

c Any three of poor nutrition, alcohol and drug use, stress, lack of sleep, diseases such as HIV.

3 dead micro-organisms and dead white cells

4 A mosquito (vector) carries malaria (disease).

5 HIV (human immunodeficiency virus), AIDS (acquired immune deficiency syndrome)

Understanding

6 Exposure to blood, semen or vaginal fluid through blood transfusions or sexual contact spreads HIV from person to person.

7 **a** The skin sheds its dead cells whereby harmful pathogens will often fall off with the dead skin cells. Skin also has good bacteria that compete with invading bacteria, preventing them from reproducing.

b Leucocytes converge onto pathogens, digesting and engulfing them.

8 Viruses are far too protected within the body cells to be affected by antibiotics.

9 When exposed to the measles virus the first time, your body develops specific antibodies that will protect you from measles in the future.

10 Vaccines stimulate the immune system into building antibodies that fight an infection.

11 You would have developed antibodies to fight last year's cold but, unfortunately, cold viruses mutate quickly, which means that new forms arise. Therefore, last year's antibodies are not effective against this year's cold virus and new antibodies will be needed.

12 Viruses multiply rapidly, so that new strains appear all the time. They are also incredibly small and difficult to isolate in the laboratory.

13 Left-hand side shows mode of transmission (spreading) and right-hand side shows the body's response to being infected.

Applying

14 **a** direct

b indirect

c indirect

d direct

Analysing

15 **a** Direct transmission happens through direct contact with the infected person or their body fluids, whereas indirect transmission occurs via an agent (vector), air or contaminated water.

b Bacteria are microscopic but can be seen with a light microscope. They can remain inactive for periods of time and be killed using antibodies. However, viruses cannot be seen with a light microscope and are not living like bacteria. They invade the DNA/RNA material of cells.

c An antigen triggers the production of antibodies.

d Active immunity stimulates the body into making its own antibodies, whereas passive immunity involves injecting the antibodies produced by another organism.

16 The overuse of antibiotics has led to the development of antibiotic-resistant strains of bacteria. It takes up to 20 years to develop new drugs and it is likely that doctors might soon be left without any drugs to fight the new, developing strains. Particularly worrying is the recent rise of drug-resistant and deadly tuberculosis.

Evaluating

17 Children's immune systems don't produce long-term antibodies to fight reinfection.

18 Their immunity is weakened in trying to fight off the first disease and they may not be eating and sleeping well. They are therefore more susceptible to other diseases.

19 **a** AZT prevents formation of new HIV particles in cells; therefore, people may feel they are protected from developing AIDS, so they take greater risks.

b There are other diseases besides HIV that can spread sexually.

20 Condoms may not be readily available to HIV-infected individuals.

21 The population may cease to exist because infants are born with HIV and they die before reaching adulthood.

22 The immune system of people infected with AIDS is low and they are susceptible to many other infections. Also, because these individuals are unable to fight the infection (they cannot develop antibodies), they die.

Creating

23 Students' responses will vary.

4.4 Practical activities

Prac 1: Modelling the transmission of disease

Common mistakes

This experiment would lend itself well to a large group exercise rather than as a small group exercise.

Possible results

Students model the transmission route of a disease.

Suggested answers

1 *It is not possible because the students move around the room in a random fashion.*

2 *There were greater numbers infected.*

3 *The degree of infection was lowered significantly.*

Prac 2: Effectiveness of antiseptics

Common mistakes

To avoid contamination of more than one source, instruct students to close the Petri dish lid immediately after inoculation.

Possible results

The antiseptics that are effective against bacterial growth will show a bare area (zone of inhibition) around the inoculation pattern, or a bacterial colony of fungi will be able to grow, but no other bacteria will show any growth.

Suggested answers

1 *Student diagram.*

2 *Answers here will depend on the types of antiseptics used. Each antiseptic will have a different effect on each type of bacteria. The antiseptics that were effective against bacterial growth will show a bare area (zone of inhibition) around the inoculation pattern, or a bacterial colony of fungi was able to grow, but no other bacteria.*

3 *Again, the answer here will depend on the types of antiseptics used. The most effective antiseptic will have the largest zone of inhibition surrounding the pattern of inoculation. Some may have fungal growth only, which would indicate that the antiseptic was not effective in inhibiting fungal growth, but was effective in inhibiting the growth of other bacteria.*

4 *The most effective antiseptic will have the largest zone of inhibition surrounding the pattern of inoculation. It shows that the antiseptic has the ability to inhibit the growth of a variety of bacteria (broad-spectrum antiseptic).*

5 *Each type of bacteria has a different level of resistance to antiseptics. If cross-contamination occurred, then it would be difficult to determine which antiseptic was the most effective in inhibiting the growth of the bacteria.*

4.5 Answers

Remembering

1 **a** false
b false
c true
d true
e true

2 Students' responses will vary. Some examples are listed below.
a anxiety disorders, bipolar disorder, schizophrenia, phobias
b obesity, anorexia, diabetes
c albinism, haemophilia
d Down syndrome

3 Students' responses will vary. Some examples are listed below.
a smoking, exposure to radiation, poor diet, genetic predisposition
b heart damage, deterioration of CNS, liver damage
c radiation, heavy metals

4 Students' responses will vary.

5 1 mm

Understanding

6 They are not infectious; they are abnormalities in chromosomes.

7 Both parents are carriers of the condition.

8 People who eat lots of hamburgers and fries can still be malnourished because they are not maintaining a regular intake of all minerals and vitamins.

9 **a** Thrombosis: a disease that causes a large solid mass to form on the inside wall of a blood vessel.
b Embolism: blockage of a blood vessel.
c Hypertension: persistent high blood pressure.
d Arteriosclerosis: hardening of the arteries.

10 Due to a lack of the hormone insulin, diabetes prevents glucose, our body's energy source, from being used correctly.

11 regular exercise, flossing teeth, well-balanced diet

12 **a** A blockage of blood supply to parts of the brain leads to a stroke.
b Passengers don't have the chance to move about during a flight and this may cause deep vein thrombosis, whereby a thrombus forms in blood vessels in the legs or feet. The thrombus can move from the legs to other organs, such as the heart, brain or lungs, blocking off blood supply, leading to death.

13 Injections of special chemicals soon after the onset of a stroke sometimes dissolve embolisms in the brain. Also, a microscopic 'corkscrew' can burrow into the embolism to allow bits of the embolism to be pulled away, clearing the blockage.

14 Surgery: removal of cancerous cells.

Radiotherapy: uses radiation to kill localised growth.

Chemotherapy: uses chemicals to poison cancerous cells.

15 Metastases are cancer cells that have travelled from the original site of the tumour via the circulatory or lymph systems to other parts of the body. This makes it more difficult to treat the cancer because it has spread.

16 Alcohol depresses the CNS, slowing down its responses.

17 A blood alcohol level of 0.60% leads to death, due to heart and respiratory failure.

18 Long-term alcohol abuse can lead to digestive problems, due to the alcohol destroying the lining of the stomach, cirrhosis of the liver, heart damage, hardening of artery walls and destruction of the brain and overall nervous system.

Analysing

19 **a** Individuals with anorexia nervosa starve themselves and so suffer extreme weight loss. Individuals with bulimia nervosa deliberately vomit whatever they eat during 'binge and purge' cycles, but are often of normal weight.

b In a benign tumour the cells are not rapidly dividing, whereas in a malignant growth the cells divide and grow uncontrollably.

c Bipolar disorder is characterised by extreme mood swings and emotions, whereas schizophrenia is characterised by hallucinations, delusions and inappropriate behaviour.

20 Smoking may cause lung cancer, sitting unprotected in the sun may cause skin cancer, eating unhealthy food may cause obesity, leading to stroke.

21 In NSW, the blood alcohol content (BAC) for all P-plate drivers is zero.

22 Students' responses will vary.

Evaluating

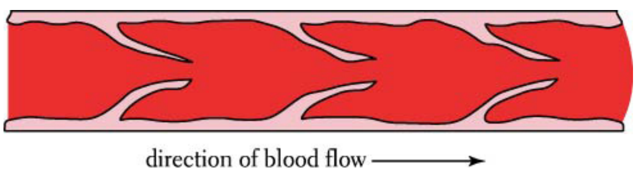
23 Drugs, such as marijuana, have the ability to alter a person's body chemistry and can therefore give people a sense of euphoria. Young people are also more likely to carry out risky behaviours.

24 Mental illnesses are not discussed because society has placed a stigma on those with mental disorders.

25 Caffeine is a drug because it alters a person's body chemistry.

Creating

26



Chapter answers

Remembering

1 Students' responses will vary.

2 fats, proteins, carbohydrates

3 Students' responses will vary. An example is anorexia nervosa.

4 fungi, protists, bacteria, viruses

5 live disabled versions of a virus or bacteria or antibodies produced by another organism

6 mercury, thallium, lead

Understanding

7 Pathologists carry out autopsies to determine the cause of death of an individual.

8 Virulence is a measure of the damage caused to a host by a disease.

9 A pathogen is an agent, such as bacteria, that causes disease. The bacteria *Legionella* causes legionnaire's disease.

10 The skin is our first line of defence, as it acts as a barrier, by being able to shed itself (in the form of skin cells), along with any bacteria on the skin's surface. Our second line of defence includes white blood cells that digest and engulf pathogens to form pus. Our third line of defence are antibodies, which are formed in response to specific antigens.

11 Individuals can fight disease by being inoculated with vaccines that contain disabled pathogens or previously produced antibodies. We can also take antibiotics, which are drugs that have the ability to selectively kill off certain pathogens.

12 Metastasis is when cancerous cells find their way into the circulatory or lymph systems and move to other parts of the body. The cancer then becomes difficult to treat because it has spread.

13 Long-term use of marijuana causes respiratory problems, depression, memory problems, decreased motivation and dependence.

14 Lead poisoning has many ill-effects, including foetal deformities in pregnant women and mental impairment in children.

15 **a** Students' responses will vary; e.g. sterilise water before drinking.

b Students' responses will vary; e.g. wear a mask.

16 When conditions are not favourable for growth, some types of bacteria form thick-walled spores that allow them to withstand cold. They can remain inactive until conditions improve.

17 Fungi are not usually associated with infection, but they will take the opportunity to infect a person if the conditions are ideal.

18 Vaccines stimulate the immune system into building antibodies to fight an infection before it can take hold in the body.

Applying

19 pathology, organism, organism, micro-organism, agent, host, shelter, Virulence, outbreak

20 fever

21 **a** *Vibrio cholera*

b *Candida albicans*

c *Clostridium botulinum*

Analysing

22 **a** mouse

b flea

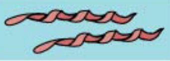
23 The people shown in the photo appear to have good health because they look well nourished, alert and ready to learn; i.e. they appear to function well in their environment.

Evaluating

24 A benign tumour is when cells are not rapidly dividing, whereas a malignant tumour is cancerous and the growth is uncontrollable.

Creating

25

Type	Appearance	Example
a Spirilla (spiral forms)		Syphilis
b Tetrads (groups of 4)		Sarcina
c Diplococcic		Gonorrhoea

5.1 Answers

Remembering

1 inherited

2 Structural (physical): both ends of a shingleback lizard look similar.

Functional: chameleons change their colour to blend in with changing backgrounds.

Behavioural: chimpanzees use broken twigs to extract termites.

3 They are not identical because variation occurs within all species. This variation comes from the difference in genes inherited from parents and genetic mutations. (Environmental factors are another reason.)

Understanding

4 **a**
- Many animals are camouflaged to blend in with their background so that they cannot be seen by predators.
- Some animals have stings, taste bad or are poisonous and their bright colours warn predators to stay away.
- Some animals have features that make them look larger and more frightening to predators.

b
- Some animals move slowly or sit still to avoid predators.
- Some predators form packs to hunt food more effectively.
- Some animals are active only at certain times of the day or year to avoid extremes of heat or cold.

5 **a** Polar bears inherit the characteristics of thick, white fur, an underlying thick layer of fat and a body shape that will allow them to survive on the ice sheets of the Arctic.

b Humans can acquire scars due to surgery or accidents, a muscular body from working out at the gym and confidence to speak in public.

Applying

6 Students' responses will vary.

7 its original environment of dark ocean caves

Analysing

8

Adaptation	Survival value	Habitat
Body colour that blends with the background	Avoidance of predators	Any
Production of small volumes of concentrated urine	Enables waste removal with minimal water loss	Salt water
Hooks and suckers on the head end of the organism	Avoids dislodgement by moving fluids	Intestines of a sheep
Broad, flat, bright green leaves	Maximum absorption of sunlight	Rainforest
Lives underground by day, and is active at night	Avoidance of the hottest parts of the day	Desert

9 **a** acquired
b inherited
c acquired
d inherited
e acquired

Evaluating

10 **a** Being able to intimidate means that an animal will warn off predators and so will have a better chance of surviving to reproduce.
b Being camouflaged means that an animal will not be seen by predators as easily and so will have a better chance of surviving to reproduce.
c Forming packs means that an individual animal will have a greater chance of surviving to reproduce. Animals in packs are also able to hunt more efficiently and so will have a better chance of surviving to reproduce.
d Hibernating through a harsh winter means that an animal will avoid extreme cold to conserve energy and so will have a better chance of surviving to reproduce.

11 Crossing in a herd means it is more difficult for a predator to attack any one individual in a herd.

12 **a** Colourful feathers: structural.
Displays with their tail feathers: behavioural.
b Colourful feathers help an individual find a mate and the displays with their tail feathers help warn off predators.

13 The large ears help them to keep cool and being nocturnal helps them avoid the extreme heat of the day.

Creating

14 Students' responses will vary.

5.2 Answers

Remembering

1
- Geographic isolation separates a population into two groups.
- Natural selection and mutation causes each group to take on its own characteristics.
- Reproductive isolation ensures that the two populations cannot interbreed.

2 **a** Divergent evolution requires geographical isolation. The conditions and organisms will vary slightly in each geographical area. Over time, natural selection occurs in each geographical area and new species evolve in each new environment.

b In convergent evolution, organisms evolve and develop similar adaptations because they either live in similar environments or habitats, or have similar lifestyles.

c In parallel evolution, related species are physically separated, but still evolve similar features in their different locations.

3 **a** They have a tail and a similar lifestyle.

b They have a streamlined body, split tail, dorsal fin and flippers.

Understanding

4 **a** Natural variation means differences exist within a population. In the case of the peppered moth, there is a light-coloured type and a dark-coloured type.

b Natural selection is the process by which the environment 'selects' favourable characteristics and reduces the likelihood of unfavourable characteristics. In the case of the peppered moths, until the mid-1800s, there were more light-coloured moths because they blended in with the colour of the lichen that covered the tree trunks. Hence, more of the light-coloured moths were able to avoid predation and survive to produce light-coloured offspring. However, during the Industrial Revolution, there were more dark-coloured moths because the coal-burning factories produced soot which darkened the trees, and so more of the dark-coloured moths were able to avoid predation and survive to produce dark-coloured offspring. Hence, the environment then favoured the darker moths.

5 **a** At first, the rabbits were controlled using the myxoma virus, but naturally resistant rabbits existed within the population and they survived and reproduced, making the virus less effective.

b MRSA is now resistant to antibiotics, such as penicillin and 20 other substances. This is of concern because *Staphylococcus aureus* infections are difficult to treat.

c Traditionally, mosquitoes were controlled using chemical pesticides, but naturally resistant mosquitoes existed within the population and they bred to make pesticides ineffective.

6 A homogenous population has no variation in characteristics and if this population is exposed to an unfavourable environmental change (pressure), the whole population could be wiped out (become extinct).

7 Natural selection takes several generations before any change is evident. Therefore, change is obvious in organisms that reproduce rapidly, such as bacteria. However, human reproduction is far too slow for us to see change in our lifetimes.

8 climate, environment, food type and availability

9 geographic isolation, natural selection, formation of a subspecies, reproductive isolation, further natural selection, formation of a species

10 In natural selection, environmental changes, which take years to occur, select favourable characteristics and it takes generations before these traits are displayed as favourable. However, when humans breed domestic animals, they select desirable traits and it doesn't take long before these traits are displayed. Therefore, artificial selection requires less time to develop new breeds or subspecies.

11 No, because they have characteristics that help them survive in colder environmental conditions, not in the warmer climates caused by global warming.

Applying

12 The more virulent disease is Ebola because it kills most of its victims within a few days.

13 **a** i

b iii

c ii

Analysing

14 **a** same

b different

c same

15 **a** common ancestor

b parallel

c New World Monkeys live in trees and have a prehensile tail to hold onto branches, whereas Old World Monkeys evolved to live on the ground and lack a prehensile tail.

Evaluating

16 The light-coloured moth will be selected because they will be better camouflaged from their predators.

17 **a** convergent

b These similarities are explained because both types of animal live in similar environments and habitats and have similar lifestyles and food sources.

18 A mutation for resistance to the chemical pesticides occurred and the mosquitoes carrying the gene for this mutation survived to reproduce.

Creating

19 Students' responses will vary.

5.2 Practical activity

Prac 1: Natural selection

Common mistakes

If the weather does not permit, or a grassy area is not available, different-coloured card as a background will work just as well.

Possible results

Students model the role of camouflage in natural selection. The camouflaged worms are most likely to survive and breed, as they are the most suited to their environment.

Suggested answers

1 *Green 'worms' are easier to see on brown dirt, whereas red 'worms' are easier to see on green grass. The easier the worms are to see, the more likely they are to be 'eaten'.*

2 ***a*** *This experiment is testing camouflage.*

b *Various answers are possible, including food availability, temperature and rainfall.*

3 *Predation can be considered to be a selective process that will change the mix of a species within a particular environment. The camouflaged worms are most likely to survive and breed, as they are the most suited to their environment. It shows natural selection at work.*

5.3 Answers

Remembering

1
- actual remains of organisms
- hard parts of organisms
- impressions, such as casts
- evidence of the presence of an organism, such as footprints

2
- Organisms must die in conditions where decay does not occur.
- Soft tissues of organisms usually do not form fossils.
- Fossilisation is more likely in water environments but unlikely on land.
- Geological processes and human activity constantly move and destroy the sedimentary rocks that contain fossils.

3 horse

4 **a** chimpanzee

b Various answers are possible; e.g. birds, reptiles.

5

Event	Time (millions of years ago)
Life on Earth begins	3500
First land organisms appear	400
Humans first appear	0.2
Complex cellular structures appear	1500
Dinosaurs become extinct	65
Earth forms	4500
First animals appear	600

6
- dramatic climate change and altered sea levels
- large asteroid and dust storm created

7 five

8
- similarities in chemicals present within organisms
- common functional parts or organelles in cells
- common chemical reactions, such as respiration, that occur within organisms

Understanding

9 the study of fossils

10 These organisms have been in existence and have remained unchanged for 400 million years.

11 *Archaeopteryx* provides a link between reptiles and birds because it shares characteristics from both groups of organisms.

12 Structures within the body that have no apparent function. It is thought that these structures once had a function in our ancestors, but, as evolution took place, these structures reduced in size and were no longer functional.

13 The pentadactyl limb in mammals indicates that mammals originated from a common ancestor.

14 *Archaeopteryx* and *Crossopterygian*: transitional forms provide the missing links in certain evolutionary paths.

15 The structure of DNA and the genetic code is universal. Apart from viruses, all organisms use the same basic code. This suggests that all living things are related and have evolved from common ancestors.

16 **a** Gene duplication is when an organism produces an extra gene for a particular characteristic.

b Gene duplication could arise from a mutation.

c Gene duplication contributes to the evolution of animals because it produces a new characteristic that arises from characteristics present in ancestral forms. This new characteristic may then be selected for if it provides the organism with an advantage.

17 During the early developmental stages of vertebrates, the embryo resembles that of different animals; i.e. embryos of different species all display gill slits, a tail and a fish-like heart and kidney. These developmental stages suggest a common ancestor.

a Homologous structures are fundamental similarities in certain structures across different species.

b Homologous structures are useful in the study of evolution because animals that share homologous structures probably evolved from a common ancestor.

18 **a** When the continents formed Gondwana, the southern continents were closer in proximity, so plants spread across them.

b The different types evolved to suit the environmental conditions of their new geographical locations.

Analysing

19 Analogous structures come from different ancestral backgrounds, but look alike and have a similar function. Homologous structures come from a common ancestral background; the basic structure is similar but it looks different to suit the environment and function.

20 **a** Pre-Cambrian, Palaeozoic, Mesozoic, Cenozoic

b Pre-Cambrian (307), Palaeozoic (33), Mesozoic (18), Cenozoic (7 days)

c **i** 1–3 January

ii 23–24 Dec

iii 31 Dec

Evaluating

21 **a** They originated from a common ancestor in North America.

b Each continent presents different environmental conditions, so different favourable traits would have been selected for and become more prominent in each geographical location.

c If they were the same species or a subspecies they would be able to breed together.

d divergent

5.3 Practical activities

Prac 1: Studying fossils

Common mistakes

Some details may be difficult to see with the naked eye. A hand lens or stereo microscope may assist in viewing the fossils.

Possible results

In this activity, students study fossils and identify how each was formed.

Suggested answer

Different timelines will be constructed, depending on the fossils provided and those selected by the students.

Prac 2: Constructing fossils

Common mistakes

Ensure that the plaster mixture is of a thick consistency before pouring into the mould.

Possible results

Students construct, bury and unearth a model 'fossil' and determine whether a realistic creature can be constructed from it.

Suggested answers

1 *Answers will vary.*

2 *Answers will vary.*

3 *Invariably, there will be alternative ways in which the bones could be arranged and assembled.*

5.4 Answers

Remembering

1 Forward focusing eyes that allow binocular vision, pentadactyl digits, four upper and lower incisors, opposable thumbs, nails on fingers and toes, large brain for their body size and flexible skeleton.

2 **a** Humans are bipedal and have flatter faces.

b Humans use various forms of verbal communication and have self-awareness.

3 gibbons, gorillas, chimpanzees, orangutans, humans

4 Students' responses will vary. Examples are bipedal, smaller teeth, reduced eyebrow ridge.

5

	Ape- or human-like?	Alternative name	Years of existence	What they did/could do
Dryopithecus	Ape		25 million years ago	
Ramapithecus	Ape		6 million years ago	
Australopithecus	Human	Southern ape	4 to 5 million years ago	Walked upright and used tools
Homo habilis	Human	Handyman	1.5–2 million years ago	Made stone tools, ate meat from animals killed
Homo erectus	Human	Java man	1.5 million years ago	Used fire, lived in caves, cared for ill
Homo sapiens	Human	Modern man	40 000 years ago to present	Intelligent, communicate, self-aware, create and use sophisticated technology
Homo neanderthalensis	Human	Neanderthal man	35 000–100 000 years ago	Cave dwellers, used tools and fire, buried their dead and communicated
Cro-Magnon	Human		10 000–40 000 years ago	Developed art, decorated themselves, traded, used tools, buried their dead

Understanding

7 Fossil evidence suggests that primates (humans) arose from a shrew-like insectivore.

8 **a** Cultural evolution is the storage, accumulation and passing from generation to generation of learning and knowledge.

b
- knowledge of starting and using fire
- reasoning powers and the sense of right and wrong

Applying

9 ability to use tools and fire and distinct social structures

10 **a** ability to more easily hunt and kill animals for meat
b ability to hunt for food
c cultural evolution
d longer life expectancy
e increased resources, such as tools
f cultural evolution

Analysing

11 prosimians, New World monkeys, Old World monkeys, apes, humans

12 **a** *Homo sapiens*
b *Homo erectus* and *Homo habilis*
c *Australopithecus africanus*
d *Homo neanderthalensis*
e *Homo sapiens*
f *Australopithecus afarensis*

13 b, c, a As humans evolved, the face flattened, there was a less prominent eyebrow ridge and a larger brain, as shown by the ordering of b, c, a.

Evaluating

14 **a** walking upright on two limbs
b move faster and leave hands free to hunt and gather
c quadrupedal

Chapter answers

Remembering

1 Students may list any two of genes inherited, mutations or environment.

2 iii, v, i, iv, ii

3

Term	Description
Parallel evolution	Produces structurally similar, closely related organisms that live in different places
Convergent evolution	Results in structurally similar but unrelated organisms
Divergent evolution	Results in adaptive radiation

4 Only small amounts of organisms are fossilised, because in order to produce fossils, organisms must die in conditions where decay does not occur. Also, geological processes destroy sedimentary rocks that contain fossils. Also, soft tissues usually do not form fossils.

5 *Homo erectus* and *Homo habilis*

6 cultural evolution

Understanding

7 **a** Adaptations are characteristics that make organisms suited to their environment and are inherited.

b Speciation usually involves geographic isolation of a population followed by reproductive isolation.

c DNA testing shows that the closest species to humans is the chimpanzee.

d The fossil record shows clearly that all current organisms have evolved slowly and gradually.

e A bat's wing, a seal's flipper and a human arm are all homologous structures called pentadactyl limbs.

f Modern humans evolved from modern apes.

8 **a** Adaptation is a characteristic that makes organisms ideally suited to their environment.

b Students' answers will vary. Some examples are as follows. Whales have a thick layer of fat to help survive the cold temperatures of the Antarctic; they have huge lungs which enable them to remain underwater for long periods of time; they have strong tails to help propel them through the water.

9 **a** Favourable characteristics are traits (characteristics) that an organism has that are best suited to the environment, as they enhance their ability to survive and reproduce.

b evolution

10 Fossils support the theory of evolution because they are evidence of past life, providing evidence of continual change.

a Homologous structures are fundamentally similar structures, such as the pentadactyl limb, found across different species because they evolved from a common ancestor.

b divergent

c Analogous structures are similar adaptations (structures) possessed by different organisms that enable them to survive in similar environments. These organisms end up looking similar even though they have different genes passed down from different ancestors.

d convergent

11 **a** gill slits and a tail

b Throughout developmental stages, these characteristics are thought to reflect their evolutionary history and suggest a common ancestor.

12 **a** Homologous structure in organisms with common ancestry.

b convergent evolution

c Vestigial structures in organisms with common ancestry.

13 **a** *Homo habilis* is believed to have scavenged meat and used stone tools.

b *Homo erectus* used fire and may have communicated.

c Modern-day humans have finer bone structures and have a larger brain than Cro-Magnon.

Applying

14 walk upright (bipedal); have fewer and smaller teeth; have a flattened face

15

Common name	Classification	Time of appearance (years ago)
Upright man	*Homo erectus*	1.5 million
Cro-Magnon	*Homo sapiens*	40 000
Handy man	*Homo habilis*	2 million
Neanderthal	*Homo neanderthalenis*	100 000
Lucy	*Australopithecus*	5 million

Evaluating

16 **a** Students may list any two of different climate, continental drift, environment, food type or different predators.

b In different conditions, different desirable characteristics will be selected. Different mutations may occur, which will lead to variation and, in turn, natural selection.

c
- A change in colour could mean that mates are not recognised.
- An altered chromosome could make sperm and egg cells incompatible.

17

Event	Time
Complex cells first appear	8.12 am
Australopithicines first appear	11.58 pm
Dinosaurs become extinct	11.34 pm
The Palaeozoic era begins	2.00 pm
Land organisms first appear	9.20 pm

6.1 Answers

Remembering

1 **a** s, metres, m
b $\vec{s}$, metres, m
c t, seconds, s
d v, metres per second, m/s
e $\vec{v}$, metres per second, m/s

2 **a** that the object is stationary
b that the object is travelling at constant speed

3 $s = vt$

4 mobile phone, radio, alcohol

Understanding

5 **a** the exact speed at a single point in time
b the distance and direction an object is from where it started
c the speed and direction of the wind

6 **a** The gradient of the graph shows speed.
b The area under the graph shows total distance travelled.

7 Seeing the emergency, sending the information to their brain and processing the information.

8 Distance is the total length travelled, so must always increase. Displacement is the distance from the origin, which could go up or down depending on whether the object is getting further from or closer to the origin.

Applying

9 **a** If you walk in a circle with a circumference of 100 m, the distance you have travelled is 100 m but your displacement is 0 m.
b An easterly breeze blowing at 15 km/h has a speed of 15 km/h but a velocity of 15 km/h East.

10 **a** speed = distance/time
b distance = speed × time
c velocity = displacement/time

11

Motion 1	Motion 2:
a 20 km	**a** 18 m
b 4 km South	**b** 0 m
c 5 km/h	**c** 2 m/s
d 1 km/h South	**d** 0 m/s

12

Speed	**km/h**	**m/s**
Athlete sprinting	42.1	11.7
Bushwalker	4.0	1.1
Racehorse	68.4	19.0
Cheetah	100.0	27.8
Greyhound	65.9	18.3
Cockroach	4.5	1.2
Speed of sound	1202.4	334
Antelope	88.0	24.4

13 **a** 110 km/h
b 12 cm/s or 0.12 m/s
14 **a** 4800 km
b 93.6 m
15 **a** 30 s
b 5 h
16 3 km/h
17 **a** 67 mm/year
b his hair was never cut
c average speed
18 **a** 498.7 s
b 1.3 s
c 19 168 s or 5.3 h

19

Speed (km/h)	Speed (m/s)	Reaction time (s)	Reaction distance (m)
20	5.6	0.7	3.9
50	13.9	0.6	8.3
60	16.7	0.9	15.0
100	27.8	0.5	13.9
110	30.6	0.8	24.5

20 2 m/s and 0.5 m/s

Analysing

21 **a** 5.9 km = 4.2 cm; i.e. 1.4 km/cm
b Path to highest point is 4.5 cm = 6.3 km in 40 s; therefore, average speed is 157.5 m/s.
c 12.6 km
d 2.6 cm = 3.64 km to the left
e parabola

22 **a** 24 m
b 12 m
c 30 m

23 **a** 12 km
b 0 km
c 6 h
d 3 km/h
e 2 km/h
f between hours 2 and 3
g 2 km/h

Evaluating

24 Although alcohol slows the reaction times of all drivers, more experienced drivers can drive more safely with higher blood alcohol levels.

Creating

25 Creative task.

6.1 Practical activities

Prac 1: They've got the runs!

Common mistakes

Time measurements may vary depending on the reflexes of the time keeper.

Possible results

The gradient on the graph is steepest when acceleration is the greatest.

Suggested answers

1 *Acceleration will be greatest at the start. Deceleration will happen as the student gets tired towards the end. The gradient on the graph is steepest when acceleration is the greatest.*

2 *The speed would be reasonably constant in the middle section, which is shown by a straight line on the graph.*

3 *Each run would be very different, so each trial would have different sets of data.*

4 *The graph should be similar in shape. It would, however, get to higher speeds so the gradient would be steeper.*

Prac 2: Ticker-timer experiment

Common mistakes

Ensure that the ticker-timer is plugged into the AC terminals on the power supply, not the DC terminals. Make sure the correct voltage is set before starting.

Possible results

Students use a ticker-timer to measure the motion of an object.

Suggested answers

1 *It was important to number the sections of tape before cutting, otherwise you would not know in which order they should be pasted to represent the motion.*

2 *An AC ticker-timer operates at 50 Hz, producing 50 dots in 1 second.*

3 ***a*** *A new dot is produced every 1/50th of a second or every 0.02 s.*

b *Five new dots are produced in 1/10th of a second or in 0.1 s.*

4 *Ticker-timers can only measure straight-line motion in one direction.*

Prac 3: Measuring speed

Common mistakes

Student-designed experiments should be assessed by the teacher for feasibility before carrying out the experiment.

Possible results

Students design their own experiment that will measure the speed of a moving object and the speed of sound.

Suggested answers

Students' answers will vary.

Prac 4: Chain reaction

Common mistakes

Time measurements may vary depending on the reflexes of the time keeper.

Possible results

Students measure how long it takes to react to a message. The more complex the message, the greater the reaction time.

Suggested answers

1. *Various answers are possible: students are to copy the results of their group.*
2. *Average reaction time to be calculated from the group's results. Students should do this by:*
   - *calculating the average time for the group to pass the message around the ring*
   - *dividing this time by the number of people in the group.*
3. *There is usually no or little difference between sending the message to the left or to the right.*
4. *The reaction times usually increase (often doubling or more) in Part C, associated with the time needed for complex thinking.*

Prac 5: Driving reaction times

Common mistakes

Measurement errors.

Possible results

Students measure their reaction times and explore factors that influence reaction times when driving.

Suggested answers

1. *Resistance does exist, even over this short distance, as there is some air resistance.*
2. *The first drop of the ruler was probably the worst. This suggests that inexperience will slow a driver's reaction time in an emergency, particularly the first time it happens to them.*
3. *Distractions usually slow reaction times, making reaction times longer.*
4. *A driver might logically encounter distractions, such as monitoring or controlling pets or young children in the car, changing CDs, talking, using a mobile phone, sending or reading an SMS, watching in-dash DVDs or a GPS-mounted map, reading a street directory, applying makeup etc.*
5. *Alcohol in the blood slows reaction times.*
6. *Although the RTA estimates reaction times to be between 0.5 and 1 s, the results in this experiment are probably less, as the 'driver' was expecting the 'emergency' to happen and was prepared for it. The response was also a simple one. In reality, drivers are not expecting an emergency and are therefore not prepared for it. They must also process a number of different factors and responses before they act, such as the following.*
   - *Is the road slippery?*
   - *Are there pedestrians that will stop me from swerving?*
   - *Will I swerve, brake etc.?*

   Reaction times are therefore typically longer than shown in this experiment.

6.2 Answers

Remembering

1 acceleration = change in velocity/change in time or $a = (v - u)/t$

2 slowing down

3 speed = initial speed + acceleration × time or $v = u + at$

4 15 m/s

Understanding

5 final speed = starting speed + acceleration × time

6 **a** increasing speed

b decreasing speed

7 Every second, the speed of the car increases by 10 km/h.

8 It occurs in the opposite direction to the velocity of the object.

Applying

9 starting velocity (u) in m/s, final velocity (v) in m/s, time taken (t) in s

10 **a** c

b a

c b

d d

11 **a** 5 m/s, 10 m/s, 15 m/s, 20 m/s

b 7.5 m/s, 12.5 m/s, 17.5 m/s, 22.5 m/s

12 D

13

Starting speed (m/s)	Final speed (m/s)	Time taken (s)	Acceleration (m/s^2)
0	50	10	5
10	50	4	10
50	30	5	–4
At rest	25	10	2.5
60	Stationary	12	–5

14

Starting speed (m/s)	Acceleration (m/s^2)	Time taken (s)	Final speed (m/s)
0	15	3	45
20	8	5	60
16	1	4	20
30	–2	10	10
15	–5	3	0

15 **a** 10 km/h/s
b 2.8 m/s^2

16 Section 1: 8 m, 4 m/s^2
Section 2: 16 m, 0 m/s^2
Section 3: 27 m, 0.67 m/s^2

17 **a** Linh: 4.8 km/h/s, Beth: 0.9 m/s^2, Brianna: 6 m/s/min
b Linh: 1.3 m/s^2, Beth: 0.9 m/s^2, Brianna 0.1 m/s^2
c Brianna, Beth, Linh
d Linh

Analysing

18 **a** The speed is constant.
b The speed is increasing.
c the outer edge of the tennis racket
d increasing
e A scale and time between images.

19 a

Speed	Reaction distance (m)	Breaking distance (m)	Stopping distance (m)
20	4	3	7
50	10	15	25
60	11	22	33
80	15	40	55
100	20	60	80

b At 60 km/h the stopping distance is 8 m more than at 50 km/h.

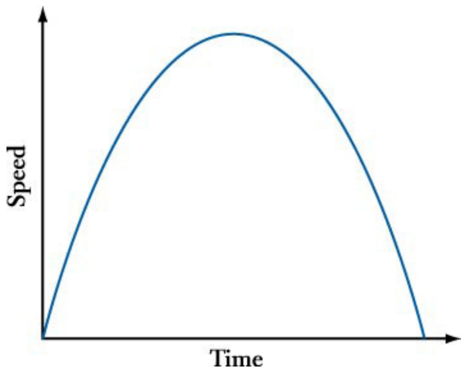
c 60 km/h: 3–4 car lengths; 100 km/h: 6–7 car lengths.

Evaluating

20 km/h/s: the speed of a car is usually measured in km/h; however, the time for acceleration is usually of the order of seconds.

Creating

21



6.2 Practical activities

Prac 1: Braking distances

Common mistakes

To correctly calculate the braking distance, students must enter the formula into the calculator in the correct order.

Possible results

Braking distance is inversely proportional to brake performance.

Suggested answers

1 ***a*** *Braking distance is inversely proportional to brake performance. Braking distance would thus increase if brake performance was less.*

b *If brake performance is halved, the braking distance would double.*

2 *Factors affecting reaction distance and braking distance*

Reaction distance	Braking distance
Alcohol and drugs in the blood	Bald tyres
Tiredness	Wet road
Noisy children in the back	Icy road
Age of driver	Poorly serviced brakes
Talking on a mobile phone	Old car

Note: In NSW, talking, sending or receiving text messages is illegal when using a hand-held phone. No mobile phone use by learner and P1 provisional drivers and riders is allowed.

Prac 2: Acceleration and datalogging

Common mistakes

Student-designed experiments should be assessed by the teacher for feasibility before carrying out the experiment.

Possible results

Students design an experiment using dataloggers, light gates and ultrasonic sensors to measure the speeds and accelerations of a moving object.

Suggested answers

Students' own answers.

Prac 3: Construct an accelerometer

Common mistakes

A long bench is required to achieve a constant speed.

Possible results

Diagrams should indicate that the paperclip swings backward when the accelerometer is pushed forwards. When the accelerometer is stopped, the paperclip should swing forwards. When travelling at a constant speed, the paperclip should hang vertically. When changing direction, the paperclip should swing out.

Suggested answers

Students' own diagrammatic answers.

6.3 Answers

Remembering

1 acceleration, deceleration, change direction, change shape

2
- An object at rest will stay that way unless a force acts on it.
- An object in motion will continue to move in the same direction at the same speed until a force acts on it.

3
- **a** true
- **b** true
- **c** false
- **d** false
- **e** false

Understanding

4
- **a** A force is a push, pull or twist that can cause an object to accelerate, decelerate, change direction or change shape.
- **b** When more than one force acts on an object but the net force is zero.
- **c** Inertia is an object's resistance to a change in motion.

5
- **a** they lean to the right
- **b** they are pushed back into their chair
- **c** they feel heavier
- **d** they feel lighter
- **e** they are thrown forward
- **f** they are thrown backwards
- **g** they are thrown to the left

6 Seatbelts hold you in position to stop you moving forward in a collision.

7 acceleration is zero

8
- **a** The tablecloth is slippery, so does not apply a large force on the objects. Their inertia holds them in position.
- **b** According to Newton's First Law, there will always be a small frictional force that will cause a small change.

9 In space, there is no air and so no air resistance to slow the rocket down.

10 **a** The car was rammed from behind.

b Fig. 1: The forces are balanced so there is no overall motion.

Fig. 2: The car is hit from behind, sending it forward while the inertia of the passenger holds her in position. As a result, she appears to be thrown backwards.

Fig. 3: Once the car stops moving forward, the inertia of the passenger continues to propel her forward until she is restrained by her seatbelt.

c Headrests stop passengers' heads from being thrown backwards violently in a back-end collision.

Applying

11 friction from the seat, a push force against the passenger's legs and the floor

12 **a** Once the car is in motion, its large inertia requires a large force to change its speed or direction. It is difficult to apply such a large force on the slippery ice.

b friction

Analysing

13

Contact forces	Non-contact forces
Lift	Electrostatic
Thrust	Weight
Friction	Magnetic
Buoyancy	
Air resistance	
Drag	

Evaluating

14 If the truck has a head-on collision and stops quickly, the inertia of the load will keep it moving and apply a very large force on the back of the cabin.

15 A large force to the head could result in brain damage or severe neck injury and paralysis.

16 **a** Seatbelts must apply a lot of force to stop the passenger from being thrown forward when the car (and passenger(s)) is travelling at high speed.

b Without a seatbelt you could hit your head, break your neck or be thrown through the windscreen.

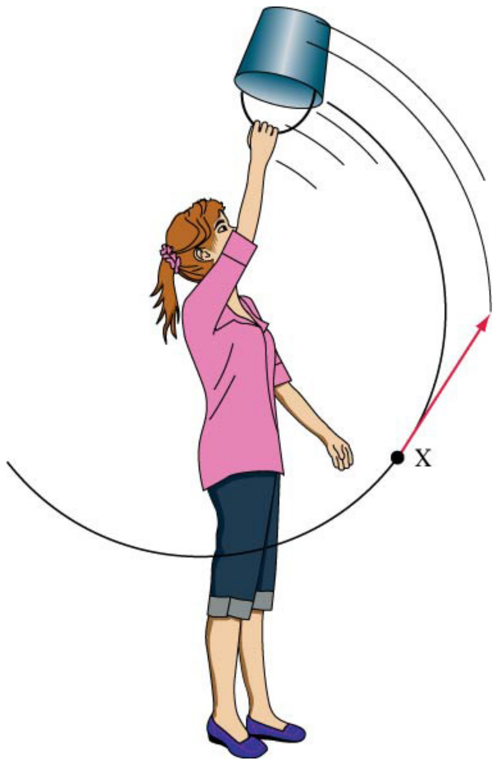
17 Yes, they are taking a serious risk. An accident can occur faster than their reaction time and without a restraint the baby could be thrown out of their arms and through the windscreen.

18 No, they can still be thrown through the windscreen or with extreme force into the seats in front.

19 Having seatbelts and restricting to seating room only would certainly be safer. However, it would mean fewer people could travel per bus. Also, the inertia of a bus is so large, in a collision with a standard car, the bus itself would not experience a sudden change in direction.

Creating

20



6.3 Practical activities

Prac 1: Crash test dummies

Common mistakes

Soft malleable plasticine will assist this exercise. If the plasticine is too hard, place on paper towel and microwave for a very brief time (too long and it melts).

Possible results

Students carry out their own crash test to investigate the inertia of the crash test dummy. When the moving trolley hits the brick and stops, inertia causes the dummy to continue to move forwards, resulting in trauma. The seatbelt (sticky tape) stops the dummy moving forwards, avoiding the trauma. In the rear-end collision, although the trolley is knocked forward, the dummy remains stationary due to inertia.

Suggested answers

1 *Friction with the seat and resistance from any shaping of the seat cushion will slow the forward movement of the backside in a head-on collision. Therefore, the backside will not move forwards at the speed of the car before the collision, but will more likely be slower. The head, arms and legs have no friction or forces slowing their forward movement. Hence, they keep moving at the speed at which the car was travelling.*

2 *In a collision, the steering wheel, dash, windscreen (or, hopefully, the airbag) stops forward movement if no seatbelts are worn.*

3 *Head injuries are most likely if not wearing a seatbelt in a head-on collision.*

4 *The crumpling of a car in an accident increases the time it takes to complete the collision. This spreads out the deceleration and reduces the force on the body, making the collision more survivable.*

5 *The head tends to flick backwards in a rear-end collision and is the last movement at the end of a head-on collision. Headrests stop this flick of the head.*

Prac 2: Inertial eggs

Common mistakes

To avoid eggs falling and breaking, spin the eggs on a large lipped tray.

Possible results

The content inside a fresh egg is liquid. Inertia makes the content of the egg move slowly when the shell is spun, and this slows the shell. However, the liquid carries on turning when the shell is stopped, causing the egg to start spinning again when released. The hard-boiled egg acts differently because the liquid is now solid and held tightly inside the shell.

Suggested answers

1 *When a fresh egg is spun, at first, only the shell starts moving. The liquid interior tends to stay at rest until friction with the shell gets it moving.*

2 *The friction with the liquid interior will slow the spin of the shell and therefore make it harder to spin.*

3 *Stopping a fresh egg from spinning will only stop the shell. The liquid interior will keep swirling around.*

4 *Once the shell is let go, friction with the moving liquid interior will get the shell moving again.*

5 *The hard-boiled egg is solid throughout. This means that everything will be moving once the egg is spun and everything will stop when the egg's movement is stopped. There will be no friction created between the interior and the shell to either slow it down or get it moving again.*

Prac 3: The yolk's on you!

Common mistakes

A strong, high-quality sticky tape will assist this exercise.

Possible results

Student results will vary; however, the most successful method will be when the deceleration occurs over the longest period of time.

Suggested answers

There are no questions in this prac.

6.4 Answers

Remembering

1 **a** An object will accelerate if an unbalanced force is applied to it. Its acceleration will depend on the size of the force and the mass of the object.

b $F = ma$

Understanding

2 **a** the amount of matter an object contains

b kilograms (kg)

3 the rate of acceleration decreases

4 the rate of acceleration increases

5 so that the movement of the passenger's head is slowed down as gently as possible

6 **a** high

b Some of the force of the impact would cause the hammer to bend rather than push the nail in.

Applying

7 A

8 B

9 **a** 20.5 N

b 2600 N

c 1.6 N

Analysing

10 **a** 80 m/s^2

b 0.01 m/s^2

11 5 kg

12 **a** 4 m/s^2

b 14 N

13 **a** 1500 kg

b 2 m/s^2

c 5 s

14 *y*: D
z: E

15 **a** 250 N, 5 m/s^2

b 30 N, 1.5 m/s^2

16

Force (N)	Mass (kg)	Acceleration (m/s^2)
20.0	5.0	4.0
12.2	6.1	2.0
12.0	4.0	3.0
16.4	2.0	8.2
9.3	3.1	3.0

17 **b** -1 m/s^2
c -1.5 m/s^2

6.4 Practical activity

Prac 1: *F* = *ma*

Common mistakes

Ensure that the string is strong enough to withstand the force of the weights before starting the experiment.

Ensure that the retort stand is clamped to the bench before applying weight to your measuring device.

Possible results

An object will accelerate if an unbalanced force is applied to it. Its acceleration will depend on the size of the force and the mass of the object.

Suggested answers

1 ***a*** *When the mass of the trolley increased, acceleration decreased.*
b *When the mass and the force pulling the trolley along increased, acceleration increased.*

2 *An individual student response is required.*

3 *If the mass is doubled, the acceleration is halved. It is inversely proportional.*

6.5 Answers

Remembering

1 For every force, there is a force of the same size acting in the opposite direction.

Understanding

2 Sitting on a chair: Your weight pushing down is balanced by the chair pushing up.

Leaning on a wall: You push against the wall and the wall pushes back an equal amount.

Walking: Your foot pushes back against the ground, sending you forward.

3 The engine ignites an oxygen hydrogen mixture, forcing the products downwards. This, in turn, applies an upward force to the rocket, allowing it to lift off against the force of gravity.

4 The air inside the balloon is forced out of the opening. This applies a force to the balloon that propels it forwards.

5 **a** The fire hose forces large amounts of water out of the spout. This causes a reaction force on the hose itself, pushing it backwards.

b The firefighters would be pushed backwards themselves and wouldn't be able to hold the hose.

6 The force is the same but the total mass of the rocket is reduced.

Applying

7 **a** hand pushing the ball

b sent the ball flying

c force of the ball on her hand

d applied pressure to her hand

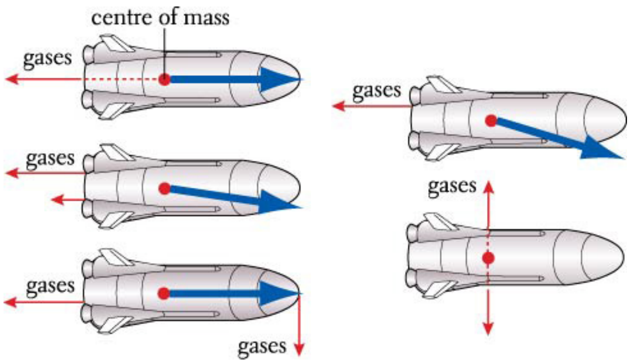
8 **a** Second Law

b First Law

c Third Law

d First Law

9



Evaluating

10 Squat and push himself along with his hands.

11 The fuel tanks add extra weight, making take-off more difficult.

12 **a** taking off at a constant speed

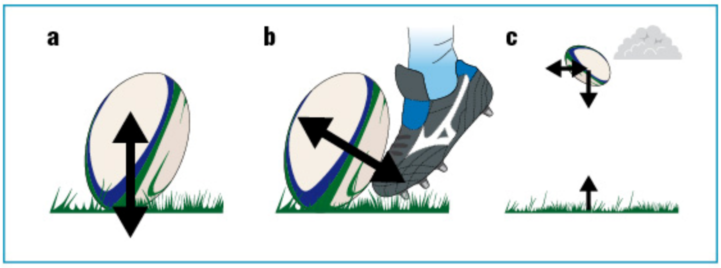
b during the initial launch

c before the initial launch

d waiting on the landing pad or cruising in space

Creating

13



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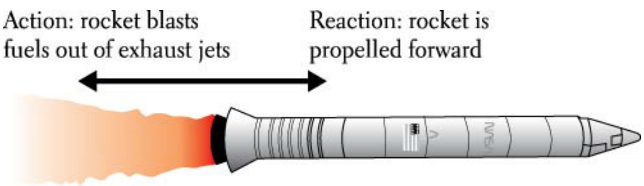

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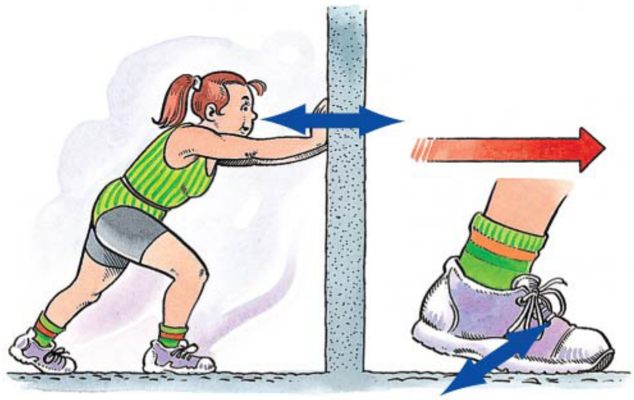


16 Investigation task.

6.5 Practical activities

Prac 1: Water rockets

Common mistakes

Ensure that the retort stand is secure when pressurising the bottle.

To prevent the rocket veering off into unexpected directions, tie a piece of string to the neck of the bottle.

Possible results

The pressure inside the bottle produces a force that pushes the water downwards and out through the cork. This action produces an equal–opposite reaction, according to Newton's Third Law, which pushes the bottle upwards.

Suggested answers

1 *The action–reaction force pair for the water rocket is:*
action: air pressure within the bottle forces water downwards
reaction: water pushes back on the bottle, forcing it upwards.

2 *The 'fuel' for this rocket was the water and the compressed air.*

3 *Air resistance and gravity slowed the ascent of the water rocket once launched.*

4 *Air resistance could be reduced by making the head of the rocket more streamlined (e.g. by attaching a cardboard cone). Nothing can be done to reduce gravity on Earth.*

5 *Generally, more water does not make the rocket fly higher. More water will take more time to exit. Hence, the rocket is more likely to launch with some water still on board. This makes it heavier and so it will reach a lower height.*

6 *Student's own answers required.*

7 *Trigonometry could be used to find the height of the rocket using the following steps.*

- *Measure out a certain distance from the launch site (the adjacent to the right-angled triangle that you will use).*
- *Measure the elevation (the angle) to the height the rocket reaches.*
- *Calculate the height by multiplying the distance from the launch site by the tangent of the elevation; i.e.*
  height = distance × tan(elevation) or
  h = d tan Ø.

Prac 2: A two-stage rocket

Common mistakes

The cut edges of the plastic cup may be jagged, causing the balloon to tear. Use paper cups instead.

Possible results

As the balloon squeezes the air out, the air pushes the balloon back, accelerating the rocket and pushing it forwards.

Suggested answers

1 *The balloon squeezed the air out (the action force) and so the air pushed the balloon back (the reaction force), accelerating the rocket and pushing it forwards.*

2 ***a*** *A third stage could be added by changing the round balloon to another long balloon and repeating the procedure with another cup and round balloon. Various answers are possible regarding how many stages you could attach.*

b *Although more stages provide a longer thrust, they also add weight, making the whole rocket less likely to take off.*

6.6 Answers

Remembering

1 *g*, m/s^2, metres per second squared

2 9.8 m/s^2

3 Weight is equal to mass times the acceleration due to gravity, $w = mg$.

4 amount of air, force of gravity and shape of the falling object

Understanding

5 **a** The force of attraction between two objects with mass.
b The force applied to an object travelling through air by the air itself.
c The amount of force an object feels due to gravity.
d The maximum velocity a falling object can attain when limited by air resistance.

6 **a** Heavier objects fall at the same rate as lighter ones.
b There is no air resistance in a vacuum.
c Mass is the same everywhere.
d Weight is measured in newtons.
e You would feel weightless in a falling lift.

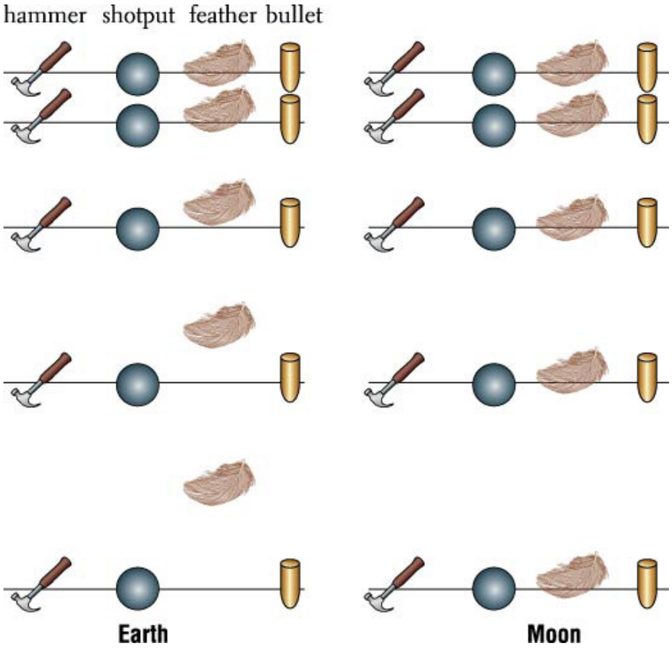
7 There is no air in space and, therefore, no air resistance.

8 Without a parachute, the humans fall at the same rate as the pumpkin, but once they open their parachutes, the pumpkin falls much faster.

9 **a** They experience a force eight times the normal force of gravity.
b The person will pass out due to lack of oxygen to the brain.

10 When an object is orbiting, it is essentially falling around the Earth; therefore, the astronauts are in a constant state of free-fall.

11



Applying

12 deep outer space

13 **a** B

b C

c A

14 **a** 50 kg, 490 N

b 50 kg, 81.5 N

c 50 kg, 185 N

Analysing

15 **a** 70 kg

b 5 m/s^2

c Planet X is smaller, having half the mass of Earth.

16 Mass is the amount of matter an object contains, whereas weight is the amount of force an object feels and is dependent on its mass and the pull of gravity. Therefore, mass is constant anywhere in the universe, whereas weight changes depending on the gravitational field.

17 They would fall at a similar rate because the Moon has no atmosphere and therefore no air resistance.

Evaluating

18 Even in space there will always be a small gravitational force from distant objects. However, if these forces were equally balanced or if you are in free-fall, then you can be considered weightless.

19 **a** The *g*-forces can be increased by accelerating faster than the acceleration due to gravity. This might occur in a roller coaster or in a fighter jet turning quickly.

b The *g*-forces can be decreased by reducing the effect of gravity on the body by letting the body fall. During a free-fall, the effect is 0*g* or weightlessness.

Creating

20 Creative task.

21 Creative task.

22 Investigation task.

6.6 Practical activities

Prac 1: Finding *g* using a ticker-timer

Common mistakes

Ensure that the ticker-timer is plugged into the AC terminals on the power supply, not the DC terminals. Make sure the correct voltage is set before starting.

Possible results

The acceleration due to gravity is calculated by determining the velocity at two different regions on the ticker-tape and the time taken for the velocity to change. '*g*' is calculated by change in velocity divided by the change in time.

Suggested answers

1 *a* *If the AC supply was 10 Hz, it would take one-tenth of a second or 0.1 s to produce one new dot. It would take five-tenths of a second or 0.5 s to produce five new dots.*

b *If the AC supply was 100 Hz, it would take one-hundredth of a second or 0.01 s to produce one new dot. It would take five-hundredths of a second or 0.05 s to produce five new dots.*

2 *The slope of a speed–time graph is equivalent to the acceleration of the object.*

3 *Various answers are possible. Most likely, the graph will indicate constant acceleration for most of the tape, followed by a section of constant speed.*

4 *The acceleration here would be less than 9.8 m/s^2 because the ticker-timer must physically grab the tape to make each new dot. Hence, the tape is slowed a little each time a dot is produced.*

5 *The dots will appear very closely spaced or on top of one another when the mass hits the ground.*

Prac 2: Measuring height with a stopwatch!

Common mistakes

Time measurements may vary depending on the reflexes of the time keeper.

Possible results

Students use a stopwatch to find the height from which a mass is dropped.

Suggested answers

1 *Answers will vary depending on measurement accuracy.*

2 *The formula doesn't take air resistance into account.*

3 *The starting speed must be zero. The object must start off stationary.*

4 *The formula makes the following assumptions.*

- *that the object will fall with an acceleration of 9.8 m/s^2 due to gravity*
- *that the object starts out stationary and is simply dropped*
- *that air resistance doesn't matter*
- *that the experiment takes place on the surface of the Earth*

6.7 Answers

Remembering

1 *W*: Work, joules, J
F: Force, newtons, N
s: displacement, m

2 kinetic energy

3 *KE*: joules, *m*: kilograms, *v*: metres per second

4 spring, tennis ball

5 *GPE*: joules, *m*: kilograms, *g*: metres per second squared, *h*: metres

6 D, C, A, B

Understanding

7 **a** the ability to do work
b energy associated with movement
c the energy stored by an object due to its position in a gravitational field
d the energy stored in a stretched object
e the ability to transform energy without energy loss

8 The work done on an object is equal to the force applied to the object multiplied by the distance the object was displaced.

9 **a** Kinetic energy is half the mass times the velocity squared, $KE = 1/2\ mv^2$.
b The gravitational potential energy is the mass times the acceleration due to gravity times the height of the object, $GPE = mgh$.
c The elastic potential energy is half the spring constant times the extension of the spring squared, $EPE = 1/2\ kx^2$.

10 Friction causes some of the energy being transferred to be lost as heat.

11 most likely, the passenger cabin

Applying

12 **a** kinetic energy
b gravitational potential energy
c elastic potential energy
d work

13 efficiency = (energy after conversion/energy before conversion) × 100%

14 c, e

15 A: double elastic bands
B: single elastic band
C: two linked elastic bands
D: three linked elastic bands

16 **a** 14 J
b 10 J

17 **a** 125 000 J
b 2025 J
c 0.04 J
d 0.000 000 038 J

18 **a** 6468 J
b 17.15 J
c 159 250 J
d 5 120 500 J

19 **a** 4900 J
b She climbed up using the chemical energy gained from food.
c Potential energy is converted to kinetic energy.
d She is moving.
e 4 900 J
f kinetic energy of the water and heat from friction

20 **a** before: 0.59 J, after: 0.44 J
b 75%

21 **a** 22.5 J
b 3.125 J
c 8.44 J
d 222.34 J

Analysing

22 When the sling is stretched twice as far, it stores four times as much elastic potential energy because $EPE = \frac{1}{2}kx^2$; i.e. if x is twice as big, EPE is four times larger.

23 $EPE(\text{1st}) = \frac{1}{2} \times 6 \times (0.1)^2 = 0.03$ J

$EPE(\text{2nd}) = \frac{1}{2} \times 6 \times (0.2)^2 = 0.12$ J

Evaluating

24 This statement is incorrect. $KE = \frac{1}{2}mv^2$, so if speed (v) is doubled, the kinetic energy will quadruple, suggesting that the crash will be four times worse.

25 **a** This statement is true. If the ball never loses energy, the energy will be continuously converted from gravitational to kinetic to elastic potential and back again.

b The ball is constantly losing energy through friction from air resistance and heat energy when the ball hits the ground.

6.7 Practical activities

Prac 1: Extension of an elastic band

Common mistakes

New elastic bands will have more elasticity and are less likely to break when extended.

Ensure that the retort stand is securely clamped to the bench before applying weights.

Possible results

The double end-to-end band arrangement will be less stiff than the single rubber band arrangement. The side-by-side double band arrangement will be the stiffest arrangement.

Suggested answers

1 *The energy stored in this experiment is elastic potential energy.*

2 *The stiffest arrangement of elastic bands should be the arrangement where the elastic bands are 'in parallel'; i.e. the third arrangement.*

Prac 2: Efficiency of a roller coaster

Common mistakes

Ensure that the retort stand is securely clamped to the bench.

Possible results

In an efficient roller coaster, the finish height will be close to the starting height. In an inefficient roller coaster, the finish height will be much lower than the starting height.

Suggested answers

1 *As the marble drops, its gravitational potential energy is converted to kinetic energy of the marble, some vibration (kinetic energy again) of the track, some sound and some heat, warming up both the track and the marble.*

2 *The marble had kinetic energy at the bottom.*

3 *A 100% efficient track would mean that no energy would ever be lost as sound, heat or vibration of the track. This is impossible, as some energy is always 'lost' as these forms.*

Prac 3: Ball bounce

Common mistakes

Old worn balls will not bounce as high. New or less worn balls will provide better results.

Possible results

Results will vary depending on what types of balls were tested. Squash balls will probably have the lowest coefficient of restitution. The coefficient of restitution should be approximately the same for each ball regardless of drop height.

Suggested answers

1 *Answers will vary depending on what types of balls were tested. Squash balls will probably have the lowest coefficient of restitution.*

2 *Answers will vary, depending on students' results. The coefficient of restitution should be approximately the same for each ball regardless of drop height.*

3 *A coefficient of 1 implies that the ball bounces back to the height from which it was dropped. This would occur only if no energy is lost. Energy is always lost, hence this situation is impossible.*

4 *Much of the energy in a bounce goes back into the bounce itself (kinetic energy). As the ball climbs higher, this kinetic energy converts back to gravitational potential energy. Most energy 'lost' in the collision is stored in the ball as heat. This will be most evident with the squash ball, which feels warmer after a few bounces.*

5 *Other variables that could affect the coefficient of restitution are temperature, whether the ball is dropped or thrown, the angle of the drop, and the surface on which it is dropped.*

Chapter answers

Remembering

1 **a** s

b v

c a

d F

e m

2 seeing the problem, sending a message to the brain, processing information

3 A force needs to be applied and the object needs to move a certain distance.

Understanding

4 Inertia is an object's tendency to resist a force due to its mass. For example, a light bowling ball might be deflected when it hits the pins, whereas a very heavy bowling ball will hardly be deflected at all.

5 Newton's First Law: An object will remain at rest or continue in a straight line unless a force acts upon it.

Newton's Second Law: Force = mass × acceleration

Newton's Third Law: For every action there is an equal and opposite reaction.

6 Station wagons have more inertia, so take longer to stop in the event of an accident.

7 The spongy mat reduces the rate of deceleration of the falling jumper and, therefore, reduces the force experienced on impact.

8 Because the dashboard compresses, it increases the time of the impact and reduces the deceleration. As a result, there is less force on impact.

9 quadruple it

10 heat energy, sound energy, elastic potential energy of the crumpled metal

11 The lack of bounce suggests that a lot of the ball's kinetic energy is being lost as heat rather than being converted to elastic potential energy.

Applying

12 **a** energy: J
b displacement: m
c time: s
d velocity: m/s
e acceleration: m/s^2
f force: N
g work done: J

13 **a** Third Law
b First Law
c Third Law
d Second Law
e First Law
f Third Law

14

Distance travelled	Time taken	Speed
20 m	5 s	4 m/s
480 km	6 h	80 km/h
1000 km	10 h	100 km/h
2.5 cm	0.5 s	5 cm/s
7.0 m	0.2 s	35 m/s

15 **a** C
b B
c A
d D

16 distance = 6 m, displacement = 0 m

17 distance = 7 m, displacement = 1 m down

18 24.8 m/s, 89.3 km/h

19

Starting speed	Accelerated for this time	Rate of acceleration	Final speed
0	5 s	15 m/s^2	75 m/s
0	12 s	4 m/s^2	48 m/s
18 m/s	6 s	2 m/s^2	30 m/s
40 km/h	5 s	5 km/h/s^2	65 km/h
20 m/s	Half a minute	3 m/s^2	110 m/s

Analysing

20 **a** Average speed is the total distance travelled divided by the total time, whereas instantaneous speed is the speed at any single point in time along the journey.

b Mass is the amount of matter an object contains, whereas weight is the force experienced by an object due to its mass and the acceleration due to gravity.

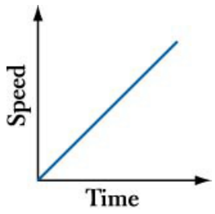
c Work is the amount of energy used to move an object, whereas a force is something that has the capacity to do work.

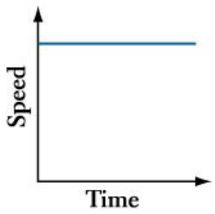
Evaluating

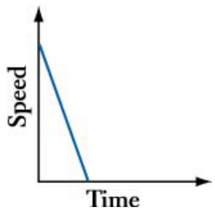
21 This statement is true in a vacuum where there is no air resistance. However, in normal everyday life, it is not completely true, as air resistance will cause some objects to fall slower than others.

Creating

22







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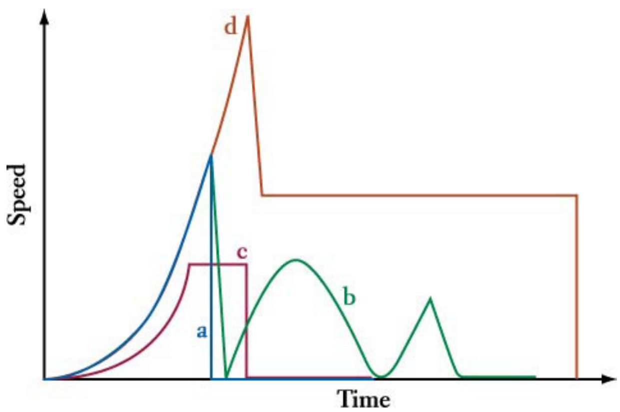


7.1 Answers

Remembering

1 energy source (battery), conducting path (wires), load (e.g. resistor, globe), switch

2 voltage: volts; current: amperes; resistance: ohms

3 light globe, bell, resistor

4 The resistance of a circuit is given by the voltage dropped divided by the current passed; $R = V/I$.

Understanding

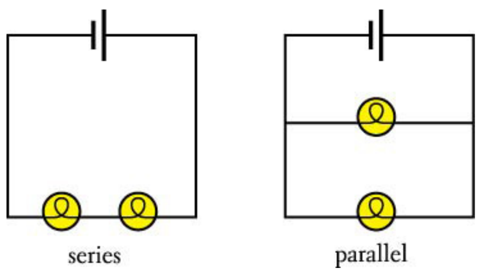
5 A circuit is a continuous conducting loop that uses a voltage source to pass an electrical current.

6 **a** Voltage: The electrical potential energy carried or used by a charge; e.g. electron.

b Current: The number of electrons passing a single point per second.

c Resistance: The amount by which a load restricts the passage of current.

7



8 The appliance requires an AC voltage of 240 V oscillating at 50 times a second to work properly.

9 In the series circuit, both globes would go out, whereas in the parallel circuit only one globe would go out.

Applying

10 **a** 600

b 15 000

c 270 000

d 2 500 000

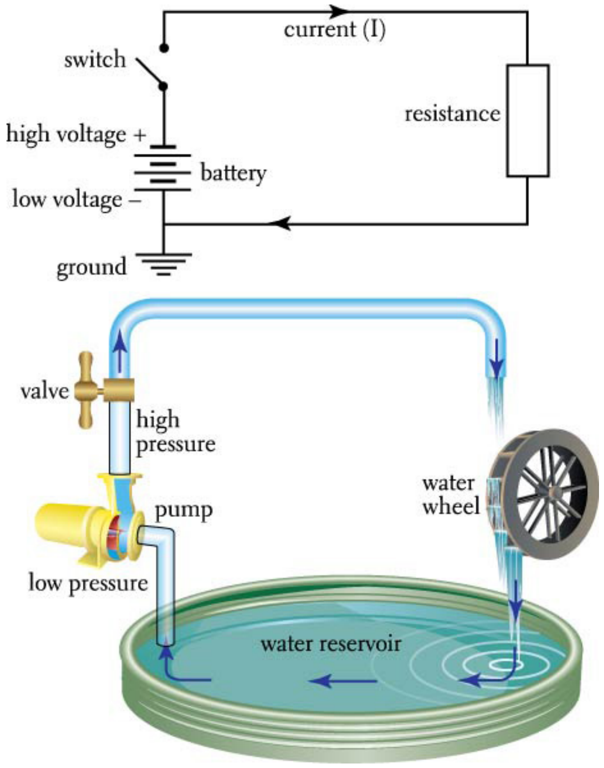
11 **a** green, blue, brown

b orange, orange, red

c yellow, violet, yellow

d brown, red, green

12



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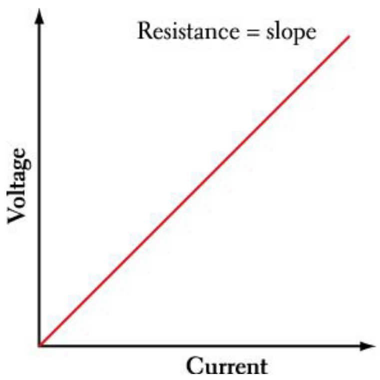


14 **a** AC

b DC

c DC

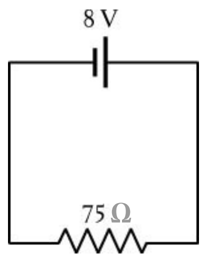
d AC

15

Current (amps)	Voltage (volts)	Resistance (ohms)
8	15	1.875
5	30	6
13.3	240	18
10	240	24
0.5	7	14
8	12	1.5

16 0.24 A

17 **a**



b 0.107 A

Analysing

18

Electrical circuit	Water pump circuit
Battery	Pump
Wire	Pipe
Voltage or energy	Pressure
Switch	Valve or tap
Current	Water flowing through pipe
Load	Waterwheel

19 All globes will glow with the same brightness.

20 In direct current, the electrons flow in one direction all the time. For alternating current, the electrons are shuttled back and forth many times per second.

Evaluating

21 so that if one light blows, the others will continue to work

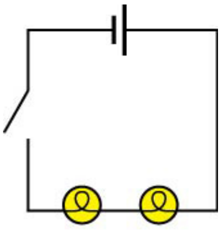
22 **a** 4900 ohms

b 2 500 000 ohms

Creating

23

a



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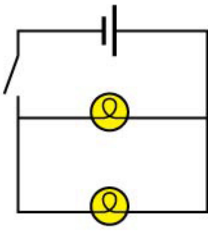

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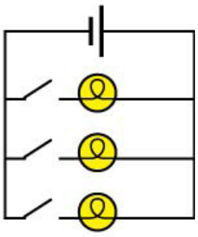

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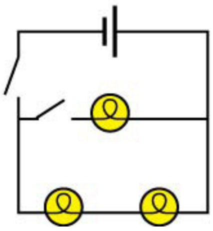


7.1 Practical activities

Prac 1: Simple series and parallel circuits

Common mistakes

Ensure the voltage selected is suitable for the globe tolerance.

Possible results

Students compare the brightness of globes in series and parallel circuits. The two globes in series will be duller than the single globe, as they need to share the voltage. The globes in parallel will be as bright as a single globe, as all globes in parallel have the same voltage.

Suggested answers

1 *Student diagrammatic answer.*

2 *Student diagrammatic answer.*

3 *The two globes in series will be duller than the single globe, as they need to share the voltage.*

4 *The globes in parallel will be as bright as a single globe, as all globes in parallel have the same voltage.*

5 *If one globe is removed when:*

- *a* *in series, the other globes will go out*
- *b* *in parallel, the other globes will remain glowing.*

Prac 2: Measuring voltage and current in circuits

Common mistakes

Ensure the voltage selected is suitable for the globe, ammeter and voltmeter tolerance.

Possible results

Students compare currents in series and in parallel. In a series circuit, the current is the same at all points and the voltage will be shared around. In a parallel circuit, the current will be split with most of the current going down the path of least resistance and the voltage will be the same in each branch of the circuit.

Suggested answers

1 *The current will be:*

- *a* *the same at all points around a series circuit*
- *b* *split in parallel circuits, with the most current going down the branch with the least resistance.*

2 *The voltages will be shared around the series circuit.*

3 *The voltages will be the same in each branch of a parallel circuit.*

Prac 3: Ohm's law

Common mistakes

Ensure the voltage selected is suitable for the resistor, ammeter and voltmeter tolerance.

Possible results

Students use Ohm's law to confirm the nominal resistance of the resistors.

Suggested answers

1 *Equipment and measurement errors could result in differences between the calculated resistance and the resistance from the slope of the graph.*

2 *The shape of the graph should be a straight line passing through the origin.*

- *a* *Current would double.*
- *b* *Current would halve.*

7.2 Answers

Remembering

1 1820

2 In an electromagnet, the magnetic field can be turned off and on.

3
- Sound speaker: The electromagnet moves the speaker back and forth to produce audible sound waves.
- Alarm bell: The electromagnet attracts and releases the striker, causing it to hit the bell repeatedly.
- Magnetic crane: The magnet attracts metallic objects, allowing them to be transported and dropped once the magnet is turned off.

4 dynamos, microphones

5 Transformers either increase (step up) or decrease (step down) the voltage of an alternating current.

6
i Power is generated with turbines at a power station.
ii Power is stepped up with a transformer.
iii Power is transported via high-voltage transmission lines.
iv Power is stepped down by a series of transformers.
v Power is transmitted and used by the home.

7
a step-down
b step-up
c step-down
d step-down

Understanding

8 A solenoid is a coil of wire that can be used to create an electromagnet when current is passed around it.

9
a A current flows around the coil of wire.
b The current flows in the opposite direction.
c An AC current is produced.

10 In a speaker, an electromagnet that is attached to a cardboard or fabric cone is wrapped around a permanent magnet. As the current in the electromagnet switches direction, the electromagnet is attracted or repelled by the permanent magnet. This makes the cardboard or fabric cone vibrate rapidly, causing audible sound waves to be emitted.

11 The coins pass through an electromagnet, causing swirling currents in the coins that interact with the magnetic field. Only the coins that interact exactly the right amount with the field will enter the machine, the others are rejected.

12 It is more efficient to transmit power at high voltages; i.e. less power is lost during transmission.

Applying

13
a yes
b no
c yes
d yes
e yes
f yes

Analysing

14 The voltages in transmission lines are much larger than in the home. The much larger voltages make transmission more efficient but are extremely dangerous.

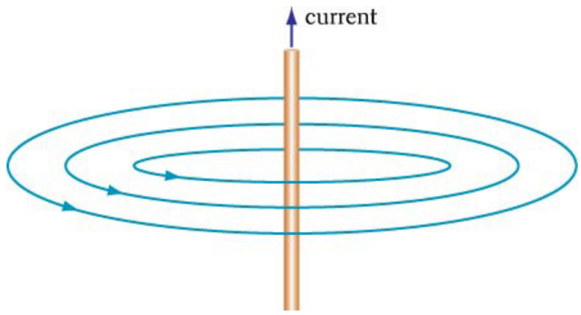
15 **a** primary: 4, secondary: 10

b step-up

16 Not only are the high voltages very dangerous to humans, but the large currents produce large magnetic fields that may have negative effects on humans and wildlife.

Creating

17



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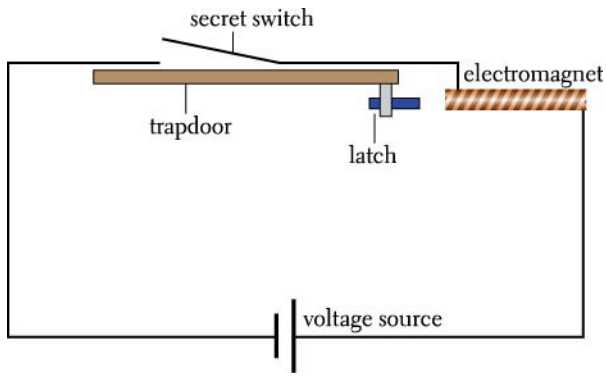


7.2 Practical activities

Prac 1: Oersted's experiment and the electromagnet

Common mistakes

Ensure the voltage selected is suitable for the circuit tolerance.

Possible results

Students investigate the magnetic field around a current-carrying wire. The strength of the magnetic field lessens as you move further away from the wire. A larger current produces a larger magnetic field.

Suggested answers

1 *The strength of the magnetic field lessens as you move further away from the wire.*

2 *A larger current produces a larger magnetic field.*

3 *Several coils (as shown in the solenoid) reinforce each other and make the field along the core stronger.*

4 *An electromagnet is stronger with an iron core.*

5 *The magnetic field at either end of the iron nail differs in its polarity. One end is north, one end is south.*

Prac 2: Force on a wire

Common mistakes

Ensure that the power pack is set on the lowest voltage.

Possible results

A magnetic field applies a force on a current-carrying wire.

Suggested answers

1 *Diagrammatic answer is required.*

2 *In the diagram supplied, current is travelling down the foil (+ to –) and the magnetic field is going left to right. In this case, the right-hand rule suggests that the aluminium foil should flex out of the page.*

3 *The conclusion should state the interdependence of current, magnetic fields and force.*

Prac 3: A simple electric motor

Common mistakes

It is important to sand only the underside of the wire to create temporary contact with the magnet.

Possible results

Students construct a simple motor.

Suggested answers

1 *Several loops will create a greater force on the coil than a single loop, making it more likely that the coil will spin.*

2 *If all the wires were not insulated, then current would escape from wire to wire. The current would not be forced around the loop and the desired force and spin would not be generated.*

3 *The wire has an insulating coating on it. Scraping allows better electrical contact with the paperclip brushes.*

4 *Various answers are possible, such as increasing the voltage (and, therefore, current), using a stronger magnet and having more loops in the coil.*

5 *Students' own answers.*

Prac 4: A simple generator

Common mistakes

If using a micro-ammeter it is important to connect the positive and negative wires to the correct terminals because unlike a galvanometer, the needle is unable to deflect backwards and a reading cannot be obtained.

Possible results

Students investigate the correlation between magnetism and current electricity. The faster the movement of the magnet, the higher the current that is produced. If the pole of the magnet is changed from north to south, the current produced is in the opposite direction. A stronger magnet will produce a greater current.

Suggested answers

1 *The current produced in this experiment is so small that it would not be able to light a globe. It is enough, however, to move the needle of a galvanometer.*

2 *A magnet must be moving in a solenoid for it to produce a current. If it is still, no current is produced.*

3 *The faster the movement of the magnet, the higher the current that is produced.*

4 *The current produced changes direction when the direction of the magnet is reversed; that is, an AC current is produced.*

5 *If the pole of the magnet is changed from north to south, then the current produced is in the opposite direction.*

6 *A stronger magnet will produce a greater current, but only if all other variables (such as speed) are kept constant.*

7.3 Answers

Remembering

1 transverse: water wave;
longitudinal: sound wave

2 **a** true
b true
c false
d false

4 **a** 300 000 000 metres per second
b Any six of: gamma rays, X-rays, ultraviolet rays, visible light, infra-red rays, microwaves, radio waves.

5 gamma rays, X-rays, ultraviolet rays, visible light, infra-red rays, microwaves, radio waves

6 gamma rays

7 6 metres

Understanding

8 Radio wave modulation allows information to be encoded in the radio wave for transmission of sound and data.

9 White light is made up of light rays with many different wavelengths.

10 An infra-red camera is sensitive to heat. Because the body temperature of a bushwalker will be much higher than his/her surroundings he/she will stand out, even in the dark.

11 Use the Geiger counter to measure the gamma radiation from a radiation source, then remeasure with the object in-between the Geiger counter and the radiation source. The object will absorb the gamma radiation, depending on its thickness and the material from which it is made, allowing the thickness to be calculated.

Applying

12 **a** red

b violet

13 short radio waves

14 2 Hz (2 waves per second)

15 **a** 0.5 seconds

b iii

16 **a** 2 metres per second

b 330 metres per second

c 300 000 000 metres per second

17 **a** radio wave

b long-wave radio

c infra-red ray

d ultraviolet ray

18 **a** 0.000 000 6 metres

b 850 nanometres

19 **a** 107 500 Hz

b 1 278 000 Hz

Analysing

20 **a** Radio waves are longer and can penetrate further through objects than microwaves. However, both are invisible and have much longer wavelengths than visible light waves.

b Blue and red light waves are both visible to humans, but blue light waves have a higher frequency and a shorter wavelength.

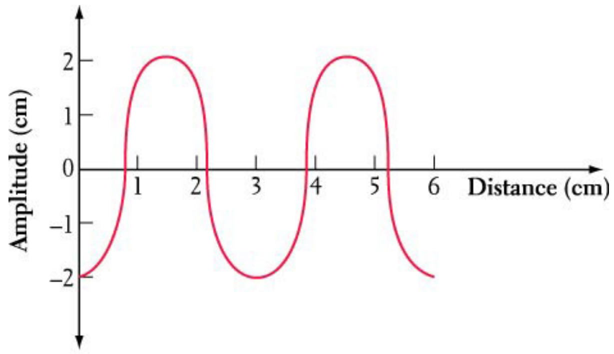
c Amplitude modulation (AM) and frequency modulation (FM) are both methods for encoding data in radio waves. However, for AM, the data are represented by changes in the amplitude of the radio wave, whereas for FM, the data are encoded by changes in the frequency.

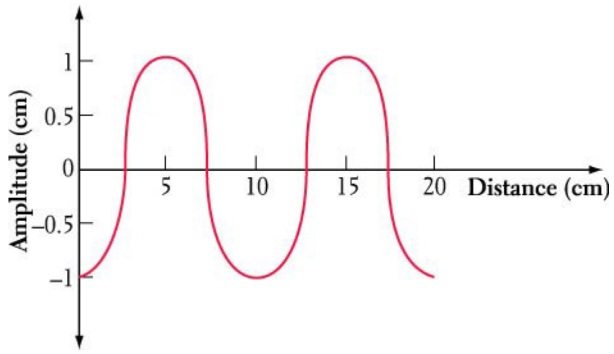
Evaluating

21 UV radiation is most often associated with negative side-effects, such as skin cancer. However, it is also necessary for the production of vitamin D, in photosynthesis and for purifying water.

Creating

22 a





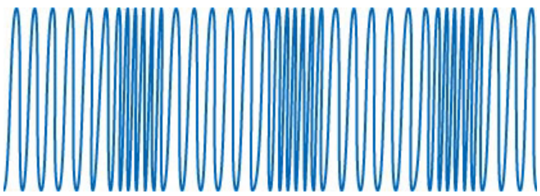
b

23

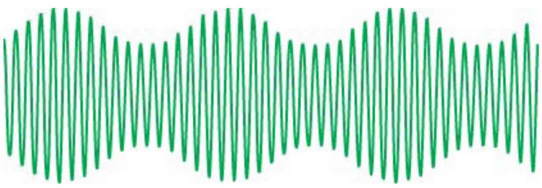
Type of electromagnetic radiation	Typical wavelength (approx.)	Source	How it is detected	Use/s
Visible light	One-millionth of a millimetre	The Sun, very hot objects	Cones in the eye, photographic film	Sight, photography
Gamma rays	1 picometre	Radioactive nuclei	Geiger counter	Radiotherapy
X-rays	0.1 nm	Decelerating electrons	Photographic plates	Imaging bones
Ultraviolet light	10 nm	Sun, UV light	Makes fluorescent materials glow	Vitamin D production, water purification

Type of electromagnetic radiation	Typical wavelength (approx.)	Source	How it is detected	Use/s
Infra-red	One-tenth of a millimetre	Warm or hot objects	Infra-red camera	Heating things
Microwaves	1/100th of a metre	Resonantly vibrating electrons	Microwave receiver/antenna	Satellite communications, heating food
Radio waves	1 m to 100 km	Oscillating electrons	Radio receiver/antenna	Communications, transmitting data

24 a



b



7.3 Practical activities

Prac 1: Waves in a slinky

Common mistakes

If the slinky is overstretched it will not return to its original form.

Possible results

Students investigate the movement of waves in a slinky. By generating transverse waves, the masking tape labels moved back and forth perpendicular to the motion of the wave itself.

Suggested answers

1 *The masking tape labels should move back and forth perpendicular to the motion of the wave itself.*

2 ***a*** *The speed should not depend on the size of the waves.*

b *The speed should not depend on the frequency of the waves. The spring itself and how tightly it is stretched determine the speed of the wave.*

3 **a** *They reinforce, building to produce a larger pulse.*

b *They cancel each other.*

Prac 2: Other waves on the slinky

Common mistakes

If the slinky is overstretched it will not return to its original form.

Possible results

Students investigate the movement of waves in a slinky. By generating longitudinal waves, the masking tape labels moved back and forth in the same direction as the travelling wave.

Suggested answers

1 *The masking tape labels should move back and forth in the same direction as the travelling wave.*

2 *Diagrammatic answer is required.*

Prac 3: Polarised!

Common mistakes

A room with large windows will assist this exercise.

Possible results

Students investigate the interaction of two polarising filters.

Suggested answers

1 *Step 1: When the second Polaroid filter is turned 90°, the light is blocked completely.*

Step 2: One Polaroid filter is sufficient to block some of the light reflected from the LCD. As the filter is turned, the amount of light reflected off its surface will change, giving a clearer view of the information on the screen. Patterns may also form.

2 *Step 1: The light is polarised by one filter, only allowing through the electric field that is in alignment with the molecules that make up the filter. A second filter at 90° also blocks this electric field. No electric field and, hence, no light, can pass through.*

Step 2: The light reflected off the LCD screens is partly polarised light. As the filter turns, this reflected light is blocked. Only the unpolarised light from the image on the screen will get through, making it clearer. Another Polaroid filter will block all light.

7.4 Answers

Remembering

1 telegraph, Morse code

2 3.2 kilometres

3 mobile phones, Internet, optical fibre

4 Any two of easier to manipulate, better reproduction, less distortion.

Understanding

5 Morse code was developed for sending messages over Samuel Morse's electric telegraph.

6 Not all the telecommunications networks have the infrastructure necessary for digital signals to be sent.

7 **a** frequency division multiplexing (FDM), time division multiplexing (TDM)

b FDM sends messages at the same time but at different frequencies that are separated at the receiving end. TDM splits the messages up into packets and sends packets from many messages down the same wire to be reconstructed at the receiving end.

8 Laser light is coherent, meaning that all the light waves travel in the same direction, reducing loss due to dispersion.

9 because the regions they work in are called cells

10 allows for greater coverage and triangulation of signals

Applying

11 1500

12 I AM HAVING FUN

Analysing

13 Digital: Data are sent in the form of a binary code where the 0s and 1s are replaced with dots and dashes.

14 You would be more conscious about the way you look, sit and form facial expressions.

15

	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	64	**32**	**16**	**8**	**4**	**2**	**1**
5	0	0	0	0	1	0	1
14	0	0	0	1	1	1	0
20	0	0	1	0	1	0	0
45	0	1	0	1	1	0	1
72	1	0	0	1	0	0	0
83	1	0	1	0	0	1	1
100	1	1	0	0	1	0	0

Evaluating

16 'Signal' refers to any type of data that is sent via a communications network, whereas 'call' refers only to telephone conversations.

17 Only analogue signals could be sent and there would be greater loss of signal quality.

18 All have five dots or dashes. Digits 0 to 5 each have zero to five dots with the rest being dashes. Digits 6 to 9 have that number minus five dashes, with the rest being dots.

19 If one fails, the other can be used as a backup.

20 As communications networks are expanding, it is becoming just as easy to talk to people on the other side of the world as it is to talk to someone on the other side of the street.

Creating

21 Students' answers will vary.

22 Classroom activity.

23 Investigation task.

7.4 Practical activity

Prac 1: Locating another mobile phone

Common mistakes

Time measurements may vary depending on the reflexes of the time keeper.

Possible results

Students design their own experiment to investigate the time it takes for a mobile phone to find another mobile phone.

Suggested answers

Students' own answers.

Chapter answers

Remembering

1 **a** volts (V)
  b ohms (Ω)
  c amperes (A)

2 longitudinal, transverse

3 television, mobile phone, iPod, modem, Nintendo

4 Any four of the following.
- X-rays: viewing bones inside the human body.
- Visible light: for seeing things.
- Infra-red: for heating things.

- Microwaves: microwave ovens.
- Radio waves: communications.

5 **a** Samuel Morse: invented the telegraph.
b Alexander Bell: invented the telephone.
c Almon Strowger: invented the electromechanical telephone exchange.
d William Shockley: invented the transistor.

6 It decreases.

Understanding

7
- Analogue signals: do not require high-tech infrastructure.
- Digital electrical signals: easy to manipulate, better reproduction, less distortion.
- Digital optical signals: very fast.

8

Term	Definition
Load	Uses up electrical energy
Voltage	The energy available to push current through a circuit
Current	The flow of charge, usually electrons
Conducting path	Wires for the electricity to flow through
Resistance	The ability of a substance to reduce the flow of current
Switch	Turns the current on and off

9 **a** A magnetic field is produced in coils and straight wires when a current is passed.
b Electricity can cause magnetism and magnetism can cause electricity.
c Electromagnets can be turned on and off.
d A relay is an electromagnetic switch.
e A generator produces current when a magnet moves inside or near its coils.
f Less energy is lost in power transmission when the voltage is higher.

10 Power is transmitted more efficiently at high voltages so it is stepped down close to the home only.

11 Current through the wire produced an electric field that turned compasses.

12 Step-down so that the high voltage used to transport electricity efficiently is converted to safer low-voltage power.

13 The lines might become crossed.

14 Transistors are miniature electrical switches that allow the electrical circuits in radios to be made smaller and lighter.

Applying

15

Current	Voltage	Resistance
3 amps	15 V	5 Ω
10 amps	60 000 V	6 kΩ
7500 amps	240 kV	32 Ω

16 **a** The voltage is shared unequally between each resistor (unless the resistors are equal).
b The current is the same for each resistor.
c If any component is removed the circuit will not work.
d The voltage is the same for each resistor.
e The current divides into each branch of the circuit.
f If one branch of the circuit is broken the other branches will still work.

Analysing

17 In a series circuit, all components are positioned along one loop. In a parallel circuit, there is more than one path from the positive to the negative side of the voltage source.

18 For direct current (DC), all the electrons move in one direction all the time. For alternating current (AC), the electrons are shuttled back and forth many times a second.

19

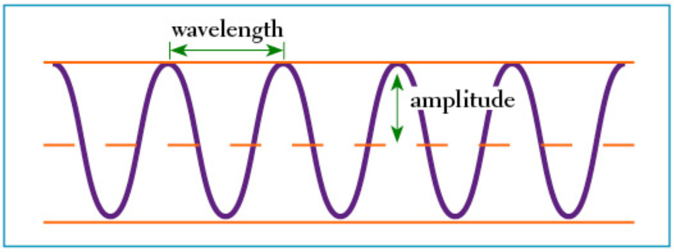
Electrical circuit	Water pump circuit
Switch	Valve or tap
Battery	Pump
Resistor	Waterwheel
Voltage or energy	Pressure
Current	Water flowing through pipe
Wire	Pipe

20 The visible spectrum is just a small part of the full electromagnetic spectrum.

21 Laser light is coherent; i.e. all the waves travel in the same direction in time with each other and have the same frequency and wavelength. Light from the Sun is made up of many different wavelengths and the waves travel in all directions.

22 **a** 5 wavelengths ÷ 10 seconds = 0.5 Hz

b, c



23 **i** MY HOVERCRAFT IS FULL OF EELS

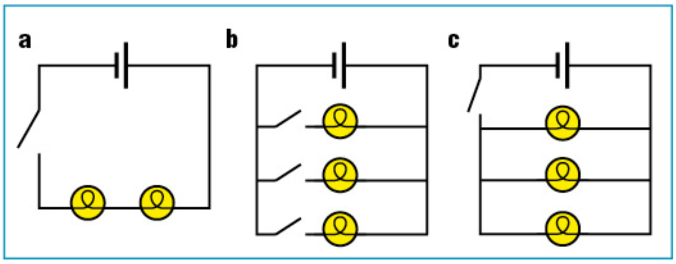
ii THE PRICE OF EGGS HAS GONE UP!

Evaluating

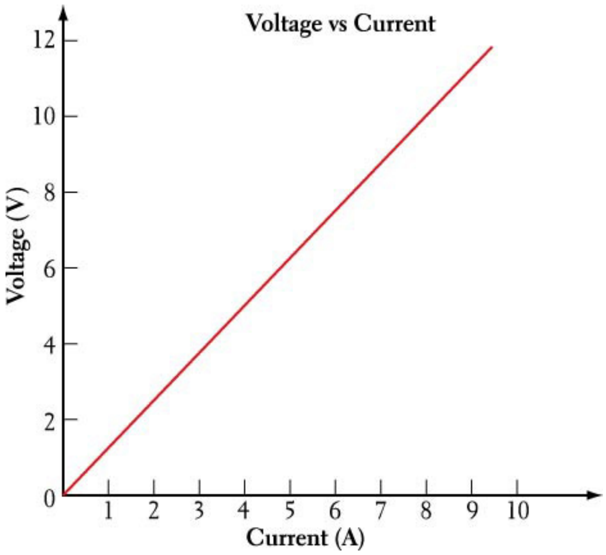
24 Each character could be assigned a number, which is sent using binary code, or the message could be sent with Morse code where 0 represents a dot and 1 represents a dash.

Creating

25



26 **a**



b resistance

c 1.25 ohms

8.1 Answers

Remembering

1 **a** a nuclear reactor
- **b** near Sydney
- **c** It produces radioactive isotopes for the diagnosis and treatment of diseases.
- **d** It produces radioactive waste and there is a danger of explosion.

2 social and economic factors, as well as values and ethics

3 **a** Advantage: Does not produce greenhouse gases.
Disadvantages: Students may list any two of slower, more expensive, no infrastructure and long recharge times required.
- **b** Advantage: Emits only water.
Disadvantages: Expensive, may make roads slippery.

Understanding

4 As nuclear power stations are becoming safer, the risk of widespread disaster is minimised. Also, fossil fuels produce greenhouse gases and also pose a risk of widespread disaster to the environment in the form of oil spills etc.

5 It is more resistant to insects and disease.

6 Industry and business have a huge impact on the environment that we all share; therefore, they must be considerate of their impact on the environment and on society.

7 **a** coal-fired power stations produce huge amounts of the greenhouse gas CO_2, people get sick and die from mining the coal
- **b** nuclear power stations produce radioactive waste, there is the potential for widespread disaster in the case of a meltdown, uranium deposits may be used for making nuclear weapons

Applying

8 **a** Costs: Government would need to build more infrastructure, the city may become more inefficient, cost of public transport may rise.
Benefits: There would be an overall reduction in the amount of greenhouse gases produced by motor vehicles, traffic problems would ease.
- **b** Costs: Loss of social interaction, feeling of isolation.
Benefits: Reduction in the number of cars on the road, reduction in greenhouse gas emissions.
- **c** No, it is difficult to weigh up the overall benefits to society against the costs to an individual.

9 **a** economics, environment, society
- **b** **i** society
  - **ii** environment
  - **iii** economics

10 **a** size (large), safety
b reliability
c size (small), economy
d appearance

Evaluating

11 Japan is a small island with limited natural resources. Australia is resource rich, so has been able to rely on fossil fuels relatively cheaply.

Creating

12 **a** For: Electricity production produces less waste, in particular, greenhouse gases.
Against: Potential for widespread disaster in the event of a meltdown.
b For: Reduced emissions from the burning of fossil fuels.
Against: Full environmental impact is still not known.
c For: A larger stock of transplant organs.
Against: May compromise religious ethics.
d For: Kills harmful bacteria in our food.
Against: Health implication of irradiated food is still not fully known.

8.2 Answers

Remembering

1 carbon dioxide
2 The levels of greenhouse gases in the atmosphere, particularly carbon dioxide, have increased due to burning of fossil fuels and deforestation. The 'blanket' of greenhouse gases in the Earth's atmosphere has effectively become thicker, leading to the enhanced greenhouse effect.
3 burning of fossil fuels, deforestation
4 c

Understanding

5 The gases form an insulating blanket to ensure that the Earth is not too hot or too cold.
6 Radiation from the Sun penetrates the atmosphere and is absorbed by the Earth. The Earth re-emits the Sun's energy as heat that is trapped by the greenhouse gases in the atmosphere.
7 The Earth's temperature would reduce dramatically, by tens of degrees below zero.
8 Clearing land emits carbon dioxide, but also reduces the Earth's ability to store carbon dioxide from the atmosphere.
9 Carbon dioxide remains for 100 years, methane remains for 11 years.
10 Much more carbon dioxide is produced each year and carbon dioxide remains longer in the atmosphere, so is more likely to build up.

11 When snow falls, it traps air between the ice crystals. As the snow is compacted into ice, the bubbles of air remain.

12 The levels have fluctuated but have remained relatively constant until the 1900s when the levels increased dramatically because of the Industrial Revolution.

13 The Earth's temperature has followed almost exactly the same pattern as the carbon dioxide levels.

14 The average temperature on Earth will increase, producing more droughts, heat waves, flooding and storms etc.

15 El Niño refers to a weakening of the westerly trade winds in the Pacific, causing warm humid air to move away from Australia, causing drought, and towards South America, causing storms.

16 drought, destruction of crops

17 The warmer atmosphere is more humid, so is more likely to precipitate water as rain.

18 If the permafrost thaws it may result in mudslides that could destroy nearby communities.

19 Venus

20

Greenhouse gas	Chemical formula	Sources
Carbon dioxide	CO_2	Burning fossil fuels
Methane	CH_4	Rotting vegetation, animals
Nitrous oxide	N_2O	Burning forests, car exhausts

21 **a** Levels of both gases remained relatively constant with minor fluctuations.

b ~1800s

c carbon dioxide: 100 ppm, methane: 1100 ppm

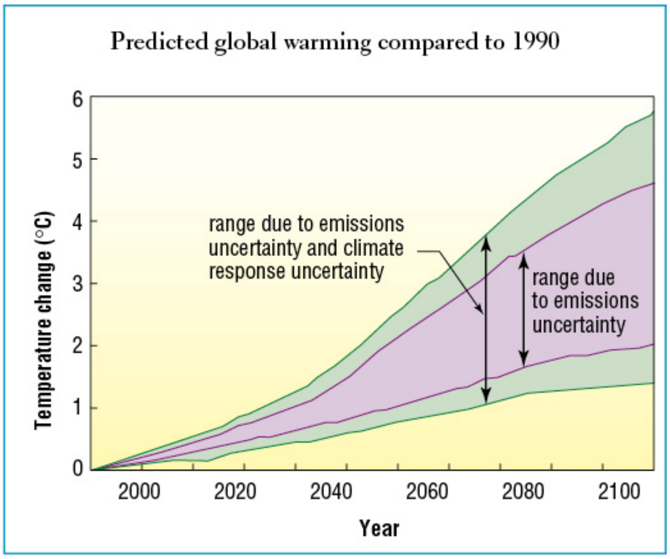
d carbon dioxide: 35.7%, methane: 157%

Applying

22 **a** 7 560 000 000 litres (7.56 billion litres)

b 2 759 400 000 000 litres (2.76 trillion litres)

23



a Two factors affecting temperature rise are:
- the range due to emissions uncertainty
- the range due to emissions uncertainty and climate response uncertainty.

b **i** increases between 0.5°C and 1.5°C

ii increases between 1°C and 4°C

24 **a** 146.5 million

b 0.93 million

c 650 million

d The world's carbon dioxide emissions from cars would double, vastly increasing global warming.

Analysing

25 Yes, to some extent. Fewer people on the planet will produce less demand for all forms of resources and this will result in a reduced production of greenhouse gases.

Evaluating

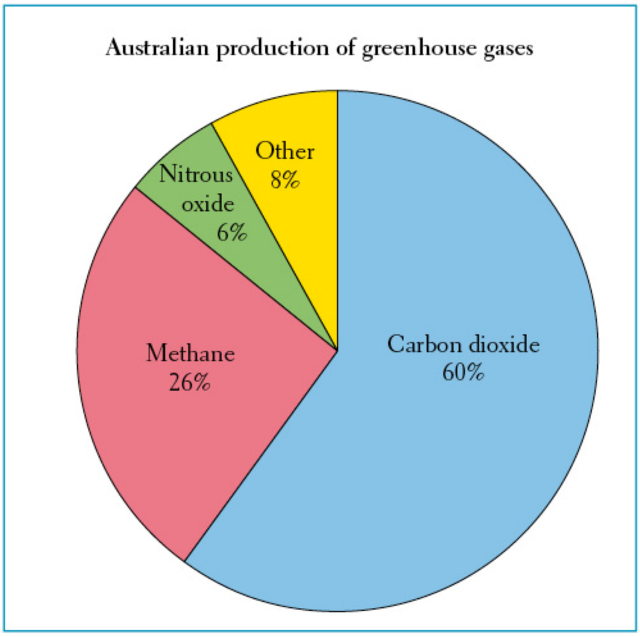
26 Such cars would greatly reduce the profits of large oil companies and, at present, they are more expensive to manufacture.

27 No immediate impact, as methane remains in the atmosphere for 11 years and carbon dioxide remains in the atmosphere for 100 years.

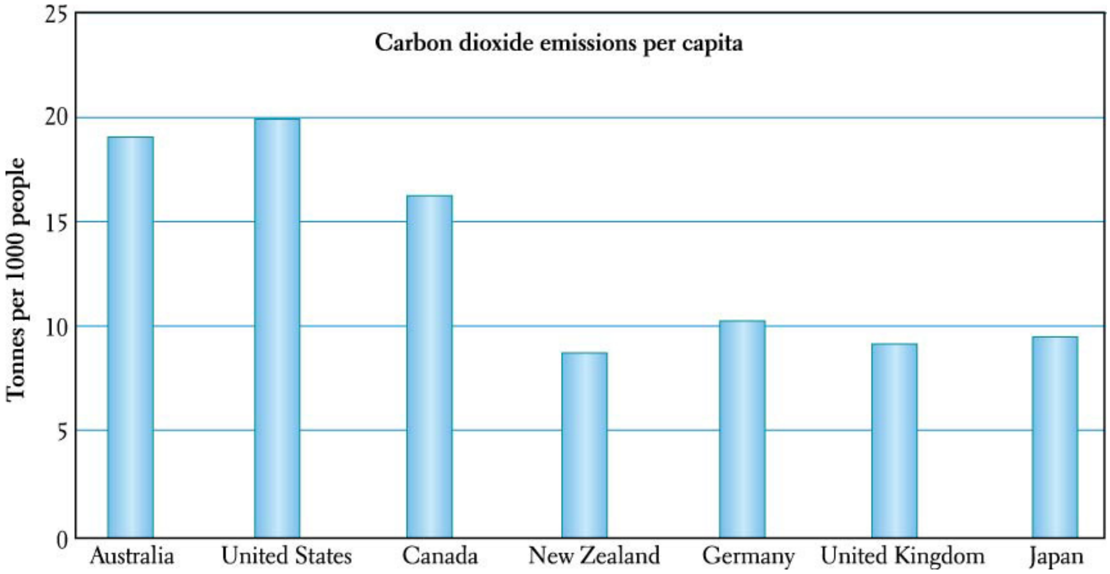
28 Wheat uses carbon dioxide to grow and create sugars and starches.

Creating

29



30 a



b New Zealand produces the least; the USA produces the most.

8.2 Practical activities

Prac 1: The greenhouse effect

Common mistakes

Ensure the hole in the cardboard is sealed around the thermometer or temperature probe to prevent heat loss.

Possible results

Students construct a model to simulate the conditions required for the greenhouse effect.

Suggested answers

1 *Graph required. Students' answers will vary.*

2 *Answers will vary, but the glass-covered side should have consistently higher temperatures.*

3 *greenhouse gases in the atmosphere*

4 *enhanced greenhouse effect*

Prac 2: Icebergs

Common mistakes

The level and temperature of the water must be kept the same across both trials to ensure a fair test.

Possible results

Students investigate the effect of melting ice on water levels. There will be a greater rise in the water level in the beaker that represents land than in the beaker that represents the sea.

Suggested answers

1 *Only slightly, because only approximately 10 per cent of an iceberg is above sea level, and because ice is slightly less dense than water.*

2 *Yes, land ice would directly increase sea depths.*

8.3 Answers

Remembering

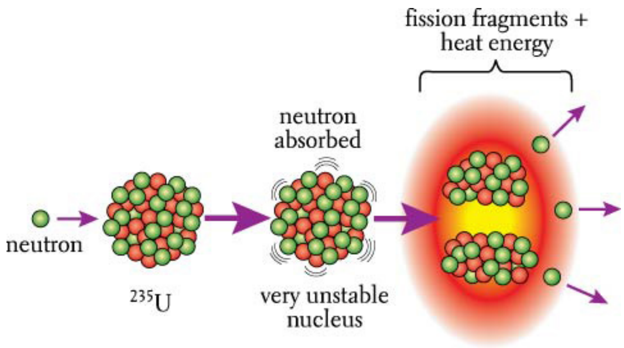
1 Nuclear fission is the splitting of large nuclei into smaller nuclei with a release of energy.

2 No radioactive waste is produced.

3 solar, wind, hydro-gravitational

Understanding

4



5 With each nuclear fission, a small amount of mass is converted to large quantities of energy.

6 Two subcritical masses of enriched uranium are pushed together to form a critical mass. A chain reaction of nuclear fission results, producing huge quantities of explosive energy.

7 A nuclear reactor uses control rods to absorb excess neutrons.

8 Students may list any two of the following.

- A meltdown of the power station would cause widespread and long-lasting damage.
- The waste products are highly dangerous and need to be stored safely for a long period of time.
- People working with radioactive isotopes may be exposed to high levels of radiation.

9 Initially, the waste is stored underwater to cool and reduce its radioactivity. It is then reprocessed or made into glass blocks and stored underground.

10 It may leach into the environment or be used for malicious purposes, such as the production of nuclear weapons.

11 Nuclear fusion requires very high temperature plasma that is so hot it cannot be contained by any material, so must be suspended in mid-air with a magnetic field.

12 **a** Uranium provides much more energy per kilogram than coal.

b Unstable atoms emit radiation.

c Natural uranium contains approximately 0.7% uranium-235.

d A critical mass of uranium-235 is one that will start a chain reaction.

e Fission is the splitting of an atom.

f One type of fusion reactor is a tokamak.

13 The nuclear reactor is used for scientific purposes and the production of radioactive isotopes for the treatment of diseases, such as cancer.

14 A magnetic bottle is a magnetic field that can be used to contain a fusion reaction.

15 None of **a**, **b** or **c**. The half-life of plutonium is 25 000 years.

16 If the fallout contaminates rural areas, cows may ingest the radioactive pollution and pass it into their milk.

17 so that air will always flow from the outside in, making sure that radioactive particles are contained within the reactor

18 At some point, Australia will need to invest in alternative energy sources as fossil fuel resources diminish. Nuclear power provides one alternative, but we should also look at other, cleaner and safer alternatives, such as solar power and wind power. Whether these are viable alternatives will depend on whether these alternatives can satisfy our demand for energy.

Applying

19 France and Sweden

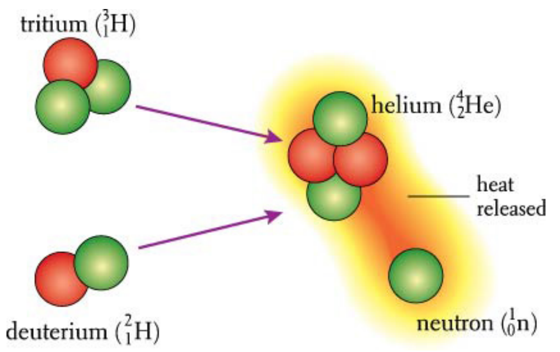
20 electrical power generation, nuclear medicines, powering submarines

21 **a** the moderator

b control rods

c high-pressure water/steam

22



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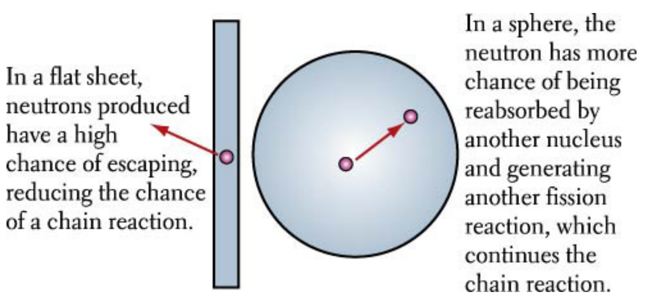


Analysing

24 In a nuclear bomb, the chain reaction is uncontrolled. However in a nuclear reactor, the number of excess neutrons is limited, keeping the reaction steady.

25 **a** high

b low

c intermediate

Evaluating

26 **a** early warning system, more frequent maintenance checks

b Sweden also experienced changes in its environment, such as increased radiation levels in the atmosphere and in water, as well as changes to fauna and flora.

c The radiation that spread from the disaster would have caused many deaths due to radiation-related illnesses, such as cancer.

Creating

27 Creative writing task.

28 Essay writing task.

8.4 Answers

Remembering

1 DDT-resistant mosquitoes, thinning of egg shells, changes in the ratios of males to females of some species

2 leaded paints

3 lesions and ulcers on his face, chest and stomach

4 pesticide, reduced the spread of mosquito-borne diseases

5 increased yield, stronger, hardier, more resistant to disease

6 sugar cane, corn, wheat

7 meat, tortilla, navy beans

Understanding

8 Larger sharks are likely to have accumulated more toxins from the food that they have consumed than smaller sharks.

9 They accumulate in the body and affect the brain and central nervous system.

10

Toxin	Effects on humans and other species
DDT	Thins egg shells, changes the ratio of males to females
Mercury	Accumulates in the brain and causes madness
Lead	Accumulates in fat and affects the central nervous system causing headache, loss of logic, diarrhoea, vomiting, learning disabilities, stunted growth and mental retardation
Dioxins	Cause cancer, affect immune system, reproductive system, cause lesions and ulcers

11 warm temperatures and high levels of nutrients, such as fertilisers

12 **a** The crops will have a higher yield and require fewer chemicals to keep pests away.

b In the past, new species of plants and animals that have been introduced have dominated natural flora and fauna, ultimately becoming a pest themselves.

13 No, bioaccumulation occurs in species at the top of the food chain, whereas plants are right at the bottom of the food chain.

Applying

14 Poor people who rely on these grains for staples, such as bread and tortillas.

Evaluating

15 People are concerned about the dangers of GM food and, therefore, wish to make an educated decision about whether or not they consume GM food.

16 It may be because dioxin is easy to conceal in food or because dioxin poisoning is difficult to treat. The alleged assassins may have wished to cause Yushchenko a painful death or severe disfigurement.

17 Students' answers will vary.

18 Countries may choose to import our GM-free crops rather than GM crops from other countries.

Creating

19 Various answers are possible.

8.4 Practical activity

Prac 1: Bioaccumulation

Common mistakes

This experiment would lend itself well to a large group exercise rather than to a small group exercise.

Possible results

Students role play bioaccumulation.

Suggested answers

1 *The counters could represent toxins, such as mercury, lead, DDT and dioxins.*

2 *The food chain is represented by people playing 'tag'. When someone is tagged, they (and their toxins) get 'eaten'.*

3 *If caught, they were eaten.*

4 *The role play models bioaccumulation, because the person who 'ate' someone else also 'ate' their toxins. As more people are caught and eaten, the toxins build up.*

8.5 Answers

Remembering

1 **a** all cell types
b skin, muscle and bone cells

2 at the blastocyst stage

3 **a** Embryonic stem cells:
- Advantages: They can be used to form any type of cell and are more easily manipulated than adult stem cells.
- Disadvantages: Ethical issues regarding the use of human embryos.

b Adult stem cells:
- Advantages: They do not need to be harvested from a foetus and contain DNA identical to that of the recipient, which avoids rejection problems.
- Ethical issues are avoided because embryos are not used.
- Disadvantages: cannot transform into any cell type as can embryonic stem cells and, therefore, are not as useful as embryonic stem cells.

4 **a** sheep
b 1996
c 6 years
d lung cancer
e six lambs

Understanding

5 **a** Adult stem cells cannot be transformed into nerve cells.
b brain injuries, Parkinson's disease, degenerative nervous conditions, such as multiple sclerosis

6 They have exactly the same DNA, so there is less likelihood of rejection.

7 The drugs stop the body's immune system from attacking the transplanted organ.

8 The original DNA is replaced with the DNA of the recipient.

9 Environmental factors may change the clone's appearance or psychology.

Evaluating

10 **a** Yes, they are two identical organisms that came from the same egg.
b–f Answers depend on students' personal preferences.

Creating

11 Essay style answer required.

Chapter answers

Remembering

1 carbon dioxide, methane, nitrous oxide

2 neutrons

3 **a** 'mad as a hatter'

b Pb

c pesticide

d Victor Yushchenko

4 **a** canola

b cotton

5 For: higher yield; requires fewer pesticides.

Against: plants may compete with natural flora and fauna; religious grounds.

6 Parkinson's disease, multiple sclerosis

7 quality of food, price, convenience

Understanding

8 not enough concentration of uranium-235

9 The radioactive waste outlasts the steel drums and will ultimately leach into the environment.

10 Sharks, being at the top of the marine food chain, have the greatest accumulation of mercury.

11 Blue-green algae are an algal bloom that is toxic to animals. Outbreaks are caused by fertilisers.

12 They believe that an embryo is a life with a soul and that harvesting stem cells is murder.

13 Embryonic stem cells are able to transform into all types of cells, whereas adult stem cells cannot.

Applying

14 17.3 tonnes

Analysing

15 Nuclear fission is the splitting of very large nuclei into smaller fragments, whereas fusion is the combination of very small nuclei into larger nuclei.

Evaluating

16 They require huge amounts of energy and expensive technology to contain the plasma.

17 Biofuels offer a renewable alternative to fossil fuels. However, as more of these crops are used for fuel, fewer crops are available for food.

18 A fully grown human has not been cloned, at least not officially, but the technology does exist, so this may have been done in secret. However, human foetuses have been cloned for stem cell research.

19 Essay style answer required.

9.1 Answers

Remembering

1 Students' responses will vary.

2 Students' responses will vary.

Applying

3

Characteristic	Description
Resourcefulness	Makes the most of the available resources and takes advantage of opportunities
Self-motivation	Knows the reason for wanting to do something and makes sure work is interesting and challenging
Creativity	Invents new ways of doing things and solves problems in unusual ways
Organisation	Makes lists and collects resources before starting work and then proceeds in a series of steps
Dedication	Meets goals and sees a project through to completion

4 Students' responses will vary.

Analysing

5 Creativity involves inventing new ways of doing things, whereas resourcefulness requires changing and modifying a plan as new ideas emerge.

Evaluating

6 A mentor provides support, advice and guidance when working alone.

7 keeping on task and maintaining enthusiasm

8 Students' responses will vary.

9 Students' responses will vary.

9.2 Answers

Remembering

1 first-hand investigation, demonstration of a scientific principle, construction of a model

2 aim, hypothesis, variables, equipment, method, results, discussion, conclusion, resource list

3 tables, diagrams, drawings or photographs

Understanding

4 Make sure you are interested in learning about your chosen topic, that it isn't too hard to complete and that it can be finished in the agreed time.

5 the variables that are kept the same throughout the experiment

6 a summary of the results of an experiment

7 to maintain a fair test that will give accurate and clear results

8 It is important to use different techniques when communicating information because it is vital to be able to communicate your results and knowledge with a variety of people.

9 a model or a poster

10 Experiments should be replicated a number of times so that a more accurate conclusion can be drawn, as this makes the results more reliable.

Applying

11 Students' responses will vary.

Analysing

12 **a** To demonstrate a scientific principle, you need to conduct a first-hand investigation to build a model to prove the principle is correct. To investigate an aspect of science, you build a model to research an aspect of science to which you don't know the answer.

b Dependent variable is the variable that is being measured and is affected by the independent variable. The independent variable is the one variable that is changed and tested.

c Qualitative observations are obtained by using one's senses of observation and are written down as a description, whereas quantitative observations are obtained by taking measurements and involve data that are numerical.

d A newspaper article provides the public with ground-breaking news that is written in everyday language, whereas a journal article is aimed at scientists and is written in technical language. A journal article is highly specific and may not be imparting ground-breaking news.

13 An aim outlines a scientific question or idea to be tested, whereas a hypothesis is an educated guess about what might happen.

14 **a** qualitative

b quantitative

c qualitative

d quantitative

e quantitative

- **f** quantitative
- **g** qualitative
- **h** quantitative
- **i** quantitative
- **j** quantitative

15 A discussion analyses and evaluates the results by explaining patterns or trends, outlining errors, difficulties and modifications.

16
- **a** closed
- **b** closed
- **c** open
- **d** open
- **e** closed
- **f** open

Creating

18 Students' responses will vary. The following are some examples.

- **a** To test the amount of light that passes through different types of glass.
- **b** The transparent glass will allow the most light to pass through.
- **c** Independent variable: type of glass.

  Dependent variable: amount of light that passes through.
- **d** Controlled variables: distance of light source from glass, thickness of glass, intensity of light.
- **e** No specific observations are required because datalogger equipment will be used. You could qualitatively observe the relative brightness of light coming through each piece of glass to ensure that it is in line with the datalogger results.
- **f** lux (light intensity)
- **g**
  1. Turn on the torch and measure the light intensity using a light sensor and a datalogger.
  2. Use a ruler to mark the position of the torch and the distance at which each glass piece will be placed.
  3. Turn on the torch and shine the light through the transparent glass.
  4. Place the datalogger with the light sensor on the other side of the glass and measure the intensity of light that has passed through.
  5. Repeat steps 3 and 4 for opaque, translucent and coloured glass.

h

Light intensity (lux)				
Glass	**Trial 1**	**Trial 2**	**Trial 3**	**Average**
Transparent				
Translucent				
Opaque				
Coloured				

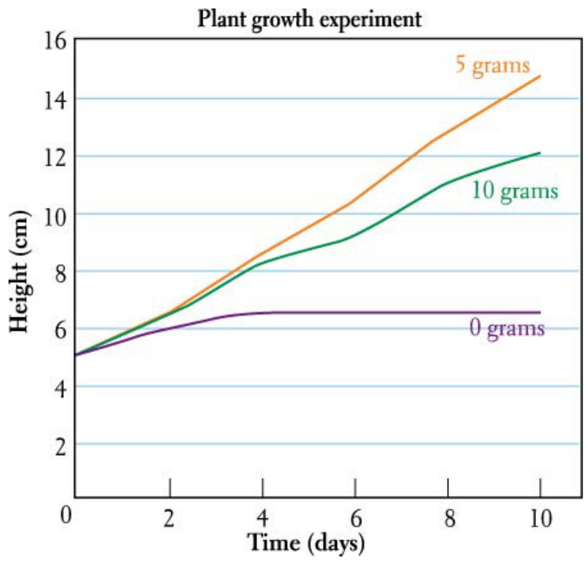
19 **a** use of fertiliser

b growth of plants

c type of plant, type and amount of soil, type and amount of water, climatic conditions, size and type of pot plant, size of plant

d The plant receiving 10 grams of fertiliser will grow bigger because it will receive the most nutrients.

e



f The fertiliser takes a few days to take effect; however, 10 grams does not produce the best results.

g Small amounts of fertiliser best increase the growth of plants.

h No, because the experiment was not repeated.

i It is a fair test because only one variable was changed, all plants started at the same height, the height of plants was recorded every 2 days, a ruler was used to measure the height and a measuring cylinder was used to accurately measure the water.

j repeating the experiment

Chapter answers

Remembering

1 timelines, safely, conduct, evaluate, scientific, solving, identifying, creative, mentor, alone, communicate, data

2 **a** true

b false

c true

d false

e false

Understanding

3 Students' responses will vary.

4

Report section	Purpose	Description of what should be included
Title	To identify the project and what it is about	A title
Aim	Outlines the idea or scientific question you are trying to test	A statement about what you will be finding out
Hypothesis	A prediction or 'educated guess' about what you may find in an experiment	A predicted answer that you think will be discovered
Equipment	To identify all materials, resources and equipment required	List of equipment and resources

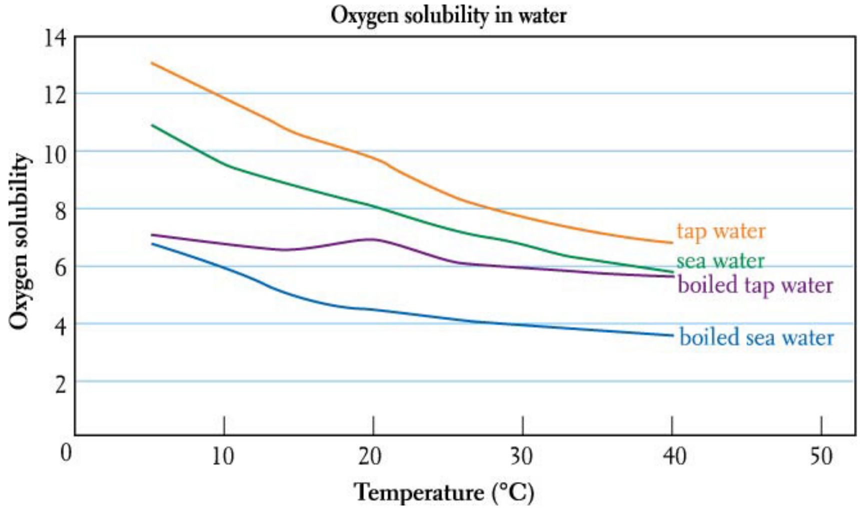
Report section	Purpose	Description of what should be included
Variables	To identify all of the variables that may affect your results and then work out which ones to change and control	Independent variable: the variable that is changed Dependent variable: the variable that is being measured Controlled variables: the variables that are kept the same throughout an experiment
Method	To provide clear, unambiguous instructions that other scientists could follow to accurately repeat your experiment	Step-by-step set of instructions, diagrams, or photographs How variables will be changed and controlled
Results	To show data and observations collected during an investigation	Quantitative data and qualitative observation. Information about what happened during the experiment.
Discussion	To analyse and evaluate your results in detail	Explanations of trends, results, errors, mistakes, problems and improvements. Display results in various forms such as graphs, diagrams or photos.
Conclusion	To summarise the results of your experiment	Whether you answered the aim. Whether the hypothesis was proved or disproved and why.
Bibliography	To identify references, and sources of information used	Lists of resources, including books, websites, journal articles etc.

5 An investigation to demonstrate a scientific principle will involve understanding the scientific principle and carrying out an investigation to prove that it is correct. An investigation into an aspect of science of your choice involves researching something to which you do not know the answer.

Creating

6 Students' responses will vary.

7, 8 a



- **b** The value of 6.9 for boiled tap water at 20°C may be wrong. The correct value should be 6.4 or 6.3.
- **c** Boiling water removes large amounts of oxygen.
- **d** The warmer the temperature of water, the lower the solubility of oxygen.
- **e** It is difficult to determine whether or not it was a fair test because even though Peter used a control and a constant increment in temperature change, the amount of water used is not mentioned, nor is the length of time each water sample was boiled.

9 The water temperature may be too warm, which means less oxygen is found in the water. This will lead to a reduced number of fish because these fish species may need higher levels of oxygen to survive.

Name	Formula
Nitrogen gas	N_2
Oxygen gas	O_2
Carbon dioxide	CO_2
	CO
	NO_2
Nitrogen monoxide	NO

Name	Formula
Hydrogen gas	H_2
Water	H_2O
Sulfur dioxide gas	SO_2
Sulfur trioxide gas	SO_3
Chlorine gas	Cl_2
Fluorine gas	F_2

Cations					
+1		+2		+3	
Sodium	Na^+	Zinc	Zn^{2+}	Iron(III)	Fe^{3+}
Hydrogen	H^+	Copper	Cu^{2+}	Aluminium	Al^{3+}
Potassium	K^+	Magnesium	Mg^{2+}		
Lithium	Li^+	Calcium	Ca^{2+}		
Silver	Ag^+	Iron(II)	Fe^{2+}		

Anions					
–1		–2		–3	
Chloride	Cl^-	Oxide	O^{2-}	Nitride	N^{3-}
Fluoride	F^-	Sulfide	S^{2-}	Phosphate	PO_4^{3-}
Iodide	I^-	Carbonate	CO_3^{2-}		
Bromide	Br^-	Sulfate	SO_4^{2-}		
Nitrate	NO_3^-				
Hydroxide	OH^-				
Hydrogen carbonate (bicarbonate)	HCO_3^-				

	Cl^-	F^-	NO_3^-	O^{2-}	CO_3^{2-}	PO_4^{3-}
Na^+	$NaCl$	NaF	$NaNO_3$	Na_2O	Na_2CO_3	a_3PO_4
H^+	HCl	HF	HNO_3		H_2CO_3	H_3PO_4
Li^+	$LiCl$	LiF	$LiNO_3$	Li_2O	Li_2CO_3	Li_3PO_4
NH_4^+	NH_4Cl	NH_4F	NH_4NO_3	$(NH_4)_2O$	$(NH_4)_2CO_3$	$(NH_4)_3PO_4$
Mg^{2+}	$MgCl_2$	MgF_2	$Mg(NO_3)_2$	MgO	$MgCO_3$	$Mg_3(PO_4)_2$
Ca^{2+}	$CaCl_2$	CaF_2	$Ca(NO_3)_2$	CaO	$CaCO_3$	$Ca_3(PO_4)_2$
Al^{3+}	$AlCl_3$	AlF_3	$Al(NO_3)_3$	Al_2O_3	$Al_2(CO_3)_3$	$AlPO_4$

Answers 1.1 Writing formulas

Formula	Name
$CaBr_2$	Calcium bromide
HCl	Hydrochloric acid
$AlCl_3$	Aluminium chloride
Na_3PO_4	Sodium phosphate
CaO	Calcium oxide
$(NH_4)_2CO_3$	Ammonium carbonate

Formula	Name
$FeCl_2$	Iron (II) chloride
HNO_3	Nitric acid
Ag_2SO_4	Silver sulfate
$NaHCO_3$	Sodium hydrogen carbonate (or sodium bicarbonate)
CuS	Copper sulfide
$Fe(OH)_3$	Iron (III) hydroxide

Answers 1.2 Chemical equations

1 The Law of Conservation of Mass (also called the Law of Conservation of Matter) states that the total mass of the products in a chemical reaction must equal the total mass of the reactants.

2 a $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

b $2KI_{(aq)} + Pb(NO_3)_{2(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$

c $H_3PO_{4(aq)} + 3KOH_{(aq)} \rightarrow 3H_2O_{(l)} + K_3PO_{4(aq)}$

d $2Al_{(s)} + 3Cl_{2(g)} \rightarrow 2AlCl_{3(s)}$

e $4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

3 a $2HCl_{(aq)} + Mg(OH)_{2(s)} \rightarrow 2H_2O_{(l)} + MgCl_{2(aq)}$

b $2HNO_{3(aq)} + CaCO_{3(s)} \rightarrow CO_{2(g)} + H_2O_{(l)} + Ca(NO_3)_{2(aq)}$

c $Na_2SO_{4(aq)} + Ba(NO_3)_{2(aq)} \rightarrow BaSO_{4(s)} + 2NaNO_{3(aq)}$

d $2NaOH_{(aq)} + H_2SO_{4(aq)} \rightarrow 2H_2O_{(l)} + Na_2SO_{4(aq)}$

e $H_2SO_{4(aq)} + Na_2CO_{3(s)} \rightarrow CO_{2(g)} + H_2O_{(l)} + Na_2SO_{4(aq)}$

4 a $Fe_{(s)} + Cl_{2(g)} \rightarrow FeCl_{2(s)}$

b $NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

c $Pb(NO_3)_{2(aq)} + Na_2SO_{4(aq)} \rightarrow PbSO_{4(s)} + 2NaNO_{3(aq)}$

d $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

Equation	Reaction type
$2Fe_{(s)} + O_{2(g)} \rightarrow 2FeO_{(s)}$	Combination
$H_2O_{(l)} \rightarrow H_{2(g)} + O_{2(g}$	Decomposition
$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{2(s)} + NaNO_{3(aq)}$	Precipitation
$Na_2CO_{3(s)} \rightarrow Na_2O_{(s)} + CO_{2(g)}$	Decomposition
$Mg_{(s)} + ZnCl_{2(aq)} \rightarrow MgCl_{2(aq)} + Zn_{(s)}$	Displacement
$NaOH_{(aq)} + HNO_{3(aq)} \rightarrow NaNO_{3(aq)} + H_2O_{(l)}$	Neutralisation
$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$	Neutralisation
$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$	Combustion
$Pb_{(s)} + O_{2(g)} \rightarrow PbO_{2(s)}$	Combination
$2Ag_{(s)} + CuSO_{4(aq)} \rightarrow Ag_2SO_{4(aq)} + Cu_{(s)}$	Displacement
$NH_4OH_{(aq)} + HCl_{(aq)} \rightarrow H_2O_{(l)} + NH_4Cl_{(aq)}$	Neutralisation
$Pb(NO_3)_{2(aq)} + CuSO_{4(aq)} \rightarrow PbSO_{4(s)} + Cu(NO_3)_{2(aq)}$	Precipitation
$Ca(OH)_{2(aq)} + HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)}$	Neutralisation
$C_{10}H_{8(l)} + 12O_{2(g)} \rightarrow 10CO_{2(g)} + 4H_2O_{(g)}$	Combustion

2 $2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$
$Ca(OH)_{2(aq)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + 2H_2O_{(l)}$

3 **a** **i** Neutralisation
ii Sulfuric acid + potassium hydroxide → potassium sulfate + water
iii $H_2SO_{4(aq)} + 2KOH_{(aq)} \rightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$

b **i** Displacement
ii Silver + zinc chloride solution → silver chloride solution + zinc metal
iii $2Ag_{(s)} + ZnCl_{2(aq)} \rightarrow 2AgCl_{(aq)} + Zn_{(s)}$

c **i** Combination
ii Sulfur + iron → iron sulfide
iii $S_{(s)} + Fe_{(s)} \rightarrow FeS_{(s)}$

d **i** Decomposition
ii Hydrogen peroxide (H_2O_2) → oxygen gas + water
iii $2H_2O_{2(l)} \rightarrow O_{2(g)} + 2H_2O_{(l)}$

Part A

a The **rate** of reaction is a measure of how quickly **reactants** are turned into **products**.

b The **yield** is the amount of product obtained in a reaction. It is measured as a **percentage** of the expected product that is obtained.

There are several ways to increase the rate of a reaction:

c **Increase** the temperature. This will increase the **kinetic** energy of the reactants, causing more collisions. These collisions will also have **higher** energy and be more likely to cause a reaction.

d Increase the **concentration** of a reactant. Having more reactant available causes more successful **collisions** between particles.

e Increase the **surface area** by breaking a solid reactant into **smaller** pieces. This allows more collisions between the reactants.

f Add a **catalyst** to speed up a reaction. A **catalyst** helps a reaction proceed but is not used up in the reaction.

Increasing the rate may also increase the yield. Some other ways to increase the yield are:

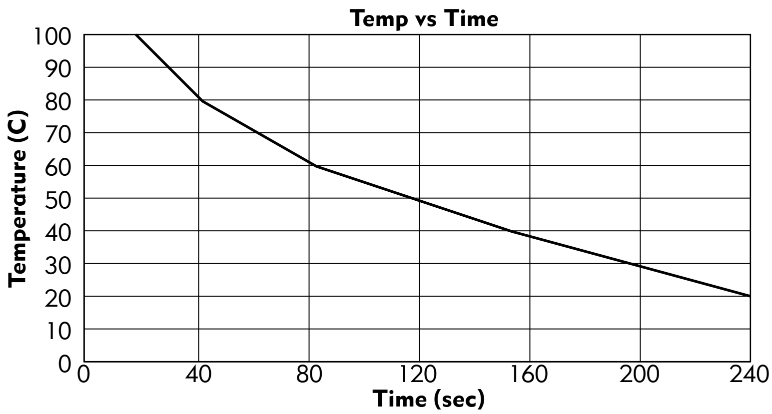
g Removing **products** as they form.

h Adding **reactants** as they are used up.

i Mixing the reactants and products in the correct **ratio** or amounts.

Part B

1



2 As temperature increases, the time taken to react decreases.

3 **a** 120 sec

b 35 sec

4 Increasing the temperature increases the rate of reaction.

5 No, not necessarily. Although the results look good, the experiment was not repeated at each temperature to check whether the results are correct.

6 It is not a fair test as there is no repetition to check results.

7 Repeat each temperature at least twice more.

Experiment 1: The activity series

1 a calcium and magnesium

b calcium

c copper

2

Most reactive	Calcium
	Magnesium
	Aluminium
	Zinc
	Iron
Least reactive	Copper

3 a If you made a saucepan out of calcium, the calcium would react with water and the saucepan would dissolve.

b If you spilt battery acid on a car made of iron, the acid would react with the iron and the car would corrode.

Experiment 2: Rusting

4 a Boiling the water removes most of the air and oxygen from the water.

b Oil keeps oxygen from dissolving into the water.

5 a Tube C would have the most rust, as this tube contains water, and oxygen can easily enter the water to maintain the rusting process.

b Tube B would have the least rust, as this tube has no water, so rusting cannot proceed.

6 a Tube C would produce more rust than tube D. Oxygen can continue to enter the water in tube C, so rusting can continue in this tube. Once the oxygen in tube D is used up no more will be able to enter because the oil will stop this from occurring, so tube D will only rust a little and then stop.

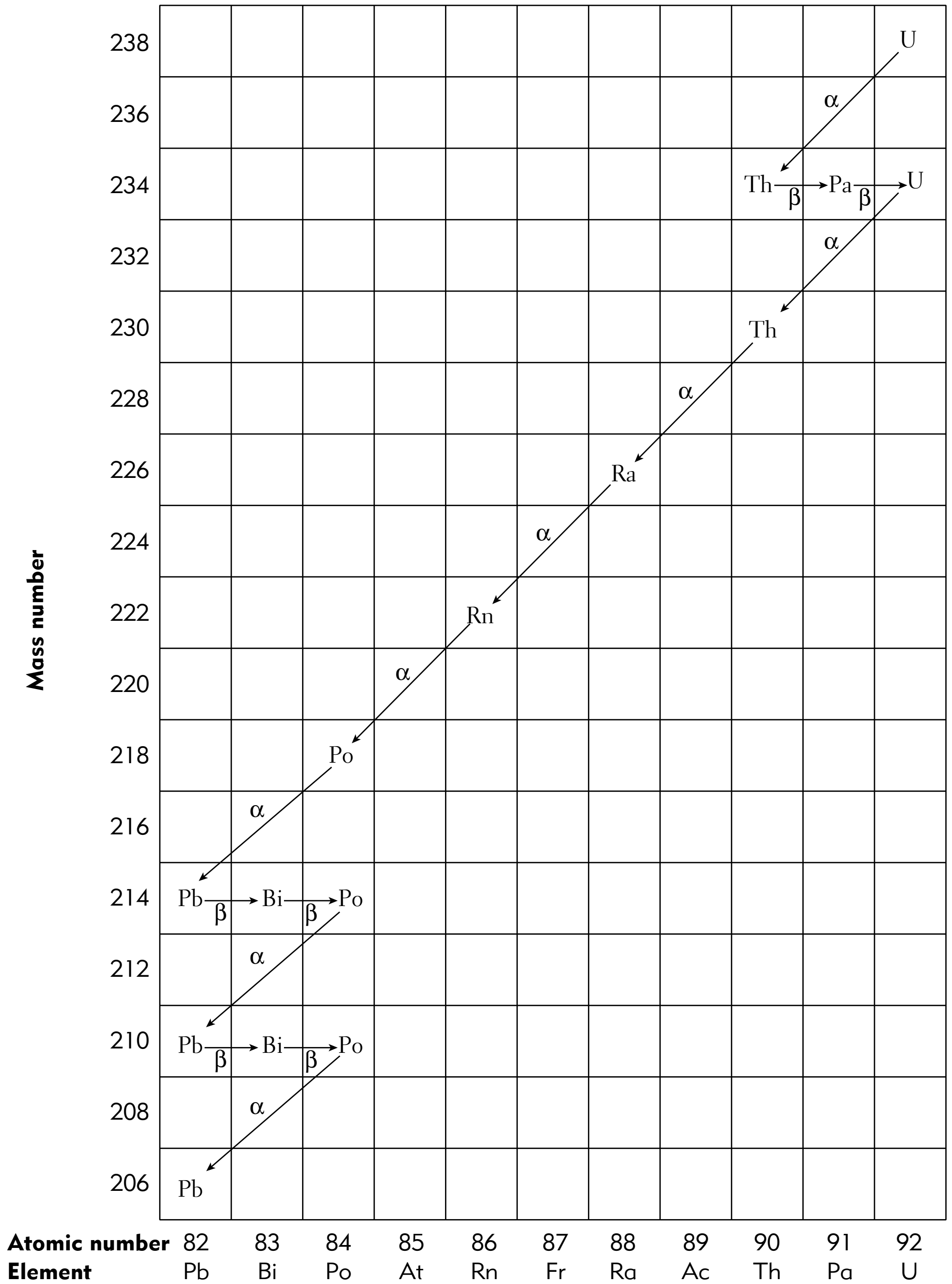
b Tube E would rust quite a bit because even though the water is boiled it is not sealed, so oxygen can re-enter the water and cause rusting. Tube F will not rust much at all because oxygen has been removed and oil placed on top to keep any further oxygen from entering the tube.

7 a There would be rusting in tube A, although it would occur slowly. Oxygen and water from the air can cause the nail to rust.

b The galvanised nail would not rust. Galvanising is coating iron with zinc. The zinc corrodes as it is more reactive than iron, and the iron stays protected. This is called sacrificial protection.

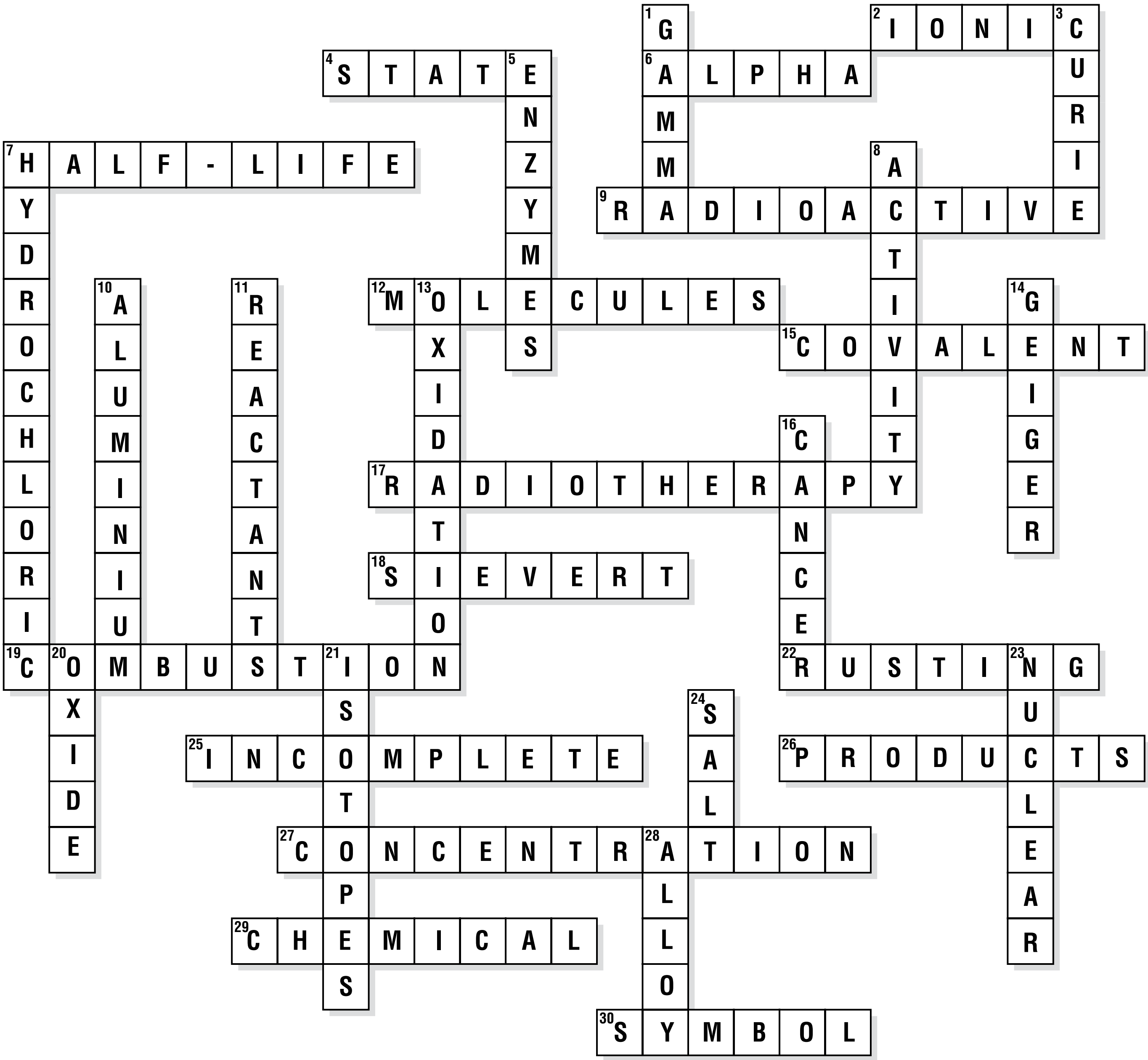
8 Any methods that reduce contact of the metal with air and water. For example, painting, chrome plating, oiling, plastic coating.

Answers 1.6 Uranium decay series



Extension

Students' answers will vary.


1 GAMMA
2 IONIC
3 CURIE
4 STATE
5 ENZYMES
6 ALPHA
7 HALF-LIFE
7 HYDROCHLORIC
8 ACTIVITY
9 RADIOACTIVE
10 ALUMINIUM
11 REACTANT
12 MOLECULES
13 OXIDATION
14 GEIGER
15 COVALENT
16 CANCER
17 RADIOTHERAPY
18 SIEVERT
19 COMBUSTION
20 OXIDE
21 ISOTOPES
22 RUSTING
23 NUCLEAR
24 SALT
25 INCOMPLETE
26 PRODUCTS
27 CONCENTRATION
28 ALLOY
29 CHEMICAL
30 SYMBOL

Unit 1.1: Chemical reactions

Clue	Word
1 How fast a reaction occurs	rate
2 Substances present at the start of a reaction	reactants
3 Substances present at the end of a reaction	products
4 Describes a chemical reaction in words	word equation
5 A reaction that has equal numbers of each atom on both sides of the equation	balanced
6 These show what physical state a substance is in	subscripts
7 Has the subscript (aq)	aqueous
8 Makes a reaction go faster, but is not used up in the reaction	catalyst

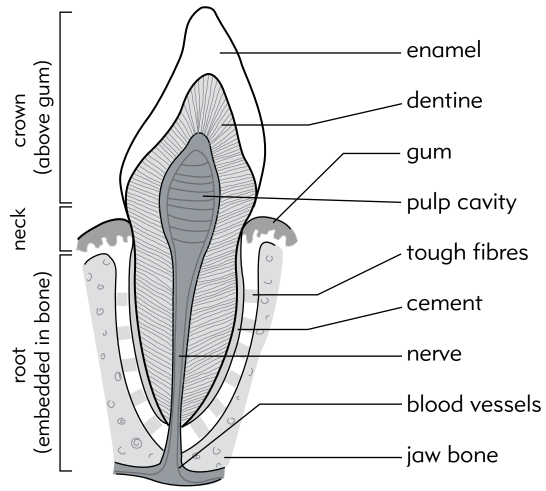
Unit 1.2: Corrosion and oxidation

Clue	Word
1 Reaction of metal with water or air	corrosion
2 Common name for iron (III) oxide	rust
3 Coated in molten zinc	galvanised
4 Protecting a metal by attaching another metal to it. The attached metal reacts, saving the first metal from corrosion.	sacrificial protection

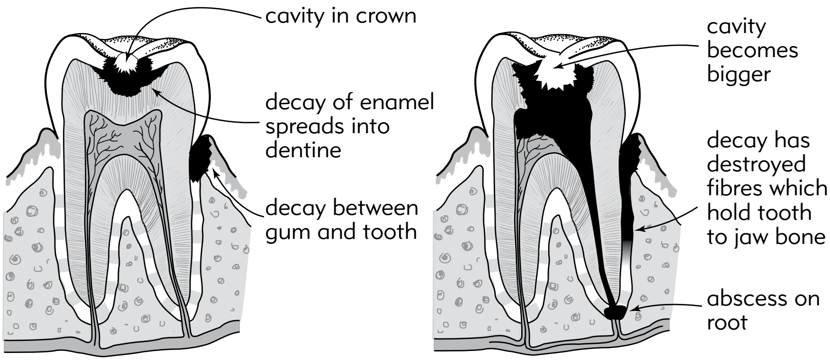
Unit 1.3: Nuclear reactions and radiation

Clue	Word
1 Element whose atoms undergo decay	radioactive
2 Element which has the same number of protons, but a different number of neutrons	isotope
3 Type of nuclear radiation consisting of two neutrons and two protons	alpha
4 An electron produced in the nucleus	beta
5 A ray that carries energy in the form of a burst of high frequency electromagnetic radiation	gamma
6 The time taken for half of a radioactive sample to decay	half-life
7 Radiation from the Earth's crust	terrestrial
8 Radiation from outer space	cosmic
9 Unit of radiation	sievert
10 Medical use of nuclear radiation to kill cancerous cells	radiotherapy
11 Radioisotope used for diagnosis that concentrates in a particular part of the body	tracer
12 Used to sterilise food or medical instruments	irradiation
13 Type of bomb that contains radioactive material	dirty

1 a



b



2 The enamel protects the dentine, which, in turn, protects the pulp with its load of nerves. It needs to be tough to provide all that protection!

3 **a** The most attractive fillings for front teeth would be those that are a similar colour to tooth enamel; i.e. white. Porcelain and nylon are both white. Polythene is a milky white.

b We don't commonly see the back teeth in everyday life. Hence, the fillings in the back teeth can be any colour.

4 **a** If a tooth filling was harder than the tooth it filled, the tooth in which it sat would wear faster than the filling. After many years, the filling would be more exposed, possibly leaving rough and uncomfortable edges. Because the filling was harder than the tooth itself, the filling would act something like sandpaper on the other teeth, wearing them down even faster.

b If tooth fillings were softer than the teeth they filled, the fillings would be worn away quickly, leaving a hole in the tooth and allowing a path for decay and infection to enter the tooth.

5 Fillings should be about the same hardness as tooth enamel. Enamel is the outer surface of the teeth and is the surface that we see. It is also the surface that will scrape across the other teeth and fillings. If a filling is not the same hardness as the enamel, it will either scratch the enamel of other teeth if harder, or will be scratched by the other teeth if softer.

6 All except mercury, polythene and nylon would expand in a similar way to the tooth and therefore could safely be used as fillings. They might fail, however, on some other criteria such as toxicity or being too difficult for the dentist to mould.

7 Porcelain is white, expands at about the same rate as teeth and is as hard as tooth enamel. It is therefore an ideal material for false teeth and caps. These are specially made outside the dental surgery and are not made 'in-the-mouth'. Thus, the dental technician uses special machines to mould the porcelain into the shape required.

8 **a**

Hardness similar to enamel	Expansivity less than 30	Appropriate colour for front teeth	Appropriate colour for back teeth	Safe	Easily melts at room temp	Can be shaped easily in the mouth	Not too expensive
Aluminium	✓		✓	✓			✓
Amalgam	✓		✓	✓		✓	✓
Brass	✓		✓	✓		✓	✓
Copper	✓		✓	✓			✓
Gold	✓		✓	✓	✓	✓	
'Gold' alloy	✓		✓	✓	✓	✓	✓
Lead	✓		✓		✓	✓	✓
Polythene	✓	✓	✓	✓			✓
Silver	✓		✓	✓	✓	✓	✓
Stainless steel	✓		✓	✓			✓

b Amalgam and 'gold' alloy are the most appropriate fillings for teeth, particularly back teeth where their colour will not be obvious. Amalgam is cheaper and harder than gold.

Answers 2.2 Media analysis 1

1 **a** Teflon was discovered on 6 April 1938 by a chemist from Du Pont, Roy J. Plunkett Junior.

b The actual chemical name of Teflon is polytetrafluoroethylene (lots of tetrafluoroethylene linked together).

2 **a** Teflon is a solid, slippery, white, waxy powder.

b Teflon is very inert (it will not react with other substances), is not affected by heat, is very slippery (more slippery than wet ice on wet ice) and is a terrific electrical insulator (i.e. it will not conduct electricity). These properties make it extremely useful as a coating for many purposes.

3 Inert means that it will not react with other substances.

4 **a** Plunkett was looking for a new gas to use as a refrigerant in refrigerators when he discovered Teflon.

b When Plunkett opened the valve of his cylinder of tetrafluoroethylene, none came out. He knew it was not empty, however, as the cylinder weighed the same as the cylinder when it was full.

c In the early days, Teflon was not produced commercially as it was very expensive to produce.

5 **a** Teflon cannot be a metal as it is an excellent electrical insulator, whereas metals are excellent electrical conductors. Plastics are polymers made from many monomer molecules linked into giant chains or lattices. Teflon's name, polytetrafluoroethylene, suggests that it is a polymer; i.e. a plastic.

b Tetrafluoroethylene is a gas and is stored in gas cylinders.

c Teflon is a solid.

6

Location	Use	Property related to the use
Body	Heart valves, arteries, corneas, artificial bones; e.g. jaw, nose	Unreactive (inert), slippery so blood and fat will not stick to it
Space	Spacesuits	Tough enough to withstand harsh conditions
Kitchen	Frying pans	Slippery, inert—does not react with food, hard wearing, heat resistant

Answers 2.3 Extraction of metals

1 Any five of the following:

- How much ore is there and how concentrated is it?
- How deep is the ore? What type of mine is needed?
- Is the site close to existing ports and rail lines?
- Is there a population centre nearby from which workers can be employed?
- Who owns or controls the land? If they live there, will they be happy to shift?
- What compensation is appropriate?
- What water and air pollution will it cause?
- What damage will be done to the environment and how can it be minimised?
- What will be the cost of building the mine and processing plants and repairing the environmental damage?
- What is the current and expected future price of the metal?
- What profit is expected?

Ore	Chemical composition	Metal extracted
Bauxite	Aluminium oxide, Al_2O_3	Aluminium, Al
Chalcopyrite	Copper iron sulfide, $CuFeS_2$	Copper, Cu
Galena	Lead sulfide, PbS	Lead, Pb
Haematite	Iron oxide, Fe_2O_3	Iron, Fe
Pitchblende	Uranium oxide, U_3O_8	Uranium, U
Rutile	Titanium oxide, TiO_2	Titanium, Ti
Sphalerite	Zinc sulfide, ZnS	Zinc, Zn

3

Metal	Extraction method
K	Electrolysis
Mg	Electrolysis
Al	Electrolysis
Zn	Heating with C or CO
Ni	Heating with C or CO
Sn	Heating with C or CO
Pb	Heating with C or CO
Fe	Heating with C or CO
Cu	Roasting in air
Au	Occurs naturally

4 **a** The coke reacts to form carbon dioxide.

b Limestone decomposes to form calcium oxide and more carbon dioxide.

c Carbon dioxide reacts with more coke/carbon to form carbon monoxide.

d Carbon monoxide reacts with the iron ore to form carbon dioxide and molten iron, which then runs to the bottom of the furnace.

e Waste calcium oxide reacts with sand in the iron ore, forming calcium silicate.

5 **a** $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

b $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

c $CO_{2(g)} + C_{(s)} \rightarrow 2CO_{(g)}$

d $Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(l)} + 3CO_{2(g)}$

e $CaO_{(s)} + SiO_{2(s)} \rightarrow CaSiO_{3(l)}$

6 Calcium silicate that floats on the molten iron is commonly called slag.

1 An alloy is a metal mixed with other elements (usually other metals, but sometimes carbon or silicon) to improve its properties.

2 A table of common alloys, their base metals, added impurities and their advantages can be found in Unit 2.1 of *Science Focus 4 Second Edition*.

3 **a** The name 'Nitinol' comes from the chemical symbols of nickel (Ni) and titanium (Ti).

b A 'shape memory alloy' is an alloy that can change shape but regains its original shape when heated or cooled.

4 **a** Nitinol is mechanically similar to human hair and tendons.

b Nitinol is ideal for surgical applications as it is non-toxic. Replacement parts can be made, cooled and squashed into small shapes. Because it is small, the part can be put in place easily, requiring minimal cuts or incisions. When in place, the body will heat it back to 37°C. The Nitinol part will then 'remember' the original shape it was made in and expand to the correct fit.

5 **a** Filters are surgically inserted into blood vessels to strain the blood and trap and eliminate clots that can cause a stroke or a heart attack.

b A stent is a small tube of metal mesh. Stents are used to treat conditions such as arteriosclerosis and aneurisms, which damage the walls of blood vessels. They physically keep the walls of the blood vessels from collapsing or being blocked.

6 Apart from Nitinol, stainless steel or titanium alloys are used for filters and stents.

7 Nitinol filters are deliberately buckled out of shape to make them smaller so that surgeons need to make only minimal cuts or incisions to insert them.

8 Nitinol regains the 'proper' shape for the filter or stent when the body warms it.

9 **a** Apart from filters and stents, Nitinol is also currently being used in Russia and China for bone implants.

b Many health authorities in North America and Europe have questioned the use of Nitinol for bone implants. No human clinical trials have taken place and this has restricted its further use.

c A possible future use for Nitinol is as foam pads that may be able to replace damaged discs in the spine.

Answers 2.5 Recycling

1 **a** Thermoplastic means that a plastic will soften when heated.

b A thermoplastic can be recycled because it will melt when heated, and can be remoulded into a new shape. After cooling, the thermoplastic will retain the new shape.

c A thermosetting plastic cannot be recycled because it does not melt when heated. It becomes brittle and chars. Thermosetting plastics have cross links that stop the polymer chains sliding past each other and therefore they cannot melt.

2 **a** The lid needs to be flexible in order to remove and replace it. It must be able to bend. The tub is rigid so that it can hold the liquid ice cream when filled and strong enough to be able to withstand transport.

b New PET is treated to food standards and is known to be hygienic and pure. Recycled PET may have impurities introduced that make it unsuitable for food storage. Also, during heating and cooling in the recycling process, some PET molecules may decompose and degrade, releasing unwanted chemicals into the food if used to store food again.

3 LDPE used to make plastic bags: soft, flexible, strong, able to be thin without splitting.

PVC used to make water pipes: hard, rigid, waterproof, strong, unreactive to water or chemicals.

4 Recycling saves money and energy, reduces waste going to landfill, reduces the use of new resources, and reduces pollution by reducing the amount of plastics entering the environment.

5 Answers will vary.

Extension

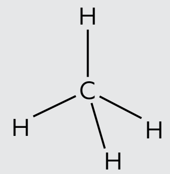
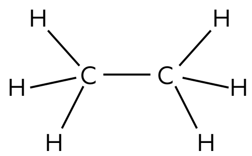
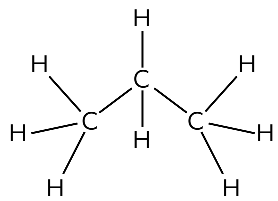
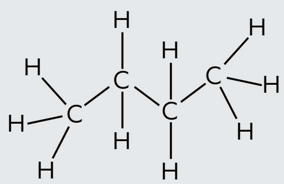
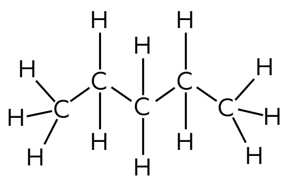
1 **Define** each of the following codes by carrying out some Internet research.

PET	Polyethylene terephthalate
HDPE	High density polyethylene
V	Poly vinyl chloride
LDPE	Low density polyethylene
PP	Polypropylene
PS	Polystyrene

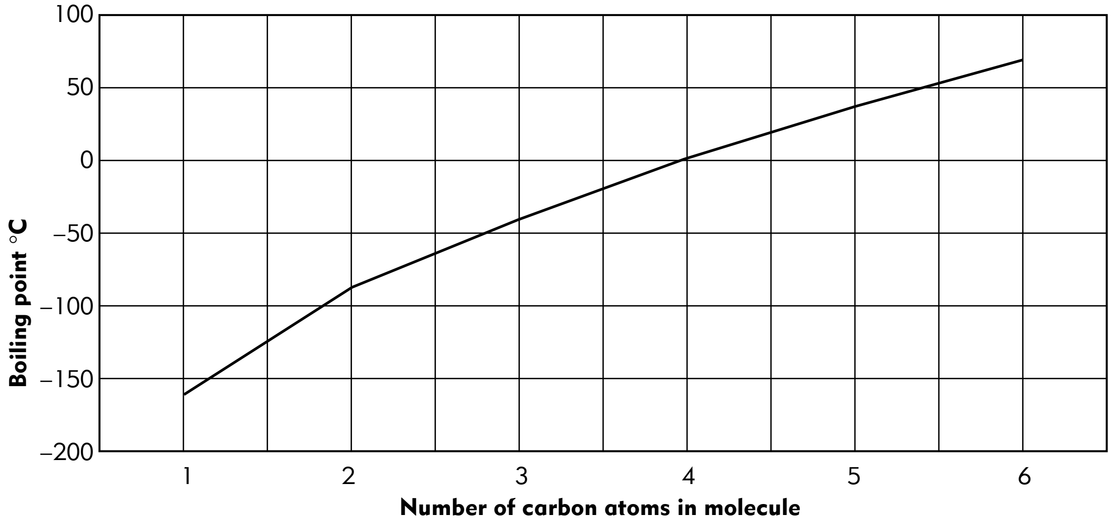
2 Students' answers will vary.

3 Students' answers will vary.

1 a

Column 1: Number of carbon atoms in molecule	Column 2: Name of alkane	Column 3: Structural formula	Column 4: Boiling point (°C)
1	Ethane		–161.5
2	Ethane		–88.6
3	Propane		–42.1
4	Butane		36.1
5	Pentane		36.1
6	Hexane	**illustration 6 is missing**	68.7

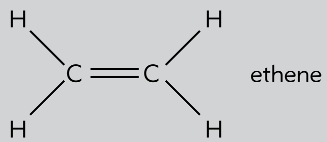
b Boiling point of butane (from graph) is approximately 0ºC.



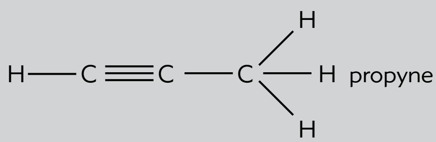
2 heating, fuel, lubricants (oil and grease), cooking (heat and cooking oils), food (margarine, cooking oils)

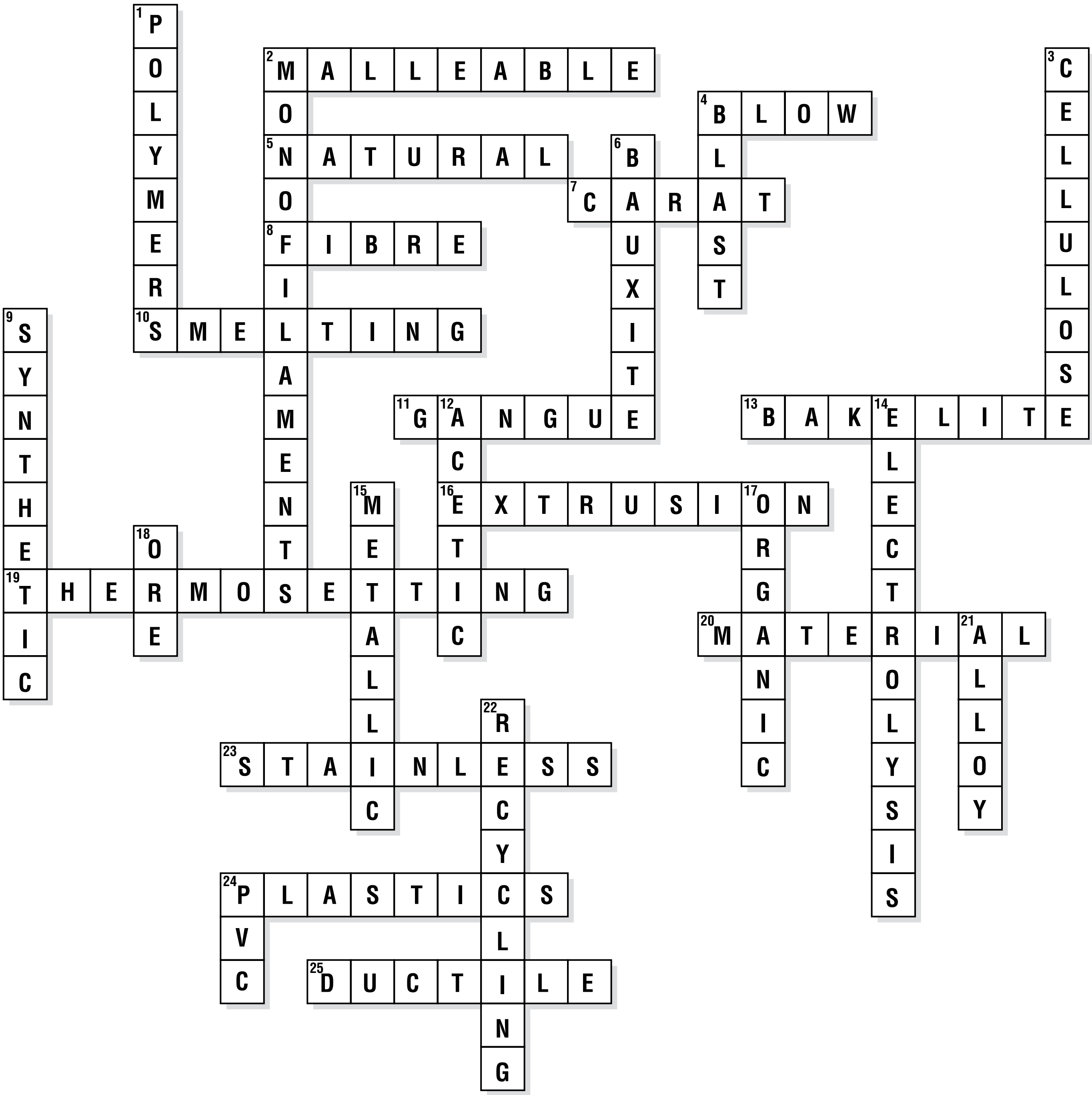
Extension

alkene: ethene



alkyne: propyne




1 POLYMER
2 MALLEABLE
2 MONOFILAMENT
3 CELLULOSE
4 BLOW
4 BLAST
5 NATURAL
6 BAUXITE
7 CARAT
8 FIBRE
9 SYNTHETIC
10 SMELTING
11 GANGUE
12 ACETIC
13 BAKELITE
14 ELECTROLYSIS
15 METALLIC
16 EXTRUSION
17 ORGANIC
18 ORE
19 THERMOSETTING
20 MATERIAL
21 ALLOY
22 RECYCLING
23 STAINLESS
24 PLASTICS
24 PVC
25 DUCTILE

Unit 2.1: Pure metals and alloys

Clue	Word
1 Able to be stretched	ductile
2 Able to be shaped	malleable
3 Metal is a good ____________ of heat and electricity	conductor
4 Mixture of a base metal and other element(s)	alloy
5 General name for alloys of iron	steel
6 Most brittle alloy of iron	cast iron
7 Element added to iron to make stainless steel	chromium

Unit 2.2: Mining and extracting metals

Clue	Word
1 Element found in its pure state	native
2 Not likely to react, unreactive	stable
3 Rocks containing a large amount of a particular metal	minerals
4 Rock containing sufficient metal to mine	ore
5 Soil and rock on top of ore, removed in open-cut mining	overburden
6 Steps created by open-cut mining	benches
7 Waste and impurities from mining	gangue
8 Removal of pure metal from the ore	extraction
9 Use of electricity to extract reactive metals	electrolysis
10 Use of heat for extraction	roasting
11 Device used for smelting iron	blast furnace

Unit 2.3: Plastics

Clue	Word
1 Carbon-based molecules used to make plastics are generally called ______________ molecules	organic
2 Process of combining many identical molecules to form longer ones	polymerisation
3 Short molecule that forms the basis of plastic	monomer
4 Long molecule made from shorter ones	polymer
5 Plastic that can be remoulded if heated	thermoplastic
6 Plastic that cannot be remoulded, and chars when heated	thermosetting
7 Not easily scratched	hard
8 Easily shattered	brittle
9 Difficult to bend	rigid
10 Burn on the edges	char

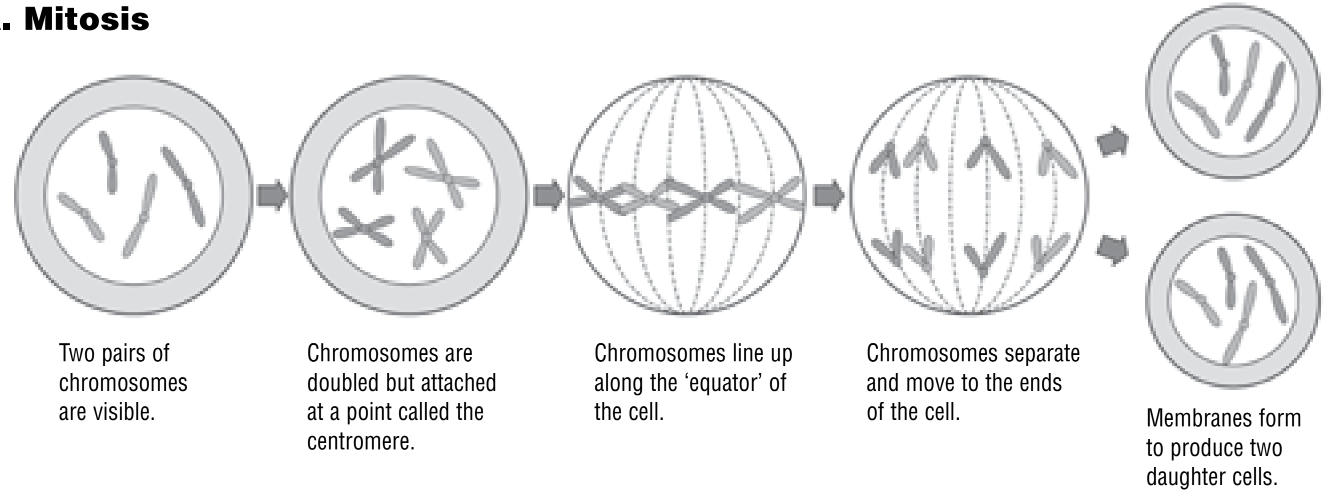
Unit 2.4: Fibres

Clue	Word
1 Material that can be woven into a fabric	fibre
2 A type of fibre made from an artificial substance	synthetic
3 Fibre with molecules the same length as the fibre	monofilament

Answers 3.1 Chapter 3: Natural selection

A. Mitosis

1



2 **a** homologous pair: a pair of chromosomes that match in size and shape. One is inherited from the mother and one is inherited from the father.

b diploid: describes a cell with a full set of chromosomes. Contains two of each type of chromosome.

c haploid: describes a cell with half a set of chromosomes. Contains one of each homologous pair.

d daughter cell: the cells that are formed after cell division of the parent cell.

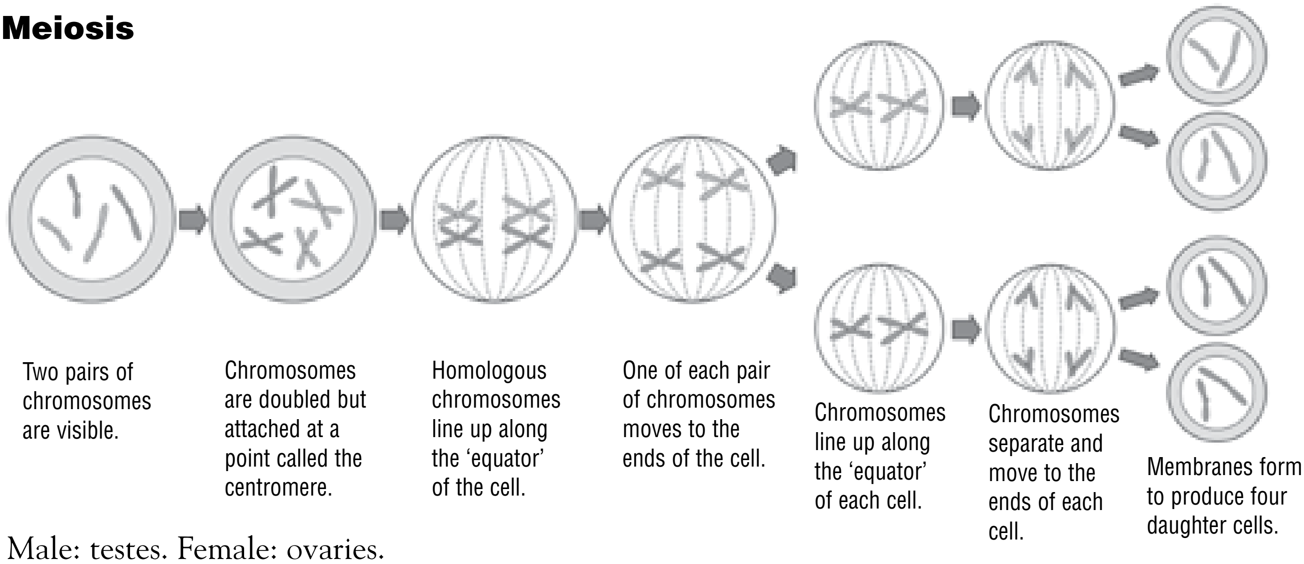
3 brain cells, stomach cells, skin cells, muscle cells

4 **a** multicellular organisms: growth, repair, replacement of all body cells

b single-celled organisms: reproduction, sometimes called binary fission

B. Meiosis

5



6 Male: testes. Female: ovaries.

7 To produce gametes (sex cells) for reproduction.

8 **a** sperm

b ova or eggs

9

	Mitosis	Meiosis
Number of daughter cells produced	2	4
Number of chromosomes in parent cells of humans	46	46
Number of chromosomes in daughter cells in humans	46	23

Answers 3.2 Heterozygous

1 **a** RR or Rr

b

P_1 / P_2	*R*	*r*
R	*RR*	*Rr*
r	*Rr*	*rr*

i 75%

ii 50%

2

P_1 / P_2	*R*	*R*
r	*Rr*	*Rr*
r	*Rr*	*Rr*

P_1 / P_2	*R*	*r*
r	*Rr*	*rr*
r	*Rr*	*rr*

a red

b 50% red, 50% white

c A white-eyed fly must be homozygous (rr), because the gene for white eye is recessive.

Answers 3.3 Pedigree analysis

1 **a** male

b A and I (and G)

2 **a** **i** xx

ii xx

iii no

b **i** XX or Xx

ii XX, Xx, xx

iii yes

3 A: Xx, B: xx, I: Xx, K: XX or Xx

1 The order of bases will be different in each student model.

2 Key:

P = Phosphate

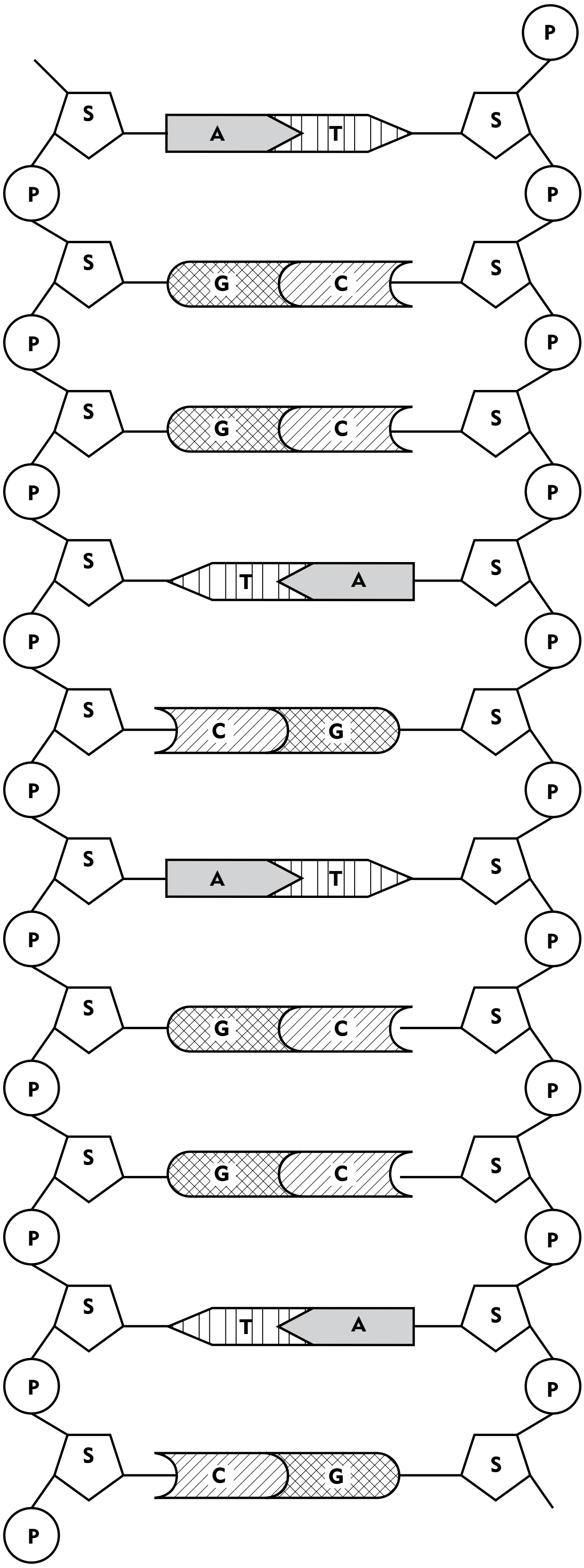
S = Sugar

A = Adenine

T = Thymine

C = Cytosine

G = Guanine



Answers 3.5 Genetic modification

1 Scientists are now using their knowledge of the structure of genes to alter characteristics by inserting genes from one organism into another. This process is known as genetic engineering or genetic modification.

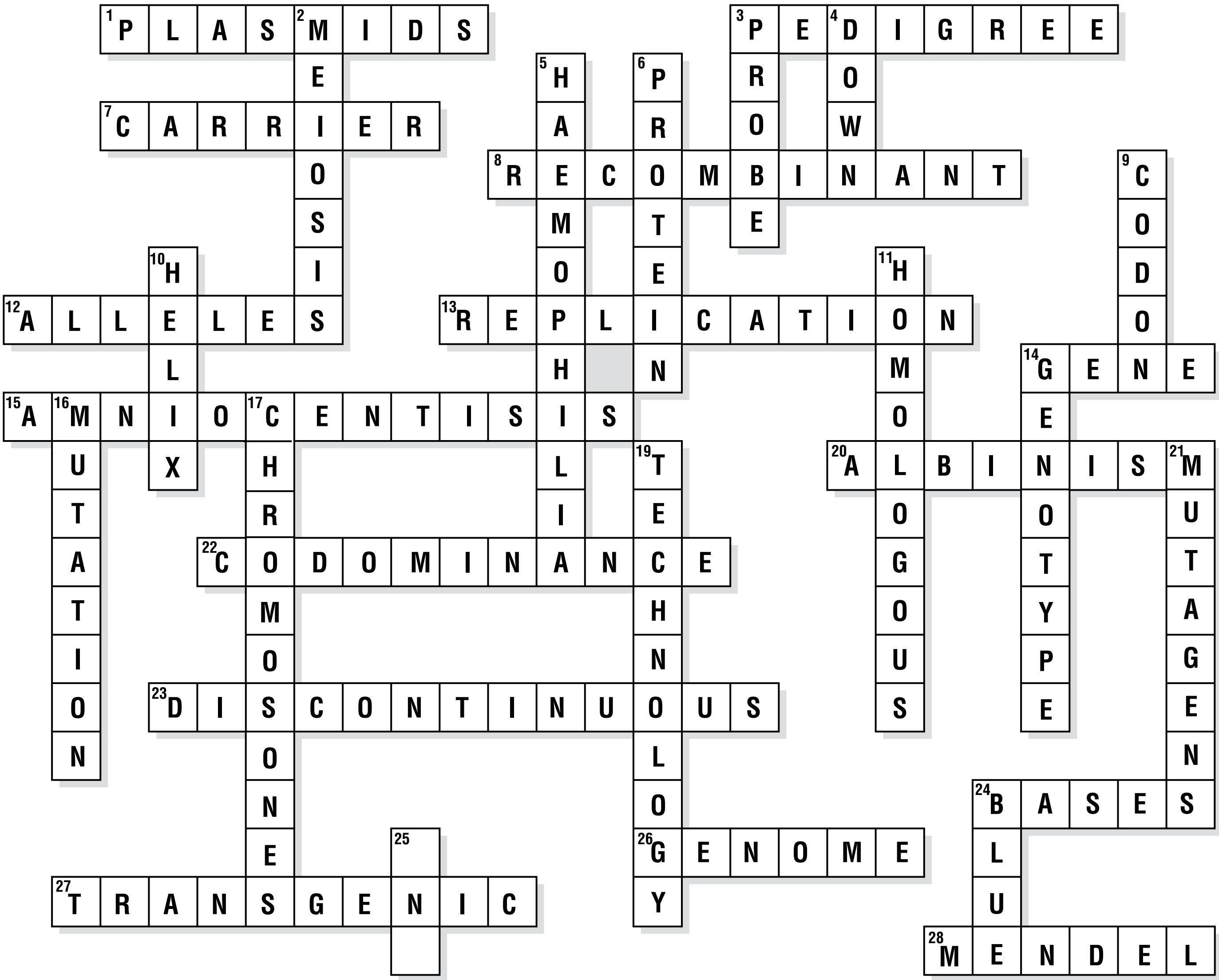
2 A piece of DNA is cut out of one chromosome and 'stuck' into the chromosome of another organism. The foreign DNA becomes a part of the new host chromosome, and when the cell reproduces its own DNA it also reproduces the attached piece of DNA. If the host cells divide rapidly, as bacterial cells do, then it is possible to produce large quantities of the 'new' DNA strands much more quickly than through traditional selection and mating. Cells can then make 'foreign' proteins.

3 Human insulin and growth hormone are both manufactured using genetically modified bacteria.

4 The health issues may include impairing the effectiveness of antibiotics, being less nutritious, and creating allergens, toxins and new viruses.

Extension

Students' answers will vary.


1 PLASMIDS
2 MEIOSIS
3 PEDIGREE
3 PROBE
4 DOWN
5 HAEMOPHILIA
6 PROTEIN
7 CARRIER
8 RECOMBINANT
9 CODON
10 HELIX
11 HOMOLOGOUS
12 ALLELES
13 REPLICATION
14 GENE
14 GENOTYPE
15 AMNIOCENTISIS
16 MUTATION
17 CHROMOSOME
19 TECHNOLOGY
20 ALBINISM
21 MUTAGENS
22 CODOMINANCE
23 DISCONTINUOUS
24 BASES
24 BLUE
25
26 GENOME
27 TRANSGENIC
28 MENDEL

Unit 3.1: Inheritance

Clue	Word
1 Inherited characteristics	heredity
2 The father of genetics	Mendel
3 Hereditary unit that carries information about inherited characteristics	gene
4 The chemical of which genes are made	DNA
5 Structures on which genes are located	chromosomes
6 Chromosomes with the same size and shape	homologous pair
7 Alternative forms of the same gene	alleles
8 A cell containing one of each type of chromosome	haploid
9 Grid used to predict types of offspring	Punnett Square
10 Cell division which produces gametes	meiosis
11 Combination of genes for a particular characteristic	genotype
12 Having only one type of allele for a characteristic	homozygous
13 The gene which is 'masked' in the heterozygous state	recessive gene
14 Both alleles produce an effect on the phenotype	codominance

Unit 3.2: Human inheritance

Clue	Word
1 Condition in which pigment is lacking	albinism
2 Family tree showing the presence of an abnormal characteristic	pedigree
3 Genetic disease where blood does not clot correctly	haemophilia
4 Females carry two of these chromosomes	X chromosomes
5 Recessive eye colour in white-skinned people	blue
6 Person with a hidden gene for a particular disease	carrier
7 An X-linked disorder	colour blindness

Unit 3.3: The molecule of life

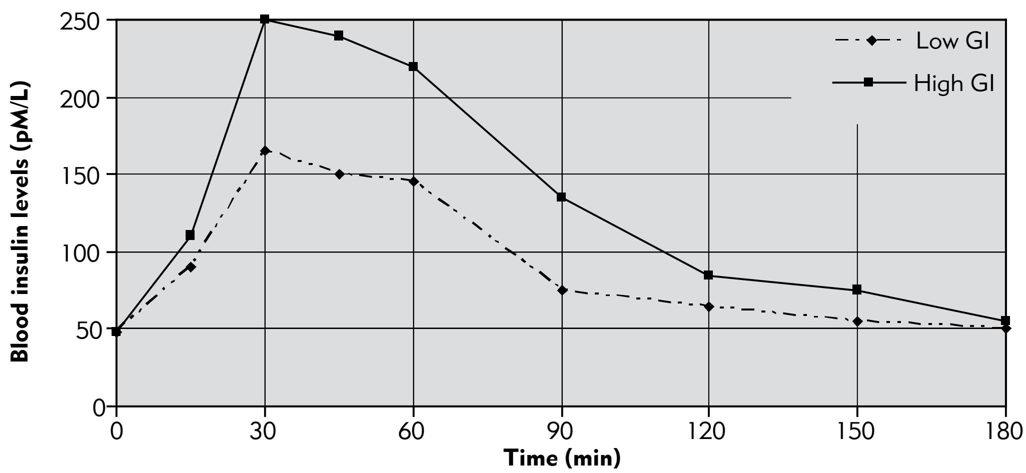
Clue	Word
1 Two strands twisted together	double helix
2 Form the rungs of the DNA ladder	nitrogen bases
3 Copying of DNA during mitosis	replication
4 Long chain of amino acids	protein
5 Spontaneous change in a gene or chromosome	mutation
6 Disease where the red blood cells are distorted in shape	sickle cell
7 Caused by an extra chromosome 21	Down syndrome
8 Chemicals or things that can cause mutations	mutagens

Unit 3.4: Controlling genetics

Clue	Word
1 Manipulating the DNA of an organism	gene technology
2 Circular pieces of DNA	plasmids
3 Molecule containing DNA from two organisms	recombinant DNA
4 Organism containing a new gene	transgenic
5 Small pieces of DNA which recognise genes	gene probes
6 Map showing the positions of genes in humans	human genome
7 The name of a scientist who studies inherited traits	geneticist

The glycemic index and load

1



2 The high-GI food raised blood sugar levels very quickly to very high levels. The levels dropped slowly over three hours to about the same level as those of a low-GI food. The low-GI food raised the blood sugar levels but not as high as the high-GI food. With the low-GI food, the blood sugar levels dropped more slowly after peaking.

3 The blood sugar levels for the low-GI food would stay at about the same level for a further period of time. The blood sugar levels for the high-GI food would probably continue to drop further.

4

Food item	GI (glucose = 100)	Serve (g)	Carbohydrate per serve	GL per serve	Classification
Coca Cola (soft drink)	53	250	26	14	M
All-Bran	30	30	13	4	L
Cornflakes	77	30	29	20	H
Weet-Bix	69	30	17	12	M
Snack Right Fruit Slice (97% fat-free)	45	25	20	9	L
Vita-wheat	55	25	18	10	L
Apple	40	120	15	6	L
Orange juice	53	250	17	9	L
Chicken nuggets (reheated in microwave)	50	100	14	7	L
Pizza Supreme (pan)	36	100	25	9	L
Pizza Supreme (thin and crispy)	30	100	23	7	L
Pizza Vegetarian Supreme (thin and crispy)	49	100	24	12	M
Spaghetti bolognaise (home made)	52	360	48	25	H
Burger rings	90	50	31	28	H
Milk chocolate	42	50	31	13	M
Roll-Ups	99	30	24	24	H
M & M's (peanut)	33	30	18	6	L
Mars Bar	62	60	40	25	H
Potato crisps (plain)	57	50	17	10	L

5 **a** natural foods, fresh foods, unprocessed foods

b highly processed foods, mostly known as junk food

Answers 4.2 Outbreak

1 Yes, this was an outbreak because there were clearly many more cases than the usual number of food poisoning cases reported, as shown in Figure 1.

2 Various answers. For example, it could be due to the chicken, which may have come from a bulk supplier, or it could be because the cream in the desserts was not kept cold enough. The important thing is that students offer a plausible explanation for their hypothesis.

3 Samples of food must be obtained from all the places where the victims ate, and must be tested for the toxin. The victims should be questioned again about their movements in the days prior to their illness. Food in their own homes should also be tested. It must be ascertained which common suppliers the eateries shared.

4 The contamination of the chicken could have occurred when the chicken was deboned. Being placed in deep pans, it probably couldn't cool rapidly enough and bacteria would have started to grow. Also, when it was sitting in the schools at room temperature, there would have been further bacterial growth.

Answers 4.3 Infections

1

Letter of definition	Term	Definition or description
E	Communicable disease	A not considered to be living things because they do not self-reproduce
H	Pathogens	B are opportunistic pathogens
F	*Yersinia pestis*	C is caused by the protist *Plasmodium*
I	Cocci	D is an opportunistic fungal infection
G	Antibiotics	E a disease that is transmitted easily from person to person
A	Viruses	F the pathogen responsible for bubonic plague
C	Malaria	G kill many types of bacteria
B	Fungi	H micro-organisms that cause disease
D	Tinea	I spherical-shaped bacteria

2 virus, bacteria, protozoa, fungi

3 **a** See *Science Focus 4 Second Edition*, Fig 4.3.11.

b Blood flukes can damage blood vessels near major organs such as the bladder and kidney. This disrupts blood flow and eventually causes death.

c There are various answers, with many examples given in the chapter.

Answers 4.4 AIDS

1 a Sub-Saharan Africa, South and South-East Asia, Latin America and the Caribbean, Eastern Europe and Central Asia, North America, East Asia, Western/Central Europe, North Africa and the Middle East, Australasia

b Various answers are possible. For example, in some countries, prostitution is rife and illicit; unprotected sex is the norm; unhygienic medical services; denial of the problem; poor education; lack of access to condoms.

2 from mother to child before or during birth or during breast-feeding; vaginal and anal unprotected sex; possibly by oral sex if open wound in or near mouth; blood products and transfusions; sharing syringes

3 Various answers are possible. The student's answer needs to focus on educating people about the risks, allowing access to effective contraception, regular health checks, fresh syringes for drug addicts, monitoring of prostitution and access to life-prolonging drugs.

Extension

Students' answers will vary.

Answers 4.5 Blood alcohol concentration

1 a Blood alcohol concentration (BAC) is the amount of alcohol in the bloodstream.

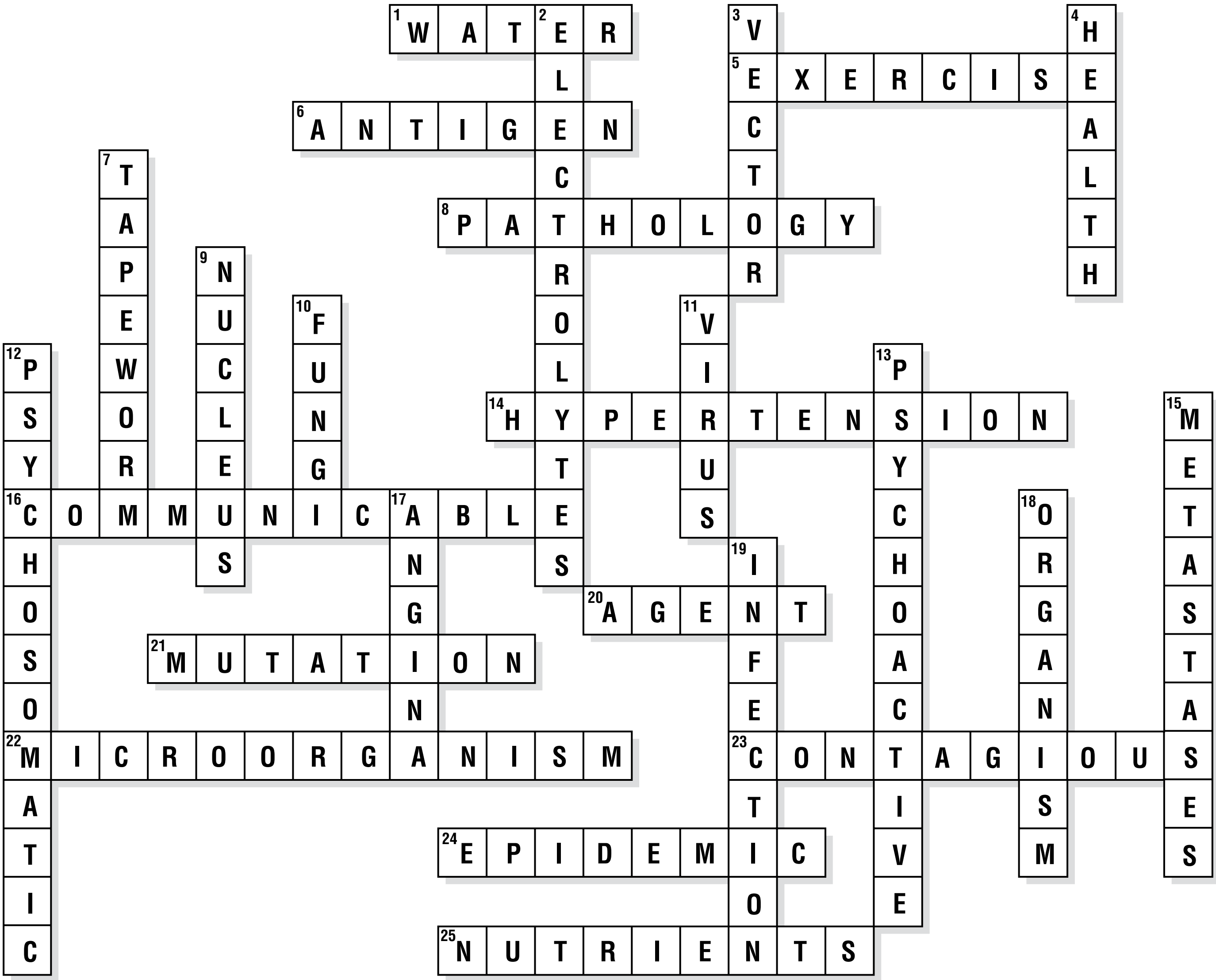
b A standard drink is defined as one that contains 10 grams of pure alcohol.

2 Body size, body fat, food in stomach and gender all affect the BAC. Refer to the bullet points at the bottom of Worksheet 4.5.

3 The alcohol content of different types of drinks varies, as does the size of wine glasses. Stubbies or mixed drinks in bottles or cans contain more than one standard drink, but each brand varies. Someone could refill your glass before you finish it, so you do not know exactly how much you have consumed.

Extension

Students' answers will vary.


1 WATER
2 ELECTROLYTES
3 VECTOR
4 HEALTH
5 EXERCISE
6 ANTIGEN
7 TAPEWORM
8 PATHOLOGY
9 NUCLEUS
10 FUNGI
11 VIRUS
12 PSYCHOSOMATIC
13 PSYCHOACTIVE
14 HYPERTENSION
15 METASTASES
16 COMMUNICABLE
17 ANGINA
18 ORGANISM
19 INFECTION
20 AGENT
21 MUTATION
22 MICROORGANISM
23 CONTAGIOUS
24 EPIDEMIC
25 NUTRIENTS

Unit 4.1: Health

Clue	Word
1 Feeling of wellbeing, able to function in one's environment	health
2 Needed for good health	balanced diet
3 Substance used by an organism	nutrient
4 The G in GI	glycemic
5 Rate at which a person uses their energy	metabolism

Unit 4.2: Disease

Clue	Word
1 Study of disease	pathology
2 Organism too small to be seen with the naked eye	microorganism
3 An infectious ______________ causes disease	agent
4 Invasion of the body	infection
5 Unusual numbers of cases of a certain illness	epidemic
6 Measure of damage done to host	virulence

Unit 4.3: Infectious diseases

Clue	Word
1 Microorganism that causes disease	pathogen
2 Pathogen, not considered living	virus
3 Opportunistic pathogens	fungi
4 Can cause disease in humans, living in the intestine	tapeworm
5 Spherical bacteria	cocci

Unit 4.4: Transmission and control of infectious diseases

Clue	Word
1 Disease transmitted by direct contact	contagious
2 This substance may carry pathogens, indirectly spreading disease	water
3 Carrier of disease	vector
4 Protect against invaders	antibodies
5 Second line of defence	leucocytes
6 Yellowish discharge	pus
7 Third line of defence	acquired immunity
8 Foreign substance	antigen
9 Innoculated	immunised
10 Drugs that kill some pathogens	antibiotics

Unit 4.5: Non-infectious diseases

Clue	Word
1 Abnormality	mutation
2 Substances that conduct electric current	electrolytes
3 Persistent high blood pressure	hypertension
4 Chest pain caused by a minor heart problem	angina
5 Secondary cancer sites	metastases
6 Medication that alters mood	psychoactive drug
7 Blockage of blood vessel	embolism
8 Cancer-causing chemical	carcinogen
9 Cancerous	malignant

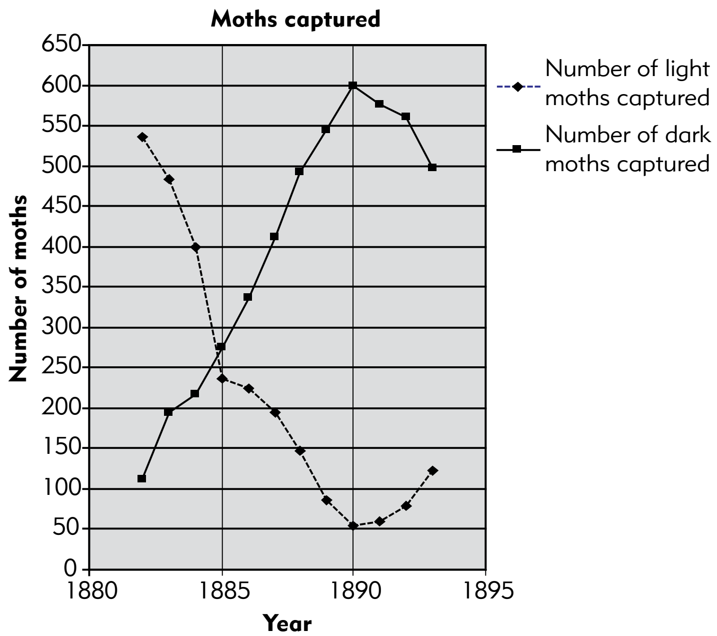
1 Predators will capture the organism that is easiest to see in the environment and therefore the easiest to catch.

2 Chopsticks were used to simulate the beak of the main predator, the bird, and to make it more difficult for a capture to occur. Using human fingers would be too easy.

3 The newspaper 'moths' were very difficult to observe in the 'newspaper' environment. The newspaper 'moths' blended in with the surroundings and were better adapted.

4 The light-coloured moths would have increased in number again, and the dark-coloured moths would have decreased in number. This is because it was easier for predators to see dark-coloured moths when the trees became lighter. The light-coloured moths became better adapted again.

5



6 The experiment carried out by Rachel and James supports this data. The graph shows how the environment changed to the advantage of the dark moths. Around 1890–93, a reduction of industrial activity or a change in industrial practice to reduce soot allowed the light-coloured moths to increase in population and the dark moths decreased in population. The experiment with the cut-out paper 'moths' showed that the 'moths' that blended in with the surroundings were better adapted as they were less easily seen and, hence, less easily picked up by the chopsticks and, therefore, less easily 'preyed' upon.

Answers 5.2 Evolution of the horse

1 a Body height has increased.
  b Toe structure of the forefoot has changed from having four toes to one toe.

2 a Increased height allows a better view of predators.
  b A spreading four-toed foot provided *Hyracotherium* with support on soft ground. The one-toed foot of *Equus* allows greater speed over harder ground (to escape predators on the grasslands).
  c 'New' teeth can accommodate the change from soft vegetation to harder grass.

Extension

a The overall process of evolution from single-celled organisms to the most complex of organisms (humans).

b A 'tree', because the evolutionary picture shows many branches which have become extinct. In addition, the development is of features more suited to new surroundings, not necessarily development of a more complex form.

Answers 5.3 The 'Hobbit'

1 a True
  b False. The discovery was made at Liang Bua, a large limestone cave on Flores, 600 km east of Bali.
  c False. The nearest anatomical equivalents lived almost 2 million years ago, with some features of the find harking back to 3 million year old human ancestors in Africa.
  d True
  e True
  f False. Their existence in South-East Asia almost up to the start of agriculture 10 000 years ago means the 'hobbit' and modern humans probably overlapped in time by tens of thousands of years.
  g False. They were the height of a three-year-old child, weighed around 25 kg and had a brain smaller than most chimpanzees.
  h True

2 A palaeoanthropologist studies prehistoric human and pre-human fossils. They look at dating fossils to determine how old they are and the anatomy of fossils. They also try to determine the behaviour of the animal from which the fossil is derived. Thus, they try to contextualise and get a broader picture of what the fossil tells us.

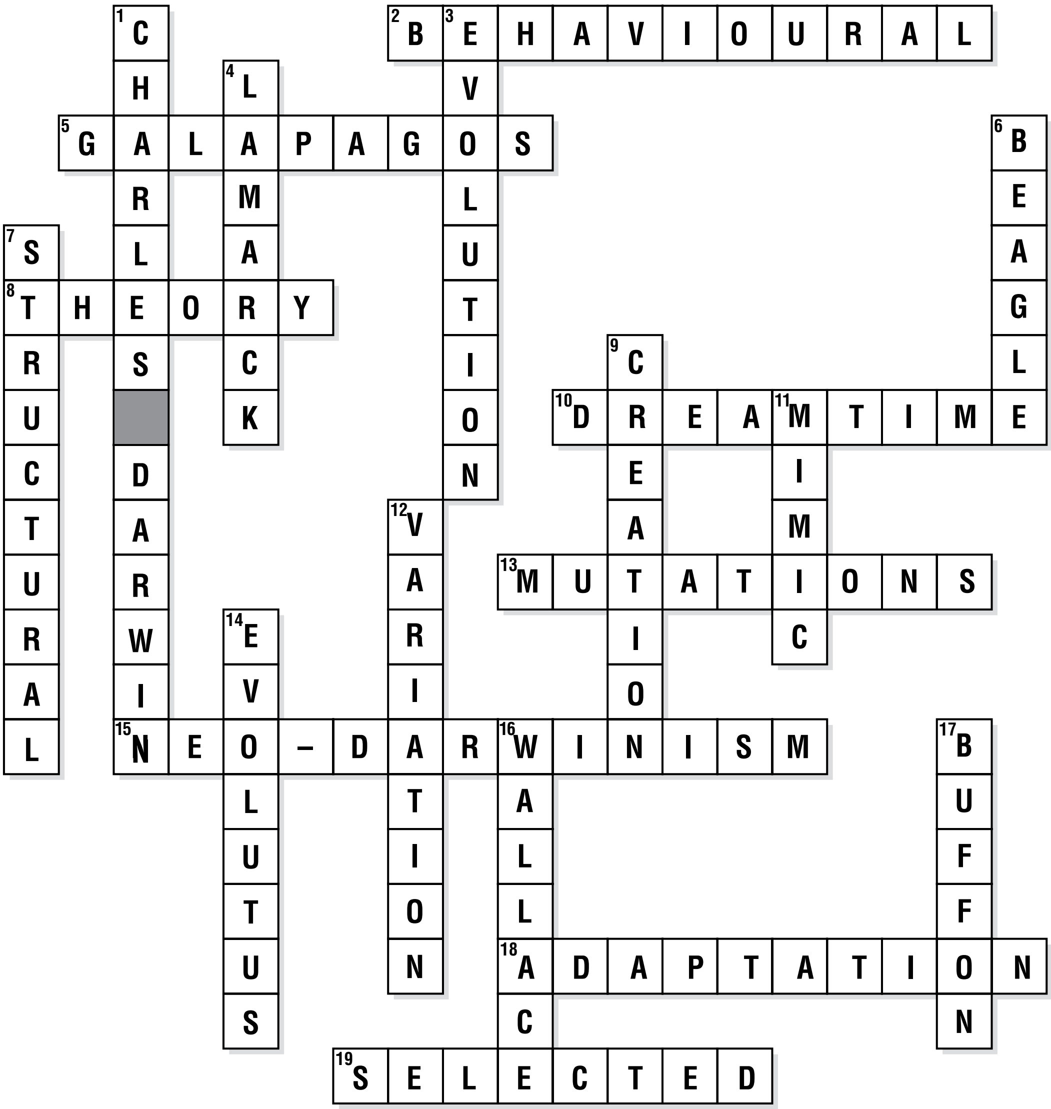
3 a The discovery by Eugene Dubois 110 years ago of the 700 000-year-old *Homo erectus* 'Java Man' fossils.
  b They used fire, made sophisticated stone tools and hunted.

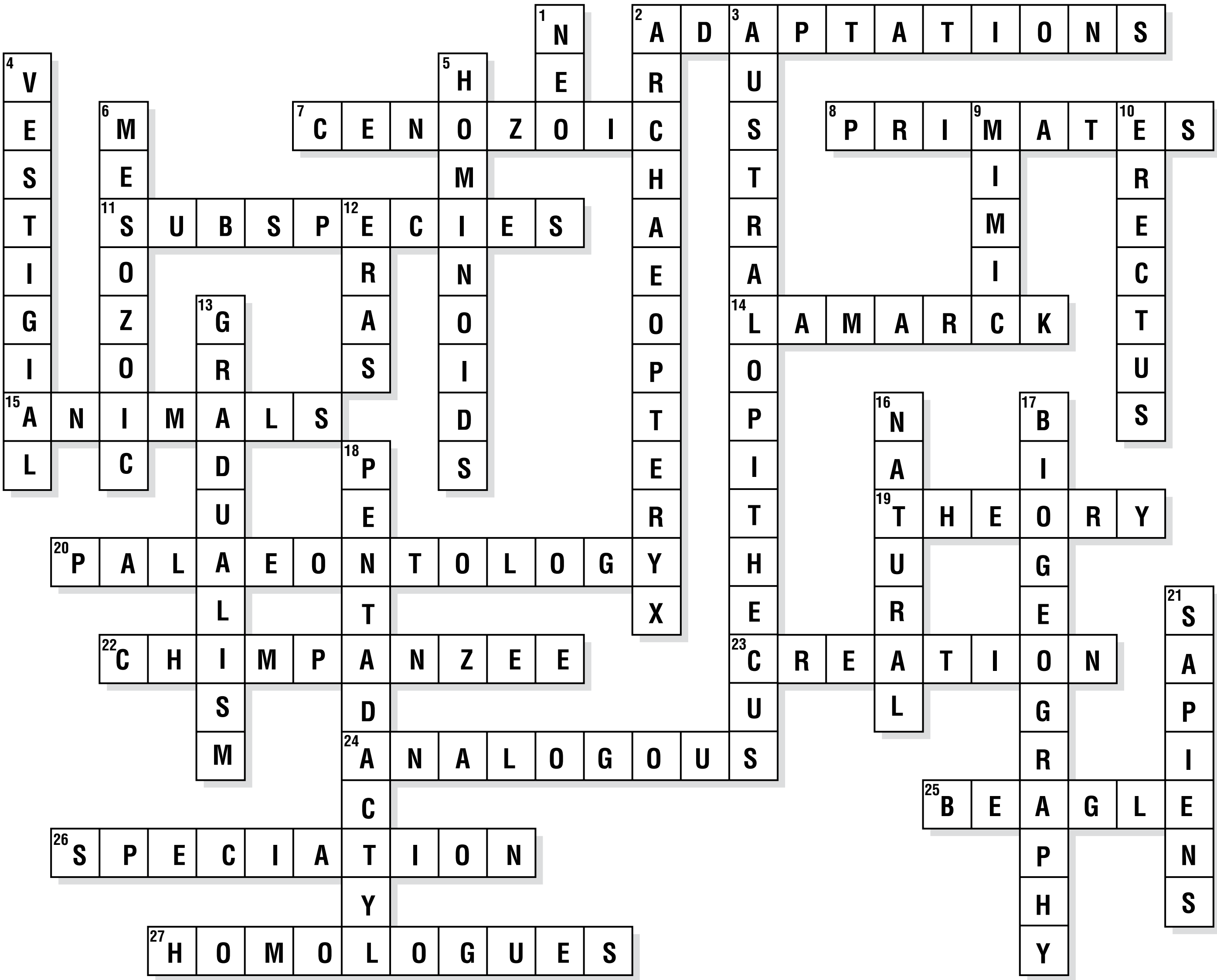
4 Diagrammatic answer is required.

5 It may help us to better understand human evolution. Also, it may provide evidence of how humans adapt to different environments. Not all human species are the same. Some information may also be gained about how humans affect the environment in which they live. This type of information can be applied to better understand how we live now and in the future.

Extension

Students' answers will vary.


1 CHARLES DARWIN
2 BEHAVIOURAL
3 EVOLUTION
4 LAMARCK
5 GALAPAGOS
6 BEAGLE
7 STRUCTURAL
8 THEORY
9 CREATION
10 DREAMTIME
11 MIMIC
12 VARIATION
13 MUTATIONS
14 EVOLUTUS
15 NEO-DARWINISM
16 WALLACE
17 BUFFON
18 ADAPTATION
19 SELECTED


1 NEO
2 ADAPTATIONS
2 ARCHAEOPTERYX
3 AUSTRALOPITHECUS
4 VESTIGIAL
5 HOMINOIDS
6 MESOZOIC
7 CENOZOIC
8 PRIMATES
9 MIMIC
10 ERECTUS
11 SUBSPECIES
12 ERAS
13 GRADUALISM
14 LAMARCK
15 ANIMALS
16 NATURAL
17 BIOGEOGRAPHY
18 PENTADACTYL
19 THEORY
20 PALAEONTOLOGY
21 SAPIENS
22 CHIMPANZEE
23 CREATION
24 ANALOGOUS
25 BEAGLE
26 SPECIATION
27 HOMOLOGUES

Unit 5.1: Being suited to your environment

Clue	Word
1 Collection of well-supported hypotheses	theory
2 Characteristics of organisms which increase their chances of survival	adaptations
3 Physical adaptation	structural
4 Adaptation involving internal function	functional
5 Adaptation involving the way an organism behaves	behavioural
6 Differences which occur between members of a species	variation

Unit 5.2: Evolution through natural selection

Clue	Word
1 Gradual development of different species from a common ancestor	evolution
2 Process whereby the environment selects favourable characteristics of organisms	natural selection
3 Group of organisms which normally interbreeds to produce fertile offspring	species
4 Formation of a new species	speciation
5 Type of evolution which results in adaptive radiation	divergent
6 Similar structures in organisms which are not closely related	analogous structures
7 New and Old World monkeys illustrate this type of evolution	parallel

Unit 5.3: The evidence for evolution

Clue	Word
1 The study of fossils	Palaeontology
2 The geological time scale is divided into four of these	eras
3 The age of the reptiles	Mesozoic era
4 The era in which humans are thought to have first appeared	Cenozoic era
5 Name given to unused structures such as the human appendix	vestigial
6 Having five digits	pentadactyl
7 Structures such as a bat's wing and a seal's flipper which are fundamentally similar but perform different functions	homologues

Unit 5.4: Human evolution

Clue	Word
1 The order to which humans belong	primates
2 Group comprising apes and humans	hominoids
3 Early fossil form known as handy man	Homo habilis
4 Early fossil form known as upright man	Homo erectus
5 The species to which you belong	Homo sapiens

Answers 6.1 Chapter 6: Distance–time graphs

1 Speed is the *distance* a vehicle travels each second. The standard units for speed are *metres per second* or *m/s*.

2 Speed = distance/time

$v = s/t$

3 a i 10 seconds

ii 35 – 10 = 25 seconds

b i v = s/t = 25/10 = 2.5 m/s

ii v = s/t = 7/5 = 1.4 m/s

iii 32 metres away from starting point and 32 metres back = total distance walked = 64 m

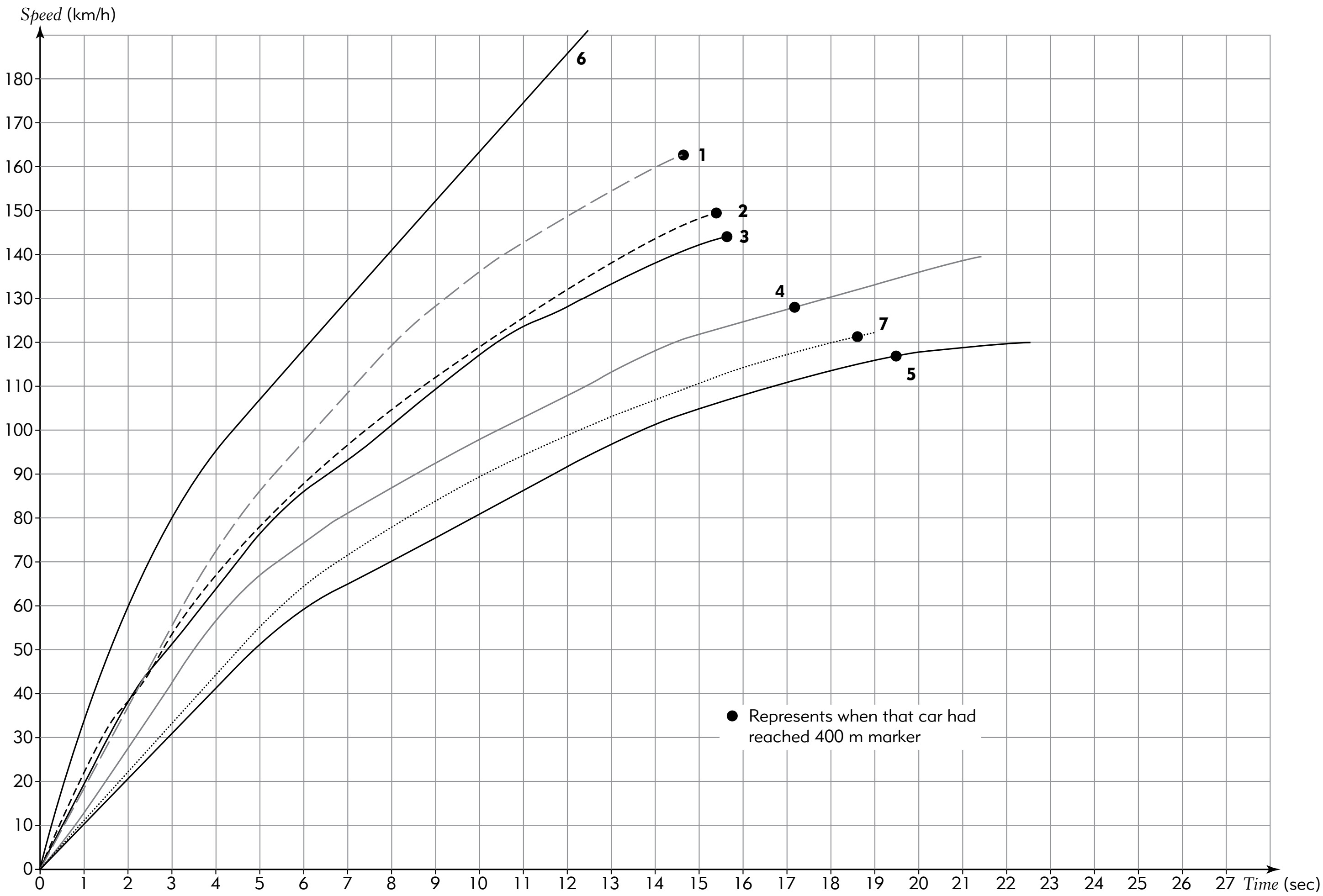
iv Starting position = 0 m. Final position = 0 m. Displacement = 0 m. He returned to where he started.

v v = s/t = 32/10 = 3.2 m/s

vi v = s/t = 64/50 = 1.3 m/s

Answers 6.2 Car performance data

1



2 According to the data and the graph, the car that has the:

a highest top speed is Car #6 (Porsche) with a calculated top speed of 200 km/h

b highest initial acceleration is also Car #6. The data for this car, however, is minimal at low speeds. Of the cars that have data at low speeds, the car that has the highest initial acceleration is Car #2, the Holden Commodore, followed closely by Car #3, the Mercedes, and then Car #1, the Subaru.

c highest average acceleration over the entire journey is Car #6, followed by Car #1.

3 Performance is normally measured in terms of movement away from traffic lights and in overtaking. Few cars ever get to their top speed. Hence, acceleration is a better measure of performance than top speed.

4 The time at which the:

a Subaru reached the same speed as the Holden was at 2.05 s (at a speed of 40 km/h)

b Mercedes reached the same speed as the Holden was at 5.10 s (at 80 km/h).

5 A speed–time graph that is steep (with a high slope) has a higher acceleration than a speed–time graph that is shallow or nearly flat.

6 Although there is insufficient data, it is probably correct to say that Car #6, the Porsche, had the greatest accelerations at all speeds. If we eliminate this car, then the car that had the greatest acceleration:

a at the very start was Car #2, the Holden

b at 30 km/h was Car #2, the Holden (it has the greatest slope at that speed)

c at 60 km/h was Car #1, the Subaru.

7 The gear that is best for:

a accelerating from traffic lights is 1st gear

b high-speed freeway driving is 5th gear

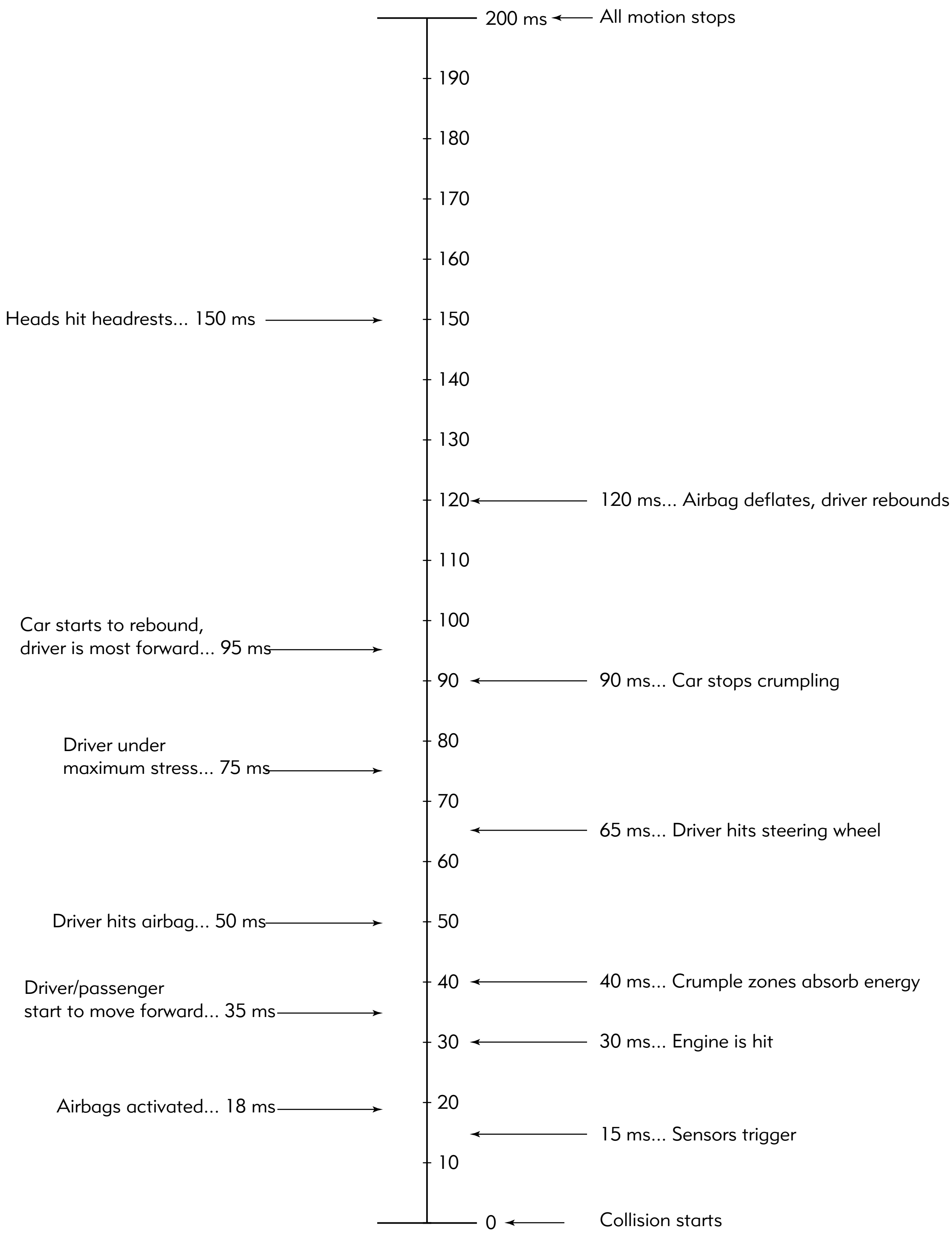
c overtaking is a high-speed/high-acceleration gear, such as 3rd or 4th gear, depending on the speed at which the car is travelling.

8 As the speed of each car gets higher, the slope of the graph becomes more shallow. Thus, acceleration decreases as the speed of the car increases. As the graph climbs, higher gears were being used.

1

Active	Passive	Passive
ABS brakes	Bumper bars	Laminated windscreen
Power steering	Airbags	Seat-belts
Stop-lights	Headrests	Child restraint capsules
Mirrors	Padded dash	Rollbars
Demister	Recessed door handles	Collapsible steering column
Fog lights	Crumple	zones

2



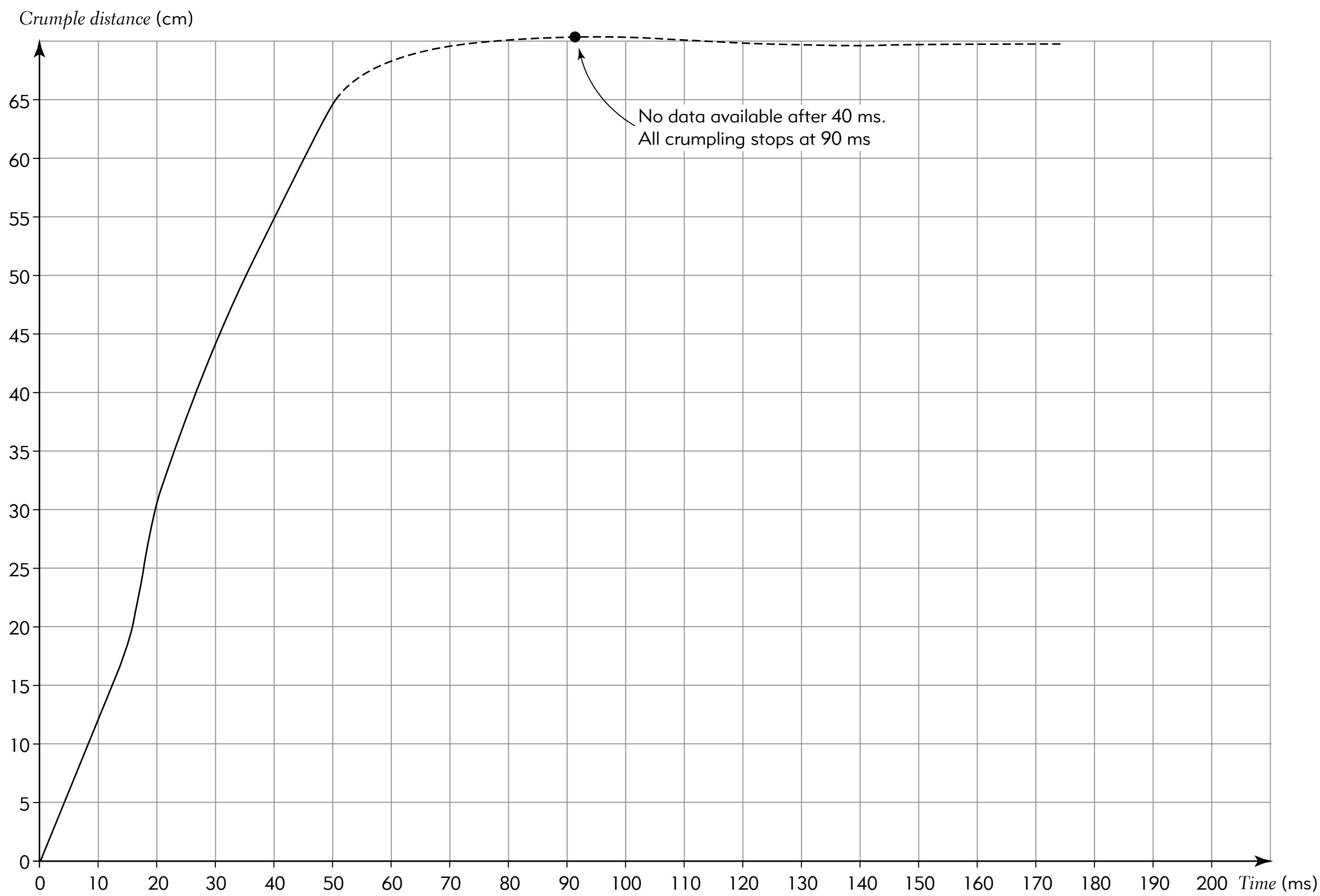
a The timeline starts when the accident has actually started and does not cover the time immediately before the accident when the driver was doing everything he or she could do to avoid it. Active safety features help us avoid an accident. Passive safety features help us avoid injury once the accident has started. Hence, only passive features are shown in the timeline.

b The driver is most likely to be injured at 75 ms, when he or she is experiencing maximum stress. The times when the driver is collapsing into the airbag and colliding with the steering column also represent great risk.

c The human body is elastic to some extent: our neck, spine and muscles all stretch but will naturally rebound to their original shape once a collision force has stopped. The body will stretch in the accident, but then contract—hence the rebound.

d Headrests stop the rear movement of the head (and its attached neck) in rebound. They also accelerate the head at the same rate as the car if the car is hit from behind. Both these actions minimise the risk of whiplash or neck injuries.

3



1

Force (N)	Mass (kg)	Acceleration (m/s^2)
20	10	2
18.9	6.5	2.9
56	7	8
24.5	3.6	6.8
108	12	9
2.9	29.0	0.1
221.4	17.3	12.8
17.5	12.5	1.4

2

Force	Mass	Acceleration
9800 N	1 tonne	9.8 m/s^2
137.5 N	66 kg	7500 m/hr^2
66 N	22 kg	10.8 km/hr^2
2.1 kN	1.6 tonne	1.3 m/s^2
172 N	1000 kg	17.2 cm/s^2
17.5 N	2500 g	7 m/s^2
2.5 kN	5000 g	500 m/s^2
416.7 N	15 000 g	100 km/hr^2

1 **a** Newton's First Law states that an object will remain *stationary* or moving at a constant *speed* in the same direction unless an overall *force* acts on it.

b Newton's Second Law is an equation about how much a force will make something accelerate: Force = *mass* × *acceleration*

c Newton's Third Law states that forces always come in pairs – for every *action* force there is an *equal* and opposite reaction force.

2

Situation	Aristotle	Galileo	My explanation of what would really happen.
A marble and a ball bearing of the same size and mass are dropped from the same height.	Both will fall at the same speed, and hit the ground at the same time, as they are of equal mass.	Both masses will fall at the same speed, and hit the ground at the same time.	Both masses will fall at the same speed and hit the ground at the same time, because the speed is determined by gravity. Both accelerate at 9.8 m/s. They are both spheres so they have similar air resistance.
A 2 kg spherical mass and a 1 kg spherical mass of the same size are dropped from the same height.	The 2 kg mass will fall with twice the speed of the 1 kg mass, hitting the ground first.	Both masses will fall at the same speed, and hit the ground at the same time.	Both masses will fall at the same speed and hit the ground at the same time, because the speed is determined by the gravity. Both accelerate at 9.8 m/s^2. They are both spheres, so they have similar air resistance.
A coin and a feather of the same mass are dropped from the same height.	Both will fall at the same speed and hit the ground at the same time because their mass is the same.	The coin will fall faster and hit the ground first. The feather will fall more slowly because of friction with the air.	The coin will fall faster and hit the ground first because it has less air friction. The feather will fall more slowly because of friction with the air.
Stop pushing a trolley across a carpeted floor.	The trolley will stop when the force stops being applied.	The trolley will continue until the force of friction stops it.	The trolley will stop. The friction of wheels on the carpet will act to stop movement.
Stop pushing a person on ice skates across ice.	The person will stop when the force stops being applied.	The person will continue until the force of friction stops them.	The person will stop, but may travel a long way as there is only a small amount of friction acting between the skates and the ice.
Stop pushing a person floating in space.	The person will stop when the force stops being applied.	The person will continue until the force of friction stops them.	The person will keep moving as there is no air or objects to cause friction. They will move indefinitely in the direction the force was applied.

Answers 6.6 Weight

1

Planet	Relative gravity	Working	Calculated planet gravity (ms^{-2})
Mercury	0.38	9.8 × 0.38	3.7
Venus	0.9	9.8 × 0.9	8.8
Earth	1	–	9.8
Mars	0.376	9.8 × 0.376	3.7
Jupiter	25.25	9.8 × 25.25	247.5
Saturn	1.064	9.8 × 1.064	10.4
Uranus	0.903	9.8 × 0.903	8.8
Neptune	1.135	9.8 × 1.135	11.1

2 Answers will vary, depending on the student's mass.

3 Answers will vary, depending on the student's mass. The answers in the following table are based on a mass of 60 kg.

Planet	Working	Your weight (N)
Mercury	60 × 3.7	222
Venus	60 × 8.8	528
Earth	60 × 9.8	588
Mars	60 × 3.7	222
Jupiter	60 × 247.5	14 850
Saturn	60 × 10.4	624
Uranus	60 × 8.8	528
Neptune	60 × 11.1	666

1 **a** F = 10 N

s = 5 m

$W = Fs$

W = 10 × 5 = 50 J

b F = 15 N

s = 1.2 m

$W = Fs$

W = 15 × 1.2 = 18 J

c m = 50 kg

v = 5 m/s

$KE = ½\ mv^2$

KE = 0.5 × 50 × 5^2 = 625 J

2 **a** $GPE = mgh$

= 60 × 9.8 × 5 = 2940 J

b When he dives, the potential energy will be converted into kinetic energy. Nearly all of his gravitational energy (minus a little heat and sound) will have been converted into kinetic energy.

c Approximately 2940 J would be expected to be converted into kinetic energy.

d He retains some of his kinetic energy as he enters the water. Most of his kinetic energy is transferred to the water as water movement. Work is being done on the water. Some heat and sound is generated.

3 **a** m = 1 kg

h = 2 m

g = 9.8 m/s^2

$GPE = mgh$

GPE = 1 × 9.8 × 2 = 19.6 J

b

Height above ground (m)	Potential energy (J)	Kinetic energy (J)
2.0	19.6	0.0
1.5	14.7	4.9
1.0	9.8	9.8
0.5	4.9	14.7
0.0	0.0	19.6

c The trends are that the total energy remains the same at all heights; i.e. 19.6 J. At 1.0 m or half-way, both energies are the same.

d m = 1 kg

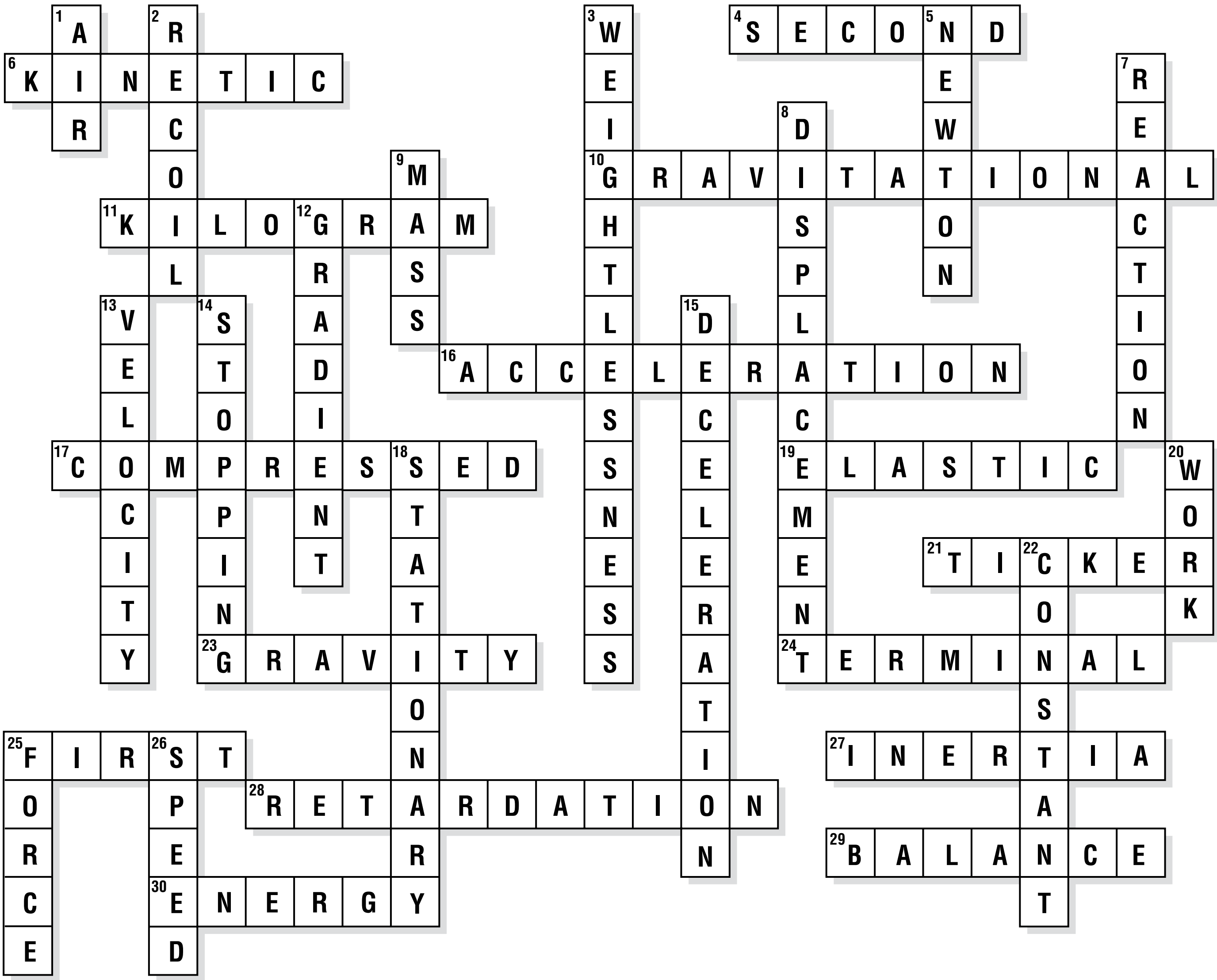
$KE = ½\ mv^2$

For this calculation you need to rearrange the subject of the equation as follows: v^2 = 2 × KE/m

= 2 × 19.6/1

v^2 = 39.2

v = 6.3 m/s


1 AIR
2 RECOIL
3 WEIGHTLESSNESS
4 SECOND
5 NEWTON
6 KINETIC
7 REACTION
8 DISPLACEMENT
9 MASS
10 GRAVITATIONAL
11 KILOGRAM
12 GRADIENT
13 VELOCITY
14 STOPPING
15 DECELERATION
16 ACCELERATION
17 COMPRESSED
18 STATIONARY
19 ELASTIC
20 WORK
21 TICKER
22 CONSTANT
23 GRAVITY
24 TERMINAL
25 FORCE
26 SPEED
27 INERTIA
28 RETARDATION
29 BALANCE
30 ENERGY

Unit 6.1: Describing motion

Clue	Word
1 Speed with direction	velocity
2 Distance and direction from the start	displacement
3 Distance/time	average speed
4 Electric hammer used to measure motion	ticker-timer
5 At rest	stationary
6 Slope of a graph	gradient
7 Time it takes to detect and respond to an emergency	reaction time

Unit 6.2: Acceleration

Clue	Word
1 Rate of change in velocity	acceleration
2 Negative acceleration	deceleration
3 m/s^2	metres per second squared

Unit 6.3: Newton's First Law

Clue	Word
1 Push or pull	force
2 The effect of no force being applied	inertia
3 The law of inertia	Newton's first law

Unit 6.4: Newton's Second Law

Clue	Word
1 Unit for force	newton
2 Amount of matter	mass
3 Unit for mass	kilogram
4 $F = ma$	Newton's Second Law
5 A change in force may cause this	acceleration

Unit 6.5: Newton's Third Law

Clue	Word
1 Pair of forces	action/reaction force pair
2 Explains action/reaction	Newton's Third Law
3 A force that propels a rocket	thrust
4 A fuel	propellant

Unit 6.6: Gravity

Clue	Word
1 A force due to gravity	weight
2 Acceleration towards a planet	gravity
3 A slowing force or friction that reduces the rate of fall	air resistance
4 A measure of increased forces	g-force
5 When weight and air resistance are balanced during a fall you reach a ______________ velocity	terminal
6 We feel this in a falling lift	weightlessness

Unit 6.7: Work and energy

Clue	Word
1 Needed to do work	energy
2 Needed to apply a force	work
3 Moving energy	kinetic energy
4 Energy due to height	gravitational potential energy
5 Energy in an elastic band	elastic potential energy
6 Measures the stiffness of an elastic material	spring constant
7 Squashed	compressed
8 A measure of the use of energy	efficiency

Answers 7.1 Chapter 7: Ohm's law

1

	Voltage (V) (volts)	Current (I) (amperes)	Resistance (R) (ohms)
a	12	6	2
b	24	12	2
c	240	120	2
d	12	4	3
e	24	4	6
f	50	1	50
g	50	2	25
h	50	5	10
i	110	5	22
j	180	3	60

2 **a** current increases
b resistance decreases
c voltage increases

Answers 7.2 Inside MLX01

1 500 km/h
2 1.742 hrs; or 1 hr, 45 minutes; or 105 minutes
3 **a** floating guide coil
b aero-wedge head
c liquid helium tank
d superconducting coil
4 **a** They are aerodynamic brakes—they slow the train by creating friction with the air.
b Rubber tyres are for use at speeds less than 100 km/h.
c to reduce air resistance
d a shock absorber

Answers 7.2 Inside MLX01

Clues	Scrambled words
1 Brakes used to stop the train if the primary brakes fail	aerodynamic
2 Metal from which the body of the MLX01 is made	aluminium
3 Contains seats	cabin
4 Used to monitor the way ahead	camera
5 A superconducting ______ is cooled by liquid helium	coil
6 These control the train	computers
7 Path on which the MLX01 runs	guideway
8 Helps cool the superconducting coil	helium
9 Energy of ______ would be dissipated by shock absorbers	impact
10 Shape of the cross-section of the cabin	oval
11 Air ______ is reduced by the shape of the MLX01	resistance

Answers 7.3 Electromagnetic spectrum

1 **a** gamma rays

b AM radio (longwave radio)

2

Electromagnetic wave	Uses	Wavelength in metres (m)
Gamma rays	Electricity generation (nuclear power), medical imaging, cancer treatment, food irradiation	10^{-12} (1 picometre)
X-rays	Medical imaging including X-rays and CAT scans, security X-rays at airports	10^{-10} to 10^{-9}
Ultraviolet rays	Tanning, disinfecting lamps for killing bacteria and microbes, chemical analysis	10^{-9} to 10^{-7}
Visible light	Human sight, communication (optical fibres), lasers, devices that involve mirrors and lenses such as telescopes and microscopes	approx. 10^{-6} (1 micrometre)

Electromagnetic wave	Uses	Wavelength in metres (m)
Infra-red waves	Radiator heaters, night vision, remote controls, some telescopes used to look at heat of stars	10^{-6} to 10^{-3} (1 micrometre to 1 millimetre)
Microwaves	Cooking, communication, satellite TV, weather radar, military radar, monitoring ozone	10^{-3} to 10^{-1} (1 millimetre to 10 cm)
Radio waves	Communication, radio and television	10^{-1} (or 10^{1}) to 10^{5}, 10 cm (or 1 metre) to 1 kilometre

3 **a** X rays (X-ray crystallography is used to look at molecular structure)

b gamma rays

4 **a** The wavelength of visible light is longer than the size of the molecules so it cannot penetrate the structure and bounce back to give a picture.

b Radio waves (FM) are approximately one metre in length. A one-metre aerial allows the radio waves to be received better.

5 Total length = 16 cm, length of visible spectrum = 0.4 cm

% = 0.4/16 × 100 = 2.5%

6 ultraviolet rays

7 **a** premature aging of skin, skin cancer, drying, burning of skin, eye cancer

b Cover up with clothing, hats and sunglasses. Use sunscreen to absorb ultraviolet rays. Keep out of the sun.

c Microwaves can cause burns. Gamma rays can cause cancer and burns. X-rays can cause cancer.

d Electromagnetic waves with a short wavelength are most dangerous to humans. These waves have higher energy than less dangerous waves, and a higher frequency.

Extension

Students' answers will vary.

Answers 7.4 Digital communication

1 Asymmetric Digital Subscriber Line

2 It allows for 'piggy backing' of both voice and data at different frequencies. These are 20 kHz to 2.2 MHz frequency for data. Phone and fax information is in the 0 kHz to 4 kHz spectrum.

3 **a** It allows more information to be carried over a broader frequency range or band.

b Broadband allows multiple pieces of information to travel at the same time along a wire. This is similar to allowing cars to travel on a six-lane highway rather than on a two-lane suburban street. More cars can travel side by side and at a faster speed on a six-lane highway. The inline filters could be compared to a road block that lets some cars through and keeps others out.

c A splitter at the local telephone exchange keeps the voice and Internet signals apart. It may interfere with those devices that you are currently using on your normal phone line.

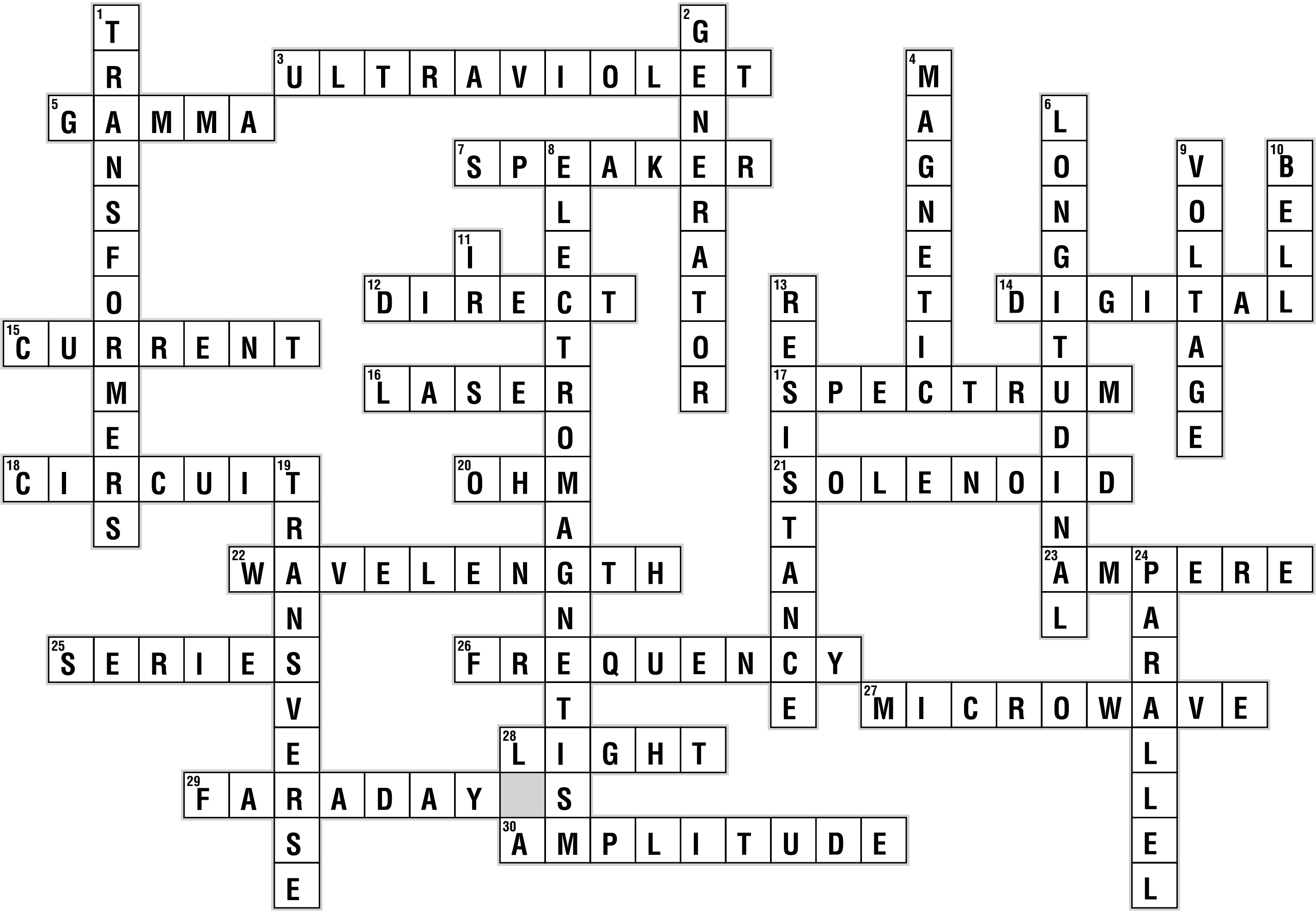
d An inline filter removes high-frequency data signals that might cause interference with the telephone, fax or answering machine.

4 An ADSL modem already has a filter built into its circuit.

5 Need to add another phone socket and an inline filter.

Extension

Students' answers will vary.


1 TRANSFORMERS
2 GENERATOR
3 ULTRAVIOLET
4 MAGNETIC
5 GAMMA
6 LONGITUDINAL
7 SPEAKER
8 ELECTROMAGNETISM
9 VOLTAGE
10 BELL
11 IR
12 DIRECT
13 RESISTANCE
14 DIGITAL
15 CURRENT
16 LASER
17 SPECTRUM
18 CIRCUIT
19 TRANSVERSE
20 OHM
21 SOLENOID
22 WAVELENGTH
23 AMPERE
24 PARALLEL
25 SERIES
26 FREQUENCY
27 MICROWAVE
28 LIGHT
29 FARADAY
30 AMPLITUDE

Unit 7.1: Electricity

Clue	Word
1 Device that uses up electricity in a circuit is called a ______________	load
2 Energy source	cell
3 Electricity easily flows through a ______________ path	conducting
4 The energy pushing electrons through a circuit	voltage
5 The flow of electrons or charges through a circuit	current
6 Turns the current on and off	switch
7 A _________ wire has more resistance than a thick wire	thin
8 DC stands for ______________ current	direct
9 AC stands for ______________ current	alternating
10 The ability of a substance to reduce the flow of current	resistance
11 $V = IR$	Ohm's Law
12 Type of circuit for home lights	parallel
13 Components connected in a line are said to be in ______________	series

Unit 7.2: Electromagnetism

Clue	Word
1 Solenoid with an iron core	electromagnet
2 Invisible force fields	magnetic fields
3 Tiny suspended magnet	compass
4 Uses a moving magnet or moving coil to produce electric current	generator
5 A generator for a bike	dynamo
6 Converts sound waves to electric current	microphone
7 Increases or decreases voltages	transformer

Unit 7.3: Waves in communication

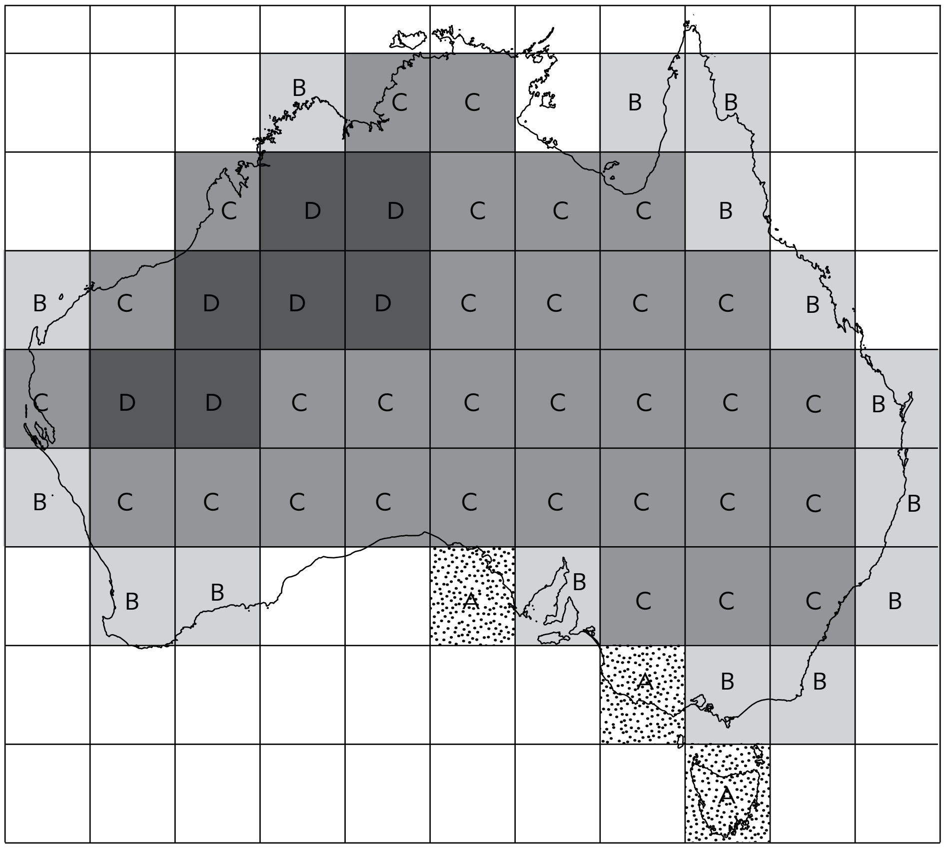
Clue	Word
1 Type of wave	transverse
2 Used to demonstrate waves	slinky
3 Number of waves per second	frequency
4 Unit of frequency	hertz
5 Distance between consecutive crests	wavelength
6 Height of a wave above its middle position	amplitude
7 Composed of a series of alternating electric and magnetic fields	light
8 Part of the electromagnetic spectrum we can see	visible
9 Short radio waves	microwaves
10 UV	ultraviolet
11 Waves associated with heat and remote controls	infra-red
12 High energy X-rays	gamma
13 The M in AM and FM. Relates to altering a carrier wave	modulation

Unit 7.4: The communications network

Clue	Word
1 Early communications system	telegraph
2 Continuously varying signal	analogue
3 Signal composed of 1s and 0s	digital
4 The sending of more than one signal at once	multiplexing
5 Fibre that can handle more communications traffic than other types of cables	optical
6 Light amplification by the stimulated emission of radiation	laser
7 ______________ waves are 'in step'	coherent
8 ______________ communication uses microwaves	satellite
9 Another word for a mobile phone	cell

1 **a** Capital cities to be marked on map.

b



City	Temperature rise predicted in 2030	Temperature rise predicted in 2070
Canberra	2.0	6.0
Sydney	2.0	6.0
Melbourne	1.7	5.1
Adelaide	1.7	5.1

City	Temperature rise predicted in 2030	Temperature rise predicted in 2070
Perth	1.7	5.1
Hobart	1.4	4.3
Darwin	2.0	6.0

2 **a** The weather in this region usually comes from the south, bringing cool air from the Antarctic region onto the coast, keeping the average temperature rise down.

b Regions marked 'D' are inland in a subtropical region which is already hot. Warm air forms here as the land warms up due to the Sun's rays. Being inland, the area will be less likely to cool down as much at night, keeping the average temperature considerably higher.

3 Environment: will become warmer and dryer with less water available. Alpine areas around Canberra will change with different vegetation taking over the higher regions. Some plants and animals will have to move or they will become extinct.

People: more heat stress in summer, properties affected by more storms and bushfires, higher rates of disease in warmer areas as bacteria are more likely to grow faster. Also, bacteria that previously were not able to survive in colder temperatures are now able to survive in the warmer climate and so new diseases would be seen.

Weather: less rain but more severe storms, bushfires, dryer, hotter days.

4 Temperature rises are the result of global warming caused by the enhanced greenhouse effect trapping more heat in the Earth's atmosphere. The greenhouse effect is caused by humans releasing more carbon dioxide and greenhouse gases into the air through processes such as land clearing and burning fossil fuels. (Diagram of the greenhouse effect may help in this answer.)

5 Answers may include:

- planting more trees to absorb carbon dioxide
- finding cleaner alternative energy sources
- walking or riding a bike instead of driving
- educating others about how to reduce greenhouse gas emissions
- building more energy-efficient homes and buildings
- recycling wood and paper to reduce clearing of forests.

Extension

Students' answers will vary.

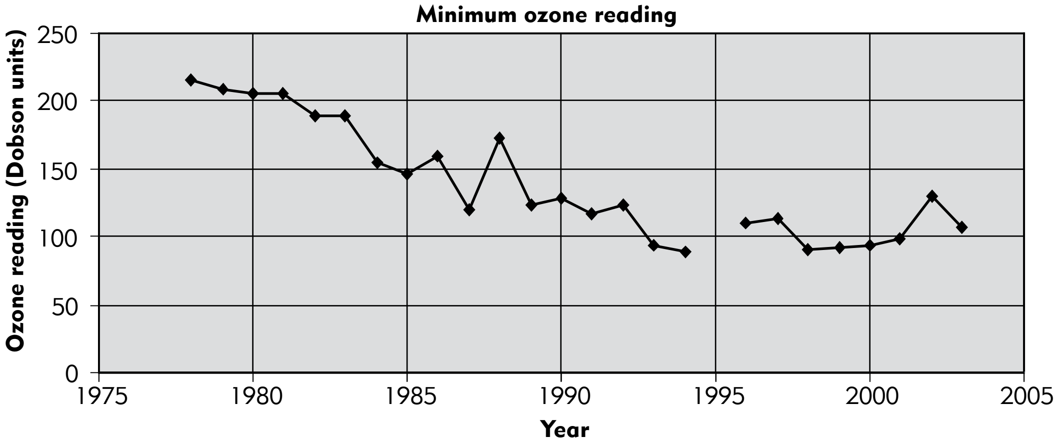
Answers 8.2 Global warming

1

Term	Description	Answer
Greenhouse effect	A Released whenever fossil fuels are burnt	D
Hot car effect	B Designed to reduce emissions of greenhouse gases by 5% in developed nations by 2012	H
Enhanced greenhouse effect	C Twenty-one times more effective than carbon dioxide in blocking escaping radiant heat	K
Carbon dioxide	D Caused by the gas carbon dioxide and other trace gases	A
Methane	E Produced by the action of sunlight on pollution from motor vehicles and industry	C
CFC	F Coal and the other main fuels: gas, petrol and oil	J
Photochemical smog	G The clearing of land, which increases greenhouse gases, because trees are destroyed and so can no longer convert carbon dioxide into oxygen during photosynthesis	E
Kyoto Protocol	H Another name for the greenhouse effect	B
Global warming	I Occurs when trade winds weaken or reverse, resulting in Australia experiencing drought and South America experiencing increased rainfall	L
El Niño	J Chlorofluorocarbons, which were, until recently, used in aerosol spray cans, refrigerators and air conditioners	I
Deforestation	K Due to an increase in greenhouse gases	G
Fossil fuels	L May result in more storms, droughts, floods, hurricanes and temperature extremes	F

2 See Figure 8.2.3 in *Science Focus 4 Second Edition*.

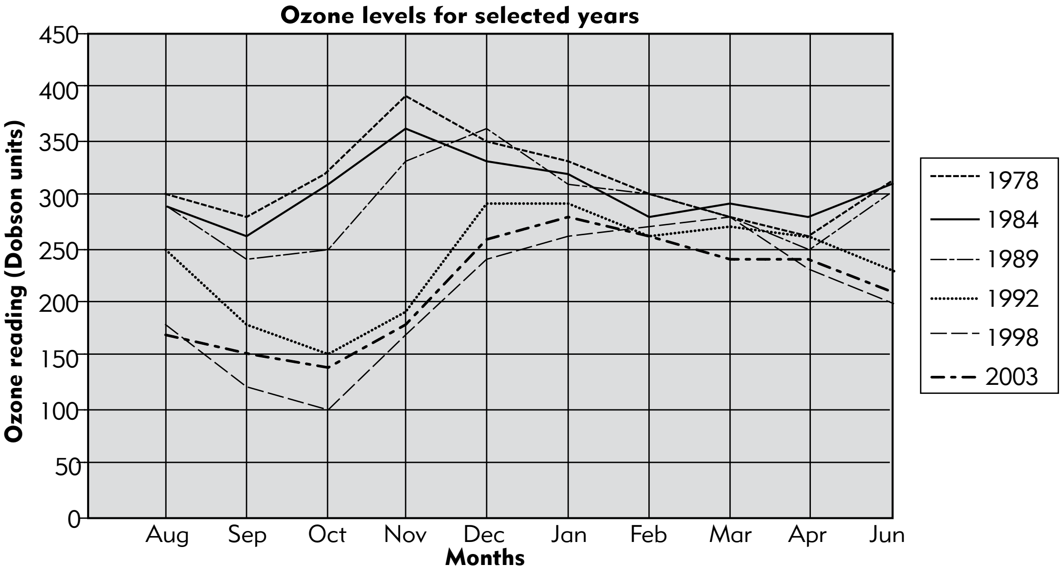
1



2 The minimum thickness of the ozone layer continued to fall from 1983 to about 2001. In the years 2002 and 2003, the thickness appeared to be increasing. A similar trend occurred in 1996 and 1997.

3 This may be the result of the banning of CFC products and the introduction of some of the Kyoto Protocol objectives.

4

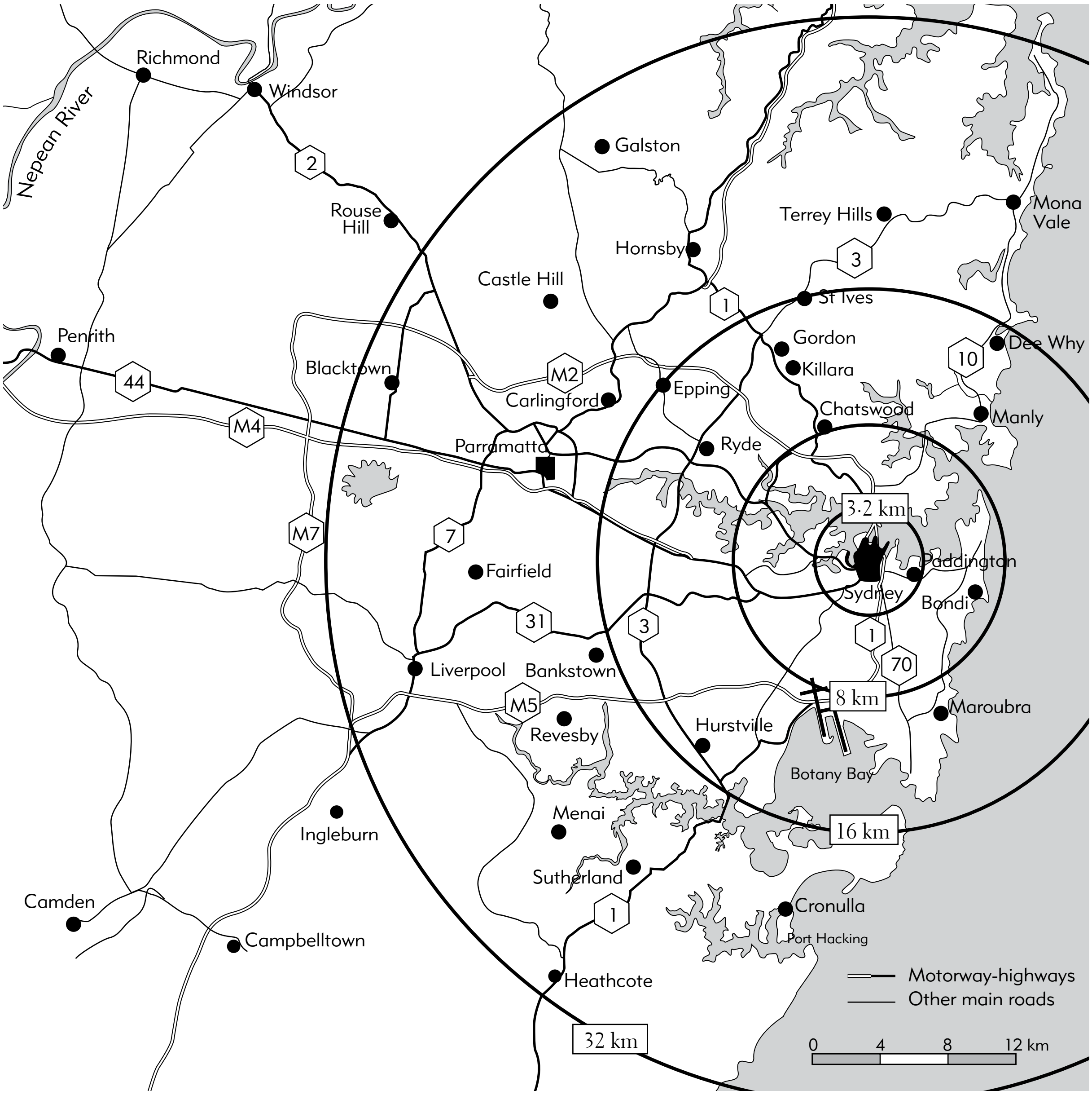


5 **a** The ozone layer is fairly constant in thickness between December and August. Between September and November the ozone hole is the thinnest. This coincides with the start of summer in Antarctica.

b In 1978 and 1984, there was only a small difference in average ozone thickness, the hole only varying by about 100 DU over each of these years. In 1998 and 2003, the ozone hole was always at least 100 DU thinner than in 1978 and 1984, and the hole at its thinnest was up to 200 DU thinner than in the previous years. This again supports the claim that the ozone layer has thinned over the years, as does the first graph.

Extension

An oxygen atom is made up of one oxygen atom. An oxygen molecule is made up of two oxygen atoms joined together by a double bond. An ozone molecule is made up of three oxygen atoms. The central O shares a double bond with one oxygen and a single bond with the other oxygen.


Richmond
Windsor
Nepean River
2
Rouse Hill
Galston
Hornsby
Terrey Hills
Mona Vale
3
Castle Hill
1
St Ives
Penrith
44
Blacktown
M2
Gordon
Killara
10
Dee Why
Carlingford
Epping
Chatswood
Manly
M4
Parramatta
Ryde
3.2 km
M7
7
Fairfield
Paddington
Sydney
Bondi
31
3
1
70
Liverpool
Bankstown
8 km
M5
Revesby
Hurstville
Maroubra
Botany Bay
Menai
16 km
Ingleburn
Sutherland
Camden
1
Cronulla
Port Hacking
Campbelltown
Heathcote
Motorway-highways
Other main roads
32 km
0
4
8
12 km

Answers 8.5 Human cloning

1 **a** Cloning is the production of a new organism from a cell of an organism.

b Stem cells are early embryonic cells that can develop into any body tissue.

2 **a** Stem cells are touted as a potential cure for diseases. New body tissue could be made using stem cells.

b They are taken from very early embryos. Those embryos, if implanted into a uterus, could develop into humans.

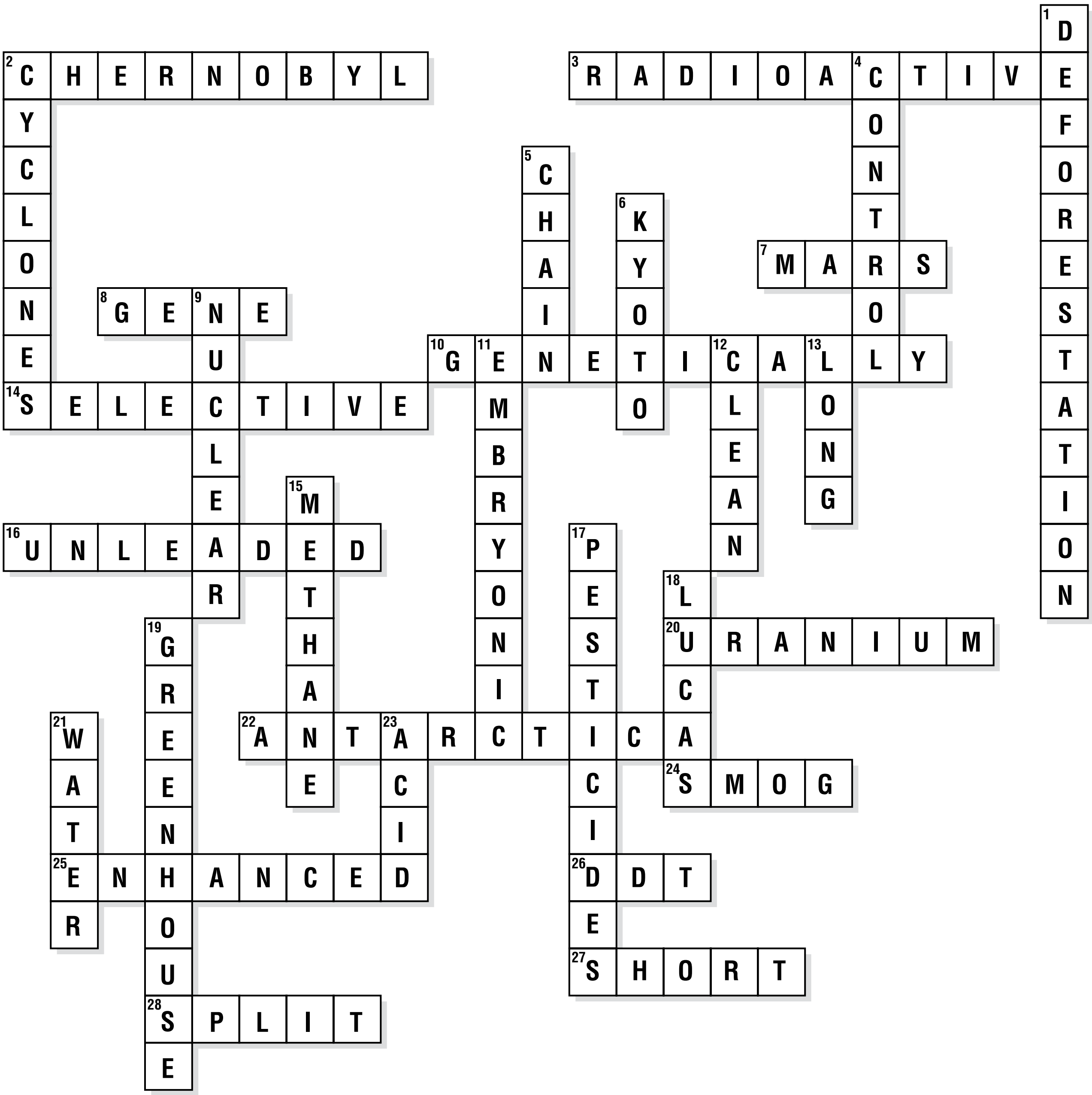
3 **a** Stem cells from the clones are a potential source of a cure for diseases including cancer and Parkinson's disease.

b The embryo is a living organism. It should be treated with respect and not be seen as a commercial resource to be 'mined'.

c Various answers are possible.

Extension

Students' answers will vary.



1 DEFORESTATION
2 CHERNOBYL
2 CYCLONE
3 RADIOACTIVE
4 CONTROL
5 CHAIN
6 KYOTO
7 MARS
8 GENE
9 NUCLEAR
10 GENETICALLY
11 EMBRYONIC
12 CLEAN
13 LONG
14 SELECTIVE
15 METHANE
16 UNLEADED
17 PESTICIDES
18 LUCAS
19 GREENHOUSE
20 URANIUM
21 WATER
22 ANTARCTICA
23 ACID
24 SMOG
25 ENHANCED
26 DDT
27 SHORT
28 SPLIT

Unit 8.1: Debates in science and society

Clue	Word
1 These are purely matters of personal taste and choice	values
2 In 2007, BMW released this hybrid 12-cylinder 7-series luxury saloon	Hydrogen-7
3 This is needed to make decisions about the effects of new technologies	evidence
4 This type of electricity is derived from renewable sources such as wind and hydroelectricity	green

Unit 8.2: Global warming

Clue	Word
1 Wavelength trapped by the Earth's atmosphere	long
2 Coal, gas and oil are ______________ fuels that contribute to global warming when burnt	fossil
3 The main greenhouse gas	carbon dioxide
4 Another greenhouse gas	methane
5 Abbreviation for chlorofluorocarbons	CFCs
6 Smog produced by sunlight and pollution	photochemical
7 Global warming will lead to more extreme _________	weather
8 Animal that is a source of methane	cow
9 Clearing of land	deforestation
10 The ______________ Protocol is an international agreement to control greenhouse gas levels	Kyoto

Unit 8.3: Nuclear power

Clue	Word
1 Fast-moving particle or electromagnetic wave	radiation
2 Type of radiation from the nucleus of an atom	nuclear
3 ______________ energy sources are those other than fossil fuels	alternative
4 Source of fissionable material	uranium
5 The splitting of a nucleus with the release of energy	fission
6 Mass that will sustain nuclear fission	critical
7 Site of a major nuclear reactor accident	Chernobyl
8 The coming together of two nuclei with the release of energy	fusion

Unit 8.4: Fiddling with food

Clue	Word
1 Another word for poison	toxin
2 This intake of toxins is called ______________	bioaccumulation
3 Metallic element with symbol Hg	mercury
4 One of the components of leaded petrol	lead
5 Family of organic compounds that are fat soluble	dioxins
6 These chemicals kill weeds	herbicides
7 Cancer-causing agent	carcinogen
8 Abbreviation for dichloro-diphenyl-trichloroethane	DDT
9 This algae is toxic to humans and animals	blue-green
10 Abbreviation for genetically modified organism	GMO
11 Fuels that can be processed from crops such as sugar cane and corn	biofuels

Unit 8.5: Biotechnology

Clue	Word
1 A type of stem cell	embryonic
2 The process of stem cells forming different and specialised cells is called ______________	differentiation
3 Abbreviation for in-vitro fertilisation	IVF
4 Transplants of any material into the human body usually lead to ______________	rejection
5 The procedure where an egg cell has its nucleus replaced with a full set of genes from one parent	cloning
6 The first animal ever cloned using a cell from an adult animal	Dolly

Unit 9.1: Being an individual

Clue	Word
1 These need to be set in order to complete a project on time	timelines
2 Process of sharing information or findings from an investigation	communicating
3 A person who is able to come up with new ideas and invent new ways of doing things is said to show ______________	creativity
4 Planning timelines, making lists and proceeding in a series of steps involves ______________	organisation
5 ______________ involves making the most of the resources you have available, and taking advantage of opportunities that arise	resourcefulness
6 Wanting to achieve and meeting goals requires ______________	dedication
7 _____-_________ requires you to know the reasons why you want to achieve. Being interested helps improves this aspect of yourself	self-motivation

Unit 9.2: My investigation

Clue	Word
1 Process of finding out new information involving the use of experiments, research and analysis	investigation
2 A questions is _________-_________ if it cannot be answered with a simple yes/no or true/false	open-ended
3 An ______________ is a hands-on way to investigate, discover or prove a scientific concept	experiment
4 Can be constructed to investigate a scientific concept or idea	model
5 Outlines the idea or scientific question you are trying to test	aim
6 Prediction or 'educated guess' about what you may find in an experiment	hypothesis
7 Factor that can change the results of an experiment	variable
8 Variable that is changed to investigate its effect	independent

9	This type of variable changes because of the independent variable changing, and it is the variable that is being measured	dependent
10	______________ variables are kept the same throughout an experiment	controlled
11	A stepwise set of instructions to follow when completing an experiment	method
12	Results of this type are based on numerical data	quantitative
13	Results of this type can be based on observations	qualitative
14	The part of a scientific report where you analyse and evaluate your results in detail	discussion
15	A simple summary of the results of your experiment	conclusion

1: Chemical and nuclear reactions

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 97 marks

Section A—Multiple choice (23 marks)

1	The substances formed after a chemical reaction are called the: **A** reactants **B** reaction **C** products **D** final chemicals.		1
2	An element consists of: **A** one type of atom **B** two or more atoms **C** a group of electrons **D** none of the above.		1
3	Ions are charged particles. A positive ion is one that has: **A** gained protons **B** gained neutrons **C** lost electrons **D** lost neutrons.		1
4	A substance that has covalent bonding: **A** shares electrons **B** shares protons **C** loses or gains electrons **D** loses or gains protons.		1
5	In all chemical reactions: **A** new atoms are formed **B** matter is created **C** mass is lost **D** new compounds are formed by rearranging atoms rather than by creating matter.		1

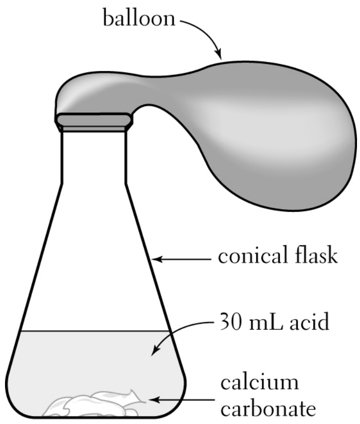
6	Given that the symbol for iron is Fe, and the formula for the chloride ion is Cl^-, the formula for iron(II) chloride is: **A** FeCl **B** $FeCl_2$ **C** Fe_2Cl **D** Fe_3Cl_4.		1
7	The Law of Conservation of Mass states that in a chemical reaction: **A** the mass of products is less than the mass of the reactants **B** the mass of products is more than the mass of the reactants **C** the mass of each chemical changes slightly **D** the mass of products is equal to the mass of the reactants.		1
8	Magnesium burns in air according to the equation: $w\,Mg + x\,O_2 \rightarrow y\,MgO$ The values of *w, x* and *y* needed (in order) to balance this equation are: **A** 2, 1, 2 **B** 1, 2, 1 **C** 2, 1, 1 **D** 1, 2, 2.		1
9	Chemical equations also include the state of the substances. In the equation: $Hg_{(l)} + S_{(s)} \rightarrow HgS_{(s)}$ list the state of mercury sulfide. **A** liquid **B** gas **C** aqueous **D** solid		1
10	A method used to increase the yield of a reaction is to: **A** lower the temperature **B** leave the reaction alone **C** use a catalyst **D** add more products.		1

11	Moving through the activity series for metals from potassium (K) to copper (Cu) the metals become more: **A** likely to be found as native metals **B** reactive **C** expensive to extract from their ores **D** likely to donate electrons.		1
12	An acid reacting with a metal hydroxide to produce a salt and water is an example of a: **A** combustion reaction **B** displacement reaction **C** neutralisation reaction **D** decomposition reaction.		1
13	A combustion reaction: **A** always has carbon dioxide as a product **B** always has water as a product **C** always has oxygen as a reactant **D** is always endothermic.		1
14	The equation for the overall reaction in photosynthesis is: $energy + 6CO_{2(g)} + 6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq)} + 6O_{2(g)}$. Photosynthesis is: **A** an endothermic process **B** an exothermic process **C** a combustion reaction **D** an acid–base reaction.		1
15	Magnesium is dissolved in acid. Its equation is Mg + 2HCl $\rightarrow$_______+ H_2. The missing chemical in the reaction is: **A** MgCl **B** Mg2Cl **C** $MgCl_2$ **D** 2MgCl.		1

16	Which of the following best represents a chemical reaction? **A** products → reactants **B** reactants → products **C** chemicals → water **D** reactants → chemicals			1
17	In the chemical reaction iron + sulfur → iron sulfide: **A** iron and sulfur are products **B** iron sulfide is the product **C** iron, sulfur and iron sulfide are products **D** sulfide is the product.			1
18	Which of the following types of radiation travels slowest? **A** gamma **B** ultraviolet **C** beta **D** alpha			1
19	Isotopes are atoms: **A** with the same mass number, but different atomic numbers **B** which are unstable and undergo radioactive decay **C** with the same atomic number, but different mass numbers **D** which have unequal numbers of protons and electrons.			1
20	Aluminium decays according to the equation shown below. $^{28}_{13}\mathrm{Al} \rightarrow ^{28}_{14}\mathrm{Si} + X$ The particle X in the above equation is: **A** an electron **B** a neutron **C** an alpha particle **D** a proton.			1

21	Am-241 has a half-life of 460 years. How long would it take a 1000 g sample of Am-241 to decay so that the sample contained only 31.25 g of Am-241? **A** 1380 years **B** 1840 years **C** 2300 years **D** 2760 years		1
22	Which type of radiation is chemically identical to a helium nucleus? **A** alpha **B** beta **C** gamma **D** X-ray		1
23	A radiation dose of 250 000 μSv would, in the short term, be likely to cause: **A** no biological effect **B** cell damage **C** radiation sickness **D** severe radiation sickness and possible death within a month.		1

Section B—Written answers (74 marks)

1	An experiment was conducted as shown in the diagram below.  $CaCO_{3(s)}$ was added to $HCl_{(aq)}$. The flask, contents and balloon were weighed before and after the reaction. The products of the reaction are a gas and a soluble salt. **a** Write a balanced equation (including states) for the reaction occurring in the flask. **b** Would you expect the mass after the reaction to be greater than, less than or equal to the mass before reaction? **Justify** your choice.		5

2	Balance the following equations. **a** $\_Li_{(s)} + \_H_2O_{(l)} \rightarrow \_LiOH_{(aq)} + \_H_{2(g)}$ **b** $\_Cu(NO_3)_{2(s)} \rightarrow \_CuO_{(s)} + \_NO_{2(g)} + \_O_{2(g)}$		6
3	Write a balanced formula equation, including states, for each of the reactions described below. **a** When aqueous solutions of lead(II) nitrate, $Pb(NO_3)_2$, and potassium iodide, KI, are mixed, the yellow solid lead(II) iodide precipitates from the solution, while the soluble salt, potassium nitrate, remains in solution. **b** An aqueous solution of ethanol, C_2H_5OH, is produced when a glucose, $C_6H_{12}O_6$, solution reacts in the presence of a yeast catalyst. Gaseous carbon dioxide is also produced.		8
4	**a** **Identify** the catalyst used during the contact process for sulfuric acid production. **b** **Explain** why a catalyst is used. **c** **Explain** why several catalyst beds are used, rather than just one.		3

5	The equations below represent three of the reactions occurring during the contact process for sulfuric acid production. I $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$ II $H_2S_2O_{7(l)} + H_2O_{(l)} \rightarrow 2H_2SO_{4(l)}$ III $SO_{3(g)} + H_2SO_{4(l)} \rightarrow H_2S_2O_{7(l)}$ **a** **Identify** which of these reactions (I to III) occurs in the: **i)** absorber **ii)** converter. **b** **Identify** the reactions (I to III) that : **i)** are exothermic **ii)** require a catalyst.		6
6	**Recall** *three* ways in which the rate of a reaction may be increased.		3
7	**a** Write a balanced equation for the corrosion of aluminium (Al) in air to form aluminium oxide (Al_2O_3). **b** Aluminium is more reactive than iron. **Explain** why aluminium window frames do not corrode as quickly as iron window frames.		4

8	A student wrote the equation below to represent the rusting of iron. $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ **Identify:** **a** the substance required for rusting that is *not* shown in this equation **b** *two* conditions that would speed up the rate of rusting of an iron garden chair		3
9	**Explain** why iron objects found in each of the following locations show little sign of rusting. **a** outer space **b** the desert **c** deep in the ocean		3
10	Uranium (U) is element number 92. Thorium (Th) is element number 90. Uranuim-238 undergoes alpha decay to form thorium-234 and an alpha particle. **a** **Clarify** what the number 238 tells us about a uranium-238 atom. **b** **Describe** the composition of an alpha particle. **c** **Recall** the nuclear equation for the alpha decay of uranium-238.		6

11	Hydrogen has the symbol ${}^{1}_{1}H$. Deuterium is a stable isotope of hydrogen with one neutron per atom. Tritium is a radioisotope of hydrogen containing two neutrons per atom. **a** **Identify** the symbols for deuterium and tritium. **b** Two deuterium nuclei may be joined to form a helium nucleus. **Construct** a nuclear equation for this reaction. **c** **Identify** the name given to the type of nuclear reaction described in part **b**.		5
12	Three types of radiation emitted during nuclear reactions are alpha, beta and gamma radiation. **Identify** which of these three types of radiation: **a** travels the fastest **b** consists of particles with the same mass as an electron **c** consists of electromagnetic waves **d** can penetrate a 1 mm-thick sheet of aluminium **e** can be stopped by a thick sheet of paper.		5
13	**a** **Explain** what is meant by the 'half-life' of a radioisotope. **b** Carbon-14 has a half-life of 5730 years. A fossil is found to contain one-eighth of the amount of carbon-14 in a living specimen. **Predict** the age of the fossil.		3

14	**Identify:** **a** *one* source of each of the following types of environmental radiation: **i)** terrestrial radiation **ii)** cosmic rays **iii)** artificially produced radiation. **b** **State** from which of the sources listed in part **a** do we receive the largest percentage of annual radiation.		4
15	**Describe** *two* uses of nuclear radiation in medicine and/or industry.		4
16	Carbon-14 dating is used to estimate the age of fossils. **Explain** why the percentage of radioactive carbon-14 decreases in dead organisms, but remains constant in living organisms.		3
17	Radioactive uranium-238 is found in many rocks. The age of rocks containing fossils may be measured by comparing the levels of uranium-238 and lead in the rock. **Propose** a reason why this form of radioactive dating, rather than carbon-14 dating, is used for rocks from the dinosaur era.		3

2: Materials

Name: ________________________ Class: ___________ Date: ________

Instructions: Write answers in the right-hand column. Score: ___________ / 68 marks

Section A—Multiple choice (21 marks)

1	Which of the following best describes the structure of metals? A lattice of: **A** alternating positive and negative ions **B** positive ions surrounded by freely moving electrons **C** molecules held together by covalent bonds **D** atoms held together by covalent bonds.		1
2	Which of the following is *not* a property of most metals? **A** malleable **B** good electrical conductors **C** poor thermal conductors **D** shiny appearance		1
3	An alloy of iron and carbon which contains 4% carbon is likely to be: **A** weaker and more malleable than pure iron **B** weaker and more brittle than pure iron **C** stronger and more malleable than pure iron **D** stronger and more brittle than pure iron.		1
4	Which of the following alloys does *not* contain tin (Sn)? **A** brass **B** bronze **C** solder **D** dental amalgam		1
5	What is the percentage of pure gold in a 12-carat gold bracelet? **A** 25% **B** 50% **C** 75% **D** 100%		1

6	Which of the following metals is *not* naturally found as a pure element? **A** platinum **B** silver **C** gold **D** sodium		1
7	During the process of froth flotation, waste material is separated from the ore. This waste material is called: **A** the overburden **B** slag **C** gangue **D** a mineral.		1
8	Moving through the activity series for metals from potassium (K) to copper (Cu), the metals become more: **A** likely to be found as native metals **B** reactive **C** expensive to extract from their ores **D** likely to donate electrons.		1
9	Which of the following equations represents the process occurring at the positive electrode during the extraction of magnesium by electrolysis of molten magnesium chloride? **A** $Mg^{2+} + 2e^- \rightarrow Mg$ **B** $Mg \rightarrow Mg^{2+} + 2e^-$ **C** $2Cl^- \rightarrow Cl_2 + 2e^-$ **D** $Cl_2 + 2e^- \rightarrow 2Cl^-$		1
10	Which of the following metals would usually be extracted from its ores by smelting? **A** potassium **B** calcium **C** copper **D** aluminium		1

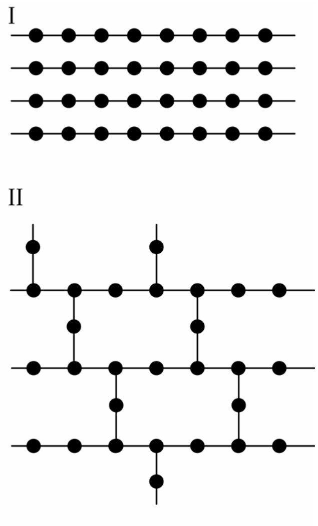
11	Most of the coke added to a blast furnace reacts: **A** with oxygen and carbon dioxide to form carbon monoxide **B** directly with iron ore (Fe_2O_3) to produce iron **C** with sand in the ore to produce slag **D** with limestone ($CaCO_3$) to produce calcium oxide.		1
12	Nails and roofing materials are commonly made of galvanised iron. Galvanised iron is iron dipped in molten: **A** tin **B** chromium **C** aluminium **D** zinc		1
13	Which of the following is a property of all thermoplastic materials? **A** scratch resistance **B** softens easily when heated **C** brittle and rigid **D** chars when heated		1
14	Which of the following plastics must be manufactured and moulded at the same time? **A** polyethene **B** polyvinylchloride (PVC) **C** acrylic **D** bakelite		1
15	Which of the following synthetic fibres is based on the natural polymer cellulose? **A** rayon **B** nylon **C** lycra **D** polyester		1

16	Monofilaments: **A** only occur in natural fibres **B** are made from polymers that are the same length as the fibre **C** are extremely flexible but can tear easily **D** are made from many short polymers which overlap each other along the fibre length.		1
17	Sulfuric acid is *not* used: **A** in car batteries **B** to process metals **C** in the refining of petroleum **D** as a fertiliser.		1
18	The chemistry of carbon compounds is called: **A** organic **B** inorganic **C** alcoholic **D** covalent.		1
19	How many electrons are shared when two atoms have a double bond between them? **A** 2 **B** 4 **C** 6 **D** 8		1
20	Alkenes are hydrocarbons that: **A** have only single carbon-carbon bonds **B** contain one double carbon-carbon bond **C** have the general formula C_nH_{2n-2} **D** contain the hydroxy (OH) functional group.		1
21	Which of the following is a naturally occurring fibre? **A** elastane **B** fibreglass **C** kevlar **D** coir		1

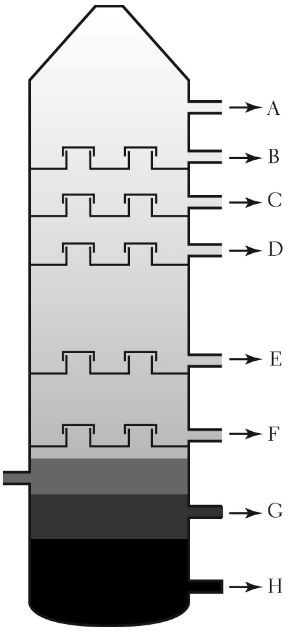
Section B—Written answers (47 marks)

1	**Identify** the metal from the list below to answer the questions that follow. *mercury, zinc, lead, copper, tin, aluminium* Name one metal which is: **a** more reactive than iron and is used as a coating to protect roofing iron **b** less reactive than iron and is used as a coating to protect iron cans **c** a liquid at room temperature **d** used to make cooking utensils and has a low density **e** an excellent electrical conductor and is used for wiring.		5
2	**Explain:** **a** why jewellery is not usually made of pure gold. **Identify:** **b** one metal that is often added to pure gold to make jewellery **c** the percentage of gold that is found in Australian 'gold' coins.		3
3	**Identify** *four* factors that would need to be considered when deciding whether it is worthwhile mining an area for a particular metal.		4

4	**Identify:** **a** the type of mining used for ores found close to the surface **b** *two* problems associated with this type of mining.		3
5	The temperature near the bottom of a blast furnace is approximately 1600^{o}C. **Explain** why it is important that this area has such a high temperature.		2
6	**Identify:** **a** *four* properties of plastics which make them useful **b** *two* disadvantages of plastics.		6

7	The diagrams below show the structures of two types of materials. **Identify** the thermosetting plastic. **Explain** your choice. 		3
8	**Identify** the type of moulding process that is commonly used to manufacture: **a** plastic toys and bottle caps **b** plastic straws and pipes **c** plastic bottles **d** synthetic fibres.		4

9	**a** **Identify** which fibres (natural or synthetic): **i)** have rough surfaces **ii)** are used for wash-and-wear fabrics. **Describe:** **b** one advantage of fibres with rough surfaces **c** one disadvantage of fibres with rough surfaces.		6
10	**Explain:** **a** why it is unwise to tumble-dry and iron most synthetic fibres **b** why it is unwise to wear synthetic fabrics on a very hot day.		4

11	The diagram below shows a fractionating tower used for the processing of crude oil.  **a** **Identify** what crude oil is formed from. **b** **Identify** the type of chemical compounds from which crude oil is composed. **c** Eight fractions (A to H) are labelled on the diagram. **Identify**: **i)** the fraction containing the smallest molecules **ii)** the fraction with the highest boiling point range **iii)** one fraction that is used primarily as fuel for transport **iv)** the fraction used to make bitumen for roads.		7

3: Genetics

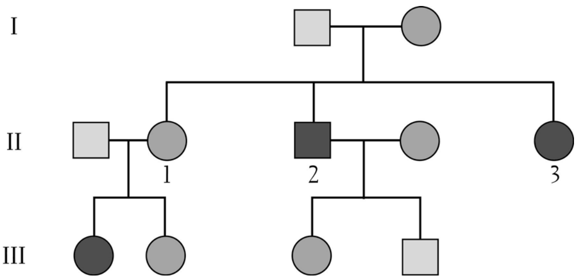
Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 84 marks

Section A—Multiple choice (14 marks)

1	Gametes are: **A** normal cells, such as muscle and brain cells **B** sex cells, sperm or eggs (ova) **C** another name for chromosomes **D** part of a strand of DNA.		1
2	Gametes of a fruit fly have four chromosomes. The diploid number for the fruit fly is: **A** 2 **B** 4 **C** 6 **D** 8.		1
3	How many chromosomes are in the gametes (sperm or ova) of a human? **A** 23 **B** 100 **C** 46 **D** 92		1
4	How many chromosomes are in the 'normal' cells (e.g. muscle cells, brain cells, blood cells) of a human? **A** 23 **B** 100 **C** 46 **D** 92		1

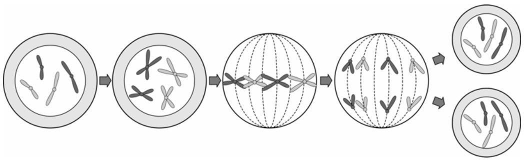
5	When a cell with three pairs of chromosomes undergoes meiosis, how many types of gametes are possible? **A** 3 **B** 4 **C** 6 **D** 8		1
6	In rabbits, the gene for long hair (*h*) is recessive to the gene for short hair (*H*). When a short-haired female was mated with a long-haired male, the offspring consisted of five short-haired and three long-haired rabbits. The genotypes of the parent rabbits must be: **A** female (*hh*), male (*HH*) **B** female (*HH*), male (*hh*) **C** female (*Hh*), male (*hh*) **D** female (*Hh*), male (*HH*)		1
7	The Rh blood grouping system is controlled by one gene with two alleles. The gene for Rh-positive blood is dominant over the gene for Rh-negative blood. Two people homozygous for Rh-positive blood produce a child. What is the probability that the child will have Rh-positive blood? **A** 0 per cent **B** 25 per cent **C** 50 per cent **D** 100 per cent		1
8	Which of the following characteristics in humans is most likely to show continuous variation? **A** skin colour **B** albinism **C** night blindness **D** blood group		1

9	Below is a pedigree showing the inheritance of a disease caused by a recessive gene.  Which of the numbered people in generation II is a female homozygous for the disease? **A** 1 **B** 2 **C** 3 **D** cannot be determined from the information provided		1
10	An X-linked or sex-linked disease in humans is one that: **A** only affects females **B** only affects males **C** is caused by a gene carried on the X chromosome **D** affects the sex organs of the female.		1
11	The term 'replication' refers to the: **A** use of a section of DNA to code for an amino acid sequence **B** copying of a section of DNA **C** appearance of a characteristic that a section of DNA codes for **D** change in a DNA sequence caused by the action of a mutagen.		1
12	A plasmid is a: **A** circular piece of DNA found in a bacterial cell **B** molecule containing DNA from two organisms **C** plant or animal with a new gene **D** small piece of DNA with a base sequence identical to part of a gene.		1

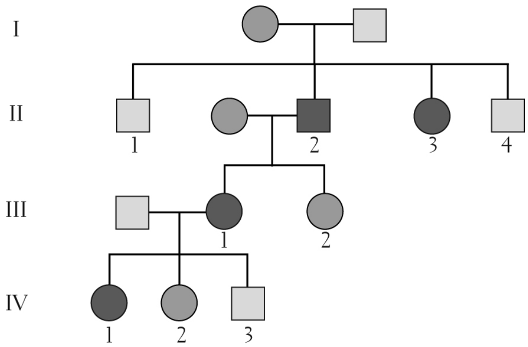
13	Which of the following is true for *both* mitosis and meiosis? **A** occurs in all body cells **B** involves the replication of DNA **C** produces cells with the same number of chromosomes as the parent cell **D** produces four daughter cells per division		1
14	The structure of DNA may be described as a twisted ladder. What forms the uprights of the ladder? **A** alternating sugar and phosphate units **B** nitrogen bases **C** amino acids **D** protein		1

Section B—Written answers (70 marks)

1	In terms of chromosomes, **explain** why a sperm or an ovum (egg) cannot possibly produce a new human on its own.		2
2	Use the alleles *M* and *m* in examples to **demonstrate** how different genotypes can give rise to the same phenotypes.		3

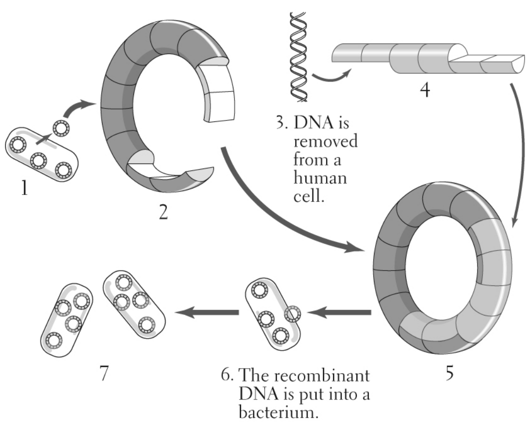
3	The diagrams below show the stages occurring during a cell division.  **a** **State** whether the cell division shown is mitosis or meiosis. **b** **Justify** your answer for part **a**. **c** **Name** one type of cell that might undergo the type of cell division shown above.		3
4	Match the following with the term that best describes them: *G* — homozygous *Gg* — allele *GG* — phenotype black hair — heterozygous		4
5	With the aid of examples, **explain** what is meant by each of the following terms. **a** alleles **b** diploid cell **c** homozygous		6

6	In shorthorn cattle, the gene for white coat (*W*) is codominant with the gene for red coat (*R*). The heterozygous organism has a roan coat. **a** **Predict** the genotype of a cow with a: **i** white coat **ii** red coat. **b** A farmer wants to ensure that all his cattle have roan coats. **Explain** which type of cattle should be mated together.		4
7	**a** In terms of chromosomes, **explain** the difference between a male and a female. **b** **Explain** why you would expect half the children born in the world to be female.		4

8	The pedigree below shows the inheritance of a disease caused by a recessive gene (g). Those with the dominant gene (G) do not show the disease.  **Identify:** **a** the genotype of an individual i) with the disease ii) heterozygous and without the disease **b** the genotypes of each of the following individuals i) Generation I female ii) Generation II number 3 iii) Generation III male iv) Generation IV number 2. **c** **Justify** your answer to question **b**, part **i)**.		8
9	Most of the proteins made by cells are enzymes. **Outline** the function of enzymes.		2

10	Suppose you could clone your pet guinea pig. **Predict** whether the clone would be identical to your pet. **Explain** your answer.		3
11	**a** **State** what the letters 'DNA' stand for. **b** **State** what the letters 'A', 'C', 'T' and 'G' stand for in a DNA base sequence.		5
12	Haemophilia is an X-linked recessive disease. The symbols used to show the relevant genes are X^S for the normal gene on the X chromosome, and X^s for the recessive gene on the X chromosome. **a** **State** the possible genotypes of a: **i** haemophiliac male **ii** non-haemophiliac male **iii** non-haemophiliac female. **b** A female may be a 'carrier' of the disease. **i** **Clarify** what is meant by the term 'carrier'. **ii** **State** the genotype of a 'carrier'.		6

13	With the aid of a labelled diagram, **explain** how the base sequence of DNA directs the formation of a protein strand.		5
14	**Explain** the meaning of gene: **a** expression **b** technology.		2
15	**a** **Define** the term ‘mutation’. **b** **State** *two* examples of mutagens.		3

16	**Propose** *three* arguments: **a** for the use of genetically modified foods **b** against the use of genetically modified foods.		6
17	The diagram below shows the stages involved in gene technology using recombinant DNA. **Explain** what is happening in: **a** stage 2 **b** stage 4 **c** stage 5 **d** stage 7.  		4

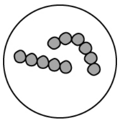
4: Health and disease

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 99 marks

Section A—Multiple choice (20 marks)

1	Which of the following nutrients supplies the least amount of energy per gram? **A** carbohydrates **B** protein **C** fats **D** minerals		1
2	Which of the following nutrients is not digested? **A** fat **B** carbohydrate **C** fibre **D** protein		1
3	Carbohydrate-containing foods are now ranked with a GI number. GI stands for: **A** glycemic index **B** glucose index **C** gluten index **D** gross index.		1
4	The study of disease is called: **A** forensic science **B** pathology **C** psychology **D** physiology.		1
5	Which of the following is an infectious disease? **A** obesity **B** mumps **C** haemophilia **D** diabetes		1

6	The pathogen for a particular infectious disease is the organism which: **A** suffers from the disease **B** carries the disease-causing organism from host to host **C** acts as a host of the parasite causing the disease **D** causes the disease.		1
7	The bacteria shown below would be described as:  **A** cocci **B** diplococci **C** streptococci **D** bacilli.		1
8	Which of the following pathogens is usually the smallest? **A** protozoan **B** fluke **C** virus **D** bacterium		1
9	A communicable human disease is one which: **A** is infectious and is easily transmitted from person to person **B** is inherited **C** is caused by an environmental factor **D** affects large numbers of people in a given population.		1
10	An antibody is a: **A** drug produced to treat bacterial infections **B** special chemical produced by the body in response to the presence of a foreign substance **C** foreign substance that causes the body to produce antigens **D** type of white blood cell that can destroy some pathogens.		1

11	Which of the following is a natural method of disease control used by the human body? **A** antibiotics **B** immunisation by inoculation with a vaccine containing live organisms **C** immunisation by inoculation with a vaccine containing antibodies **D** leucocytes		1
12	The sketch below shows a person with symptoms of a common disease. Which of the following diseases is the person likely to be suffering from?  **A** mumps **B** influenza **C** measles **D** botulism		1
13	Malaria is caused by: **A** poor diet **B** parasitic worms **C** a defect in the circulatory system **D** a pathogen passed on during mosquito bites.		1
14	Which of the following is *not* true of HIV? **A** can be passed from person to person via saliva **B** does not survive well outside the body **C** destroys T4 lymphocyte cells **D** is diagnosed by a blood test		1
15	Which of the following is a symptom of a disease? **A** bacteria **B** a blood test **C** a fever **D** an epidemic		1

 ISBN 9781442515413

16	The virulence of an infectious disease is a measure of: **A** the amount of damage the disease does to the host **B** how many people in a population suffer from the disease **C** how long the symptoms of the disease take to appear in the host after infection **D** the ease with which the disease is transmitted from person to person.		1
17	Which of the following diseases is *not* caused by a virus? **A** AIDS **B** chickenpox **C** measles **D** ringworm		1
18	Which of the following diseases is *not* directly related to the heart or blood vessels? **A** angina **B** hypertension **C** arteriosclerosis **D** diabetes		1
19	A tumour with cells that are rapidly dividing is called: **A** permanent **B** malignant **C** divided **D** benign		1
20	HIV is a type of retrovirus. This means that the virus: **A** originated in a non-human organism **B** is transmitted by body fluids **C** incorporates its DNA into the host cell's DNA **D** does not survive well outside the body.		1

Section B—Written answers (79 marks)

1	**Identify** the *three* basic requirements for good health.		3
2	**a** **Define** the term 'nutrient'. **b** **Identify** *two* types of energy-providing nutrients.		4
3	**a** **Define** what is meant by a 'psychosomatic' illness. **b** **Identify** an illness that is: **i)** psychosomatic **ii)** not psychosomatic.		3
4	**List** what the Aboriginal traditional diet consisted of.		2
5	**Explain** the concern of transmitting European diseases to Aboriginal people.		2

6	**State** whether or not each of the following statements is true. Use examples to **justify** your answers. **a** ‘All bacteria are harmful and cause disease.’ **b** ‘All infectious diseases are caused by microscopic parasites.’		6
7	**Define** each of the following terms and give an example of each: **a** an infectious disease **b** a contagious disease **c** an environmental disease **d** a genetic disorder.		8

8	Using a particular disease as an example (e.g. lymphatic filariasis), **explain** what is meant by each of the following terms when describing the disease: **a** the pathogen **b** a symptom **c** a vector **d** a method of artificial control.		8
9	**Identify** *two* differences between bacteria and viruses.		4
10	**List** the following organisms in order of size from smallest to largest. *protozoan, tapeworm, virus, bacterium*		2

11	**a** **Explain** what is meant by the term 'opportunistic pathogens'. **b** **Identify** an example of a situation in which an opportunistic pathogen may cause infection.		4
12	**Account** for the fact that a person is unlikely to suffer from measles as an adult if they had measles as a child.		4
13	**a** **Describe** the difference between active and passive immunity produced by vaccination. **b** **Identify** which lasts longer—active or passive immunity.		5

14	**Explain** why it is difficult to produce immunity to the common cold.		3
15	**Account** for the following two possibilities. **a** A child has a genetic disease when there is no history of the disease in the family. **b** Two people with a genetic disease produce a child without the disease.		5
16	**a** **Describe** *two* examples of diseases that may be directly linked to diet. **b** **Explain** how a disease like diabetes mellitus may be described as both genetic and diet-related.		6

17	**Define** the following terms. **a** arteriosclerosis **b** hypertension **c** coronary heart disease **d** malignant tumour **e** benign tumour		5
18	**a** **Identify** *three* factors that might contribute to cancer. **b** **Explain** how a disease such as cancer may be described as both genetic and environmental.		5

5: Evolution

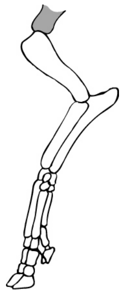
Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 67 marks

Section A—Multiple choice (12 marks)

1	Which of the following ideas is most closely associated with Jean Baptiste Lamarck's theory? **A** sudden speciation followed by long periods of stability **B** evolution by natural selection **C** evolution by inheritance of acquired characteristics **D** evolution as a result of a change in the frequency of certain genes in a population		1
2	Who developed the theory of natural selection while on board HMS *Beagle* in the Galapagos Islands? **A** Snoopy the beagle **B** Jean Baptiste Lamarck **C** Alfred Russell Wallace **D** Charles Darwin		1
3	Alfred Russell Wallace and Charles Darwin were the first to: **A** explain the source of the natural variation occurring within a species **B** challenge the idea of the 'fixity of species' **C** propose the idea of natural selection to explain how organisms evolve **D** suggest that characteristics acquired during a lifetime could be passed on to offspring.		1
4	Which type of evolution best explains the observation that the South American anteater and the African aardvark have several similarities but are not genetically closely related? **A** divergent evolution **B** convergent evolution **C** parallel evolution **D** punctuated equilibrium		1

5	Which of the following organisms is genetically most similar to *Homo sapiens*? **A** chimpanzee **B** monkey **C** gorilla **D** virus		1
6	Flying squirrels of North America and Australia's gliding possums have structures that look similar but have come from different ancestors. These similarities are known as: **A** homologous structures **B** analogous structures **C** vestigial organs **D** examples of adaptive radiation.		1
7	Which of the following is *not* an inherited characteristic? **A** the long neck of a giraffe **B** a person's blue eyes **C** a person's acquired immunity to the measles virus **D** the ability of a spider to spin a web		1
8	Which of the following statements concerning reproductive isolation and geographic isolation of two populations is correct? **A** Reproductive isolation of two populations always occurs before their geographic isolation. **B** Two populations that are geographically isolated must be two different species. **C** Subspecies form when two populations are reproductively isolated. **D** Speciation occurs when two populations become reproductively isolated.		1

9	The pentadactyl limb shown is modified for:  **A** walking **B** tearing **C** grasping **D** flying.		1
10	When the myxoma virus was first introduced into Australia, 90 per cent of rabbits in certain areas died, and less than 1 per cent of infected rabbits survived. Ten years later, only 25 per cent of rabbits in the same areas died, and 40 per cent of infected rabbits survived. Natural selection for which favourable characteristics explains these changes? **A** high resistance in the rabbits and high virulence for the virus **B** high resistance in the rabbits and low virulence for the virus **C** low resistance in the rabbits and high virulence for the virus **D** low resistance in the rabbits and low virulence for the virus		1
11	Fossilisation is most likely to occur under: **A** anaerobic conditions in sedimentary rock in a lake **B** anaerobic conditions in sedimentary rock on land **C** anaerobic conditions in igneous rock in a lake **D** aerobic conditions in sedimentary rock on land.		1
12	Which of the following is *not* an essential requirement for natural selection to occur? **A** genetic variation among the members of a species **B** variation in the characteristics of members of a species **C** sexual reproduction by members of a species **D** more offspring being produced by each generation		1

Section B—Written answers (55 marks)

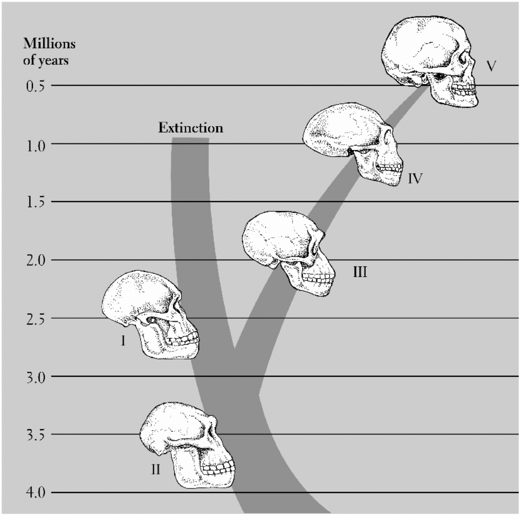
1	Organisms living in the desert are adapted to the hot, dry conditions. **a** **Explain** what is meant by the phrase 'adapted to'. **b** **Produce** *two* examples of adaptations likely to be found in desert organisms.		6
2	In hospitals, populations of bacteria resistant to certain antibiotics may develop because this resistance has been 'selected for' in previous generations. **Explain** carefully what is meant by 'selected for' in the statement above.		3

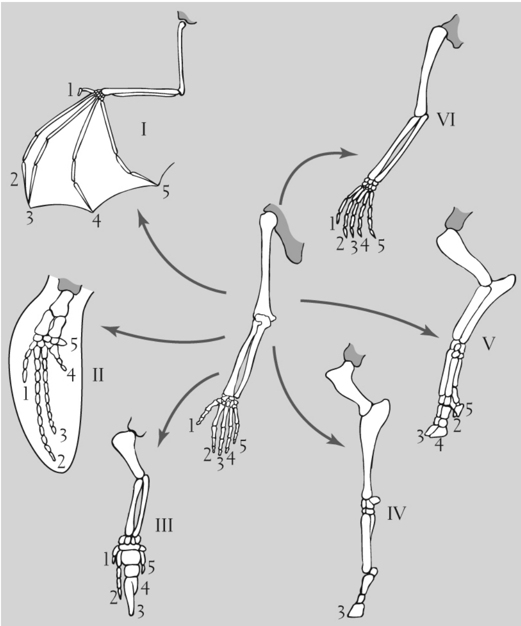
<table>
<tr><td>3</td><td>Complete the following table showing adaptations and their survival value.

<table><tr><th>Adaptation</th><th>Survival value</th></tr><tr><td>production of large quantities of dilute urine by freshwater fish</td><td></td></tr><tr><td>blubber found in marine mammals</td><td></td></tr><tr><td></td><td>enables an intestinal parasite to remain attached to its host</td></tr></table></td><td></td><td>5</td></tr>
<tr><td>4</td><td>Describe two ways in which a population may become geographically isolated to form two populations.</td><td></td><td>2</td></tr>
<tr><td>5</td><td>a Explain the term ‘reproductively isolated groups’.
b Describe two ways in which two populations of a species may become reproductively isolated.</td><td></td><td>4</td></tr>
</table>

6	**State** *two* reasons why individuals in a species may have differences in appearance.		2
7	**Select** the appropriate term (from the *two* underlined alternatives) to correctly complete each of the following statements. **a** Life on Earth is thought to have begun around 3500 / 4500 million years ago. **b** Dinosaurs became extinct around 248 / 65 million years ago. **c** Trilobites were characteristic organisms of the Cenozoic / Palaeozoic era. **d** The earliest known land organisms were vascular plants / reptiles. **e** The first clear representation of the genus *Homo* is *Homo erectus / Homo habilis*. **f** *Homo sapiens* is thought to have first appeared around 4 / 0.2 million years ago.		6

8	Darwin observed 14 species of finches during his travels around the Galapagos Islands. **Identify** *two* possible explanations for the existence of these 14 species.		2
9	Place the following events in the order in which they occurred. **a** Neo-Darwinism is formulated. **b** Darwin studies medicine. **c** Lamarck proposes his theory of evolution. **d** Darwin travels on HMS *Beagle.* **e** Wallace presents a paper on the theory of evolution by natural selection. **f** Georges Buffon questions the idea of the 'fixity of species'. **g** Darwin publishes *The Origin of Species.* **h** Mendel's work on genetics is first recognised.		4

10	The diagram below shows a possible family tree for humans.  **Identify** the labelled species (I to V) as: **a** *Homo habilis* **b** *Australopithecus afarensis* **c** *Homo erectus* **d** *Homo sapiens* **e** *Australopithecus africanus.*		5

11	The diagram below shows several pentadactyl limbs.  **a** **Define** the term 'pentadactyl limb'. **b** **Explain** the similarities of these limbs. **c** Using the numerals I to VI, **identify** which limb is modified for: **i** running **ii** tearing.		5
12	The group of flightless birds, known as ratites, occur in Australia (cassowary and emu), New Zealand (kiwi), South America (rhea) and Africa (ostrich). **Explain** the distribution of these related species.		3

13	**a** **State** *two* anatomical changes between *Homo sapiens* and *Australopithecus afarensis*. **b** **State** *two* non-anatomical changes between *Homo sapiens* and *Australopithecus afarensis*.		4
14	Humans can be said to be undergoing a cultural evolution. **a** **Explain** what this means. **b** **Produce** an example of cultural evolution taking place.		2
15	The theory of evolution is an explanation for the existence and diversity of life on Earth. **State** *two* alternative theories to account for life on Earth.		2

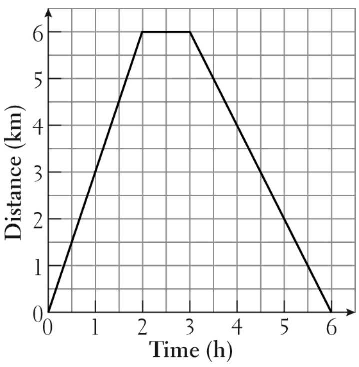
Chapter 6: Motion

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 94 marks

Section A—Multiple choice (22 marks)

1	The base unit of distance is: **A** second **B** kilometre **C** metre **D** millimetre.		1
2	What distance would an ant, walking at a speed of 6 millimetres per second, cover in 30 minutes? **A** 0.18 m **B** 8.9 m **C** 10.8 m **D** 180 m		1
3	A racehorse runs a race that starts and finishes at the same point. If the race was 1000 metres, what was the displacement of the horse when it finished? **A** 1000 metres **B** 500 metres **C** 10 metres **D** 0		1
4	A car travelled at 80 km/h over a distance of 540 km. On the return journey the car's speed was 100 km/h. What was the average speed of the car for the 1080 km round trip? **A** 85 km/h **B** 89 km/h **C** 90 km/h **D** 95 km/h		1

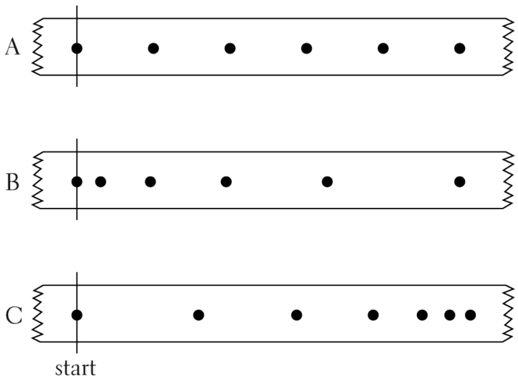
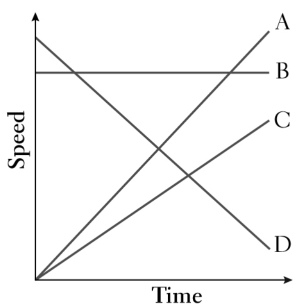
5	A train travelling at 5 m/s accelerates to reach a speed of 8 m/s in 2.5 seconds. The average acceleration of the train was: **A** 1.2 m/s^2 **B** 2.0 m/s^2 **C** 3.2 m/s^2 **D** 7.5 m/s^2.		1
6	The school bus slows from 60 km/h (16.7m/s) to 40 km/h (11.1 m/s) in the school zone in 8 seconds. The average deceleration of the bus was: **A** 5.6 m/s^2 **B** 2.5 m/s^2 **C** 44.8 m/s^2 **D** 0.7 m/s^2.		1
7	Shown below is a displacement–time graph for a journey. Which of the following statements concerning this journey is correct?  **A** The speed for the first two hours of the journey was 6 km/h. **B** Total displacement for the journey was 6 km. **C** The average speed for the journey was 60 km/h. **D** A one-hour rest break was made during the journey.		1

8	Which of the following is best explained by Newton's Third Law? **A** Unbelted passengers will be thrown forward when a car stops suddenly. **B** A gun recoils when a shot is fired. **C** The acceleration of an object when a force is applied depends on the mass of the object. **D** The weight of an object varies from planet to planet.		1
9	Which of the following is a non-contact force? **A** air resistance **B** electrostatic repulsion between like charges **C** thrust caused by expulsion of gases from a jet **D** buoyancy		1
10	A 90 N force is applied to a 65 kg mass. The mass will accelerate at: **A** 0.72 m/s^2 **B** 1.2 m/s^2 **C** 1.4 m/s^2 **D** 5.9 m/s^2.		1
11	A man exerts a force of 500 N on a 50 kg crate. The crate accelerates at 9 m/s^2. What is the friction force on the crate? **A** 50 N **B** 100 N **C** 150 N **D** 200 N		1
12	A motoring magazine states that a Honda Accord can increase its speed from 30 to 60 km/h in 5 s. The acceleration of the car is closest to: **A** 2 m/s^2 **B** 6 m/s^2 **C** 12 m/s^2 **D** 22 m/s^2.		1

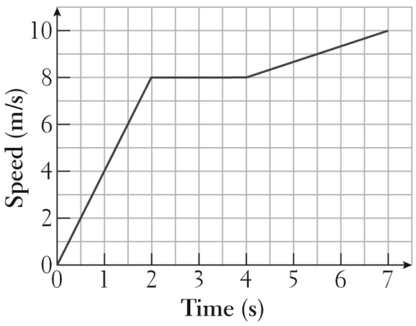
13	A person with a mass of 55 kg has a weight of 1360 N on planet X. The acceleration due to gravity on planet X is: **A** less than that on Earth **B** the same as that on Earth **C** greater than that on Earth **D** unrelated to the data given and cannot be determined.		1
14	Which of the following statements concerning falling objects is *incorrect*? **A** Gravity is the rate of acceleration at which objects fall in a vacuum. **B** The acceleration of an object falling in air will be less than if the object is falling in a vacuum. **C** The terminal velocity of a falling object depends on the shape of the object. **D** In a vacuum, heavier objects fall faster than lighter objects.		1
15	Which of the following quantities is measured in joules? **A** terminal velocity of a falling object **B** the weight of a person on the Moon **C** the force required to move an object **D** the work done when a force moves an object		1
16	A bullet has a speed of 850 m/s when it leaves the muzzle of a rifle. What is the kinetic energy of the bullet if it has a mass of 40 g? **A** 17 J **B** 14 450 J **C** 17 000 J **D** 14 450 000 J		1
17	Which of the following has the largest amount of potential energy? **A** a spring (spring constant 25 N/m) compressed by 0.5 m **B** a slinky (spring constant 5 N/m) extended by 1.5 m **C** a 30 g ball held at 12 m above the ground **D** a 2 kg object on a table 0.8 m above the ground		1

18	The tendency of a body to resist change in its motion is called: **A** inertia **B** weight **C** friction **D** gravitational potential.		1
19	A bird has a potential energy of 110 J at a height of 100 m. The potential energy of the bird at a height of 30 metres: **A** cannot be determined unless the bird's mass is known **B** is 27 J **C** is 33 J **D** is 367 J.		1
20	Which of the following best describes the energy changes occurring when an object falls from a position above the Earth's surface? **A** gravitational potential → kinetic → heat **B** elastic potential → kinetic → heat **C** gravitational potential → heat → kinetic **D** elastic potential → heat → kinetic		1
21	Which of the following changes doubles the value of the energy type listed in parentheses? **A** doubling the compression of a spring (elastic potential) **B** halving the height from which a ball is dropped (gravitational potential) **C** doubling the speed of a moving object (kinetic energy) **D** doubling the distance an object is shifted by a given force (work done)		1
22	Power is the rate at which energy is supplied. What power is needed to lift a 40 kilogram mass through a height of 10 metres in 5 seconds? **A** 80 J/s **B** 784 J/s **C** 3920 J/s **D** 19 600 J/s		1

Section B—Written answers (72 marks)

1	**Calculate** the average speed (in m/s) of **a** a man who runs 1500 metres in 3.8 minutes **b** an antelope that runs 20 kilometres in 15 minutes. **Justify** your answers with full working.		6
2	**a** **Describe** the type of motion represented by each of the ticker-tapes.  **a** **Identify** the graph that represents: **i)** deceleration **ii)** constant speed. 		5

3	**Calculate** the distance (in km) travelled by: **a** the Earth moving at a speed of 30 000 m/s around the Sun for one day **b** a man walking at a speed of 1 m/s for 45 minutes. **Justify** your answers with full working.		4
4	A ball is dropped from the top of a building. It takes 4.0 seconds to reach the ground. **a** **Calculate** the speed of the ball as it hits the ground. **b** **Identify** the assumption you made in your calculation for part **a**.		3
5	**Explain** the effect that each of the following changes (made separately) has on the acceleration of an object. **a** The force acting on the object is tripled. **b** The mass of the object is halved, while a constant force is applied.		2

6	Using the speed–time graph shown below, **calculate** the: **a** distance travelled in the first 3 seconds. **b** total distance travelled **c** acceleration in the time interval from 4 seconds to 7 seconds.  **Justify** your answers with full working.		8

<table>
<tr><td>7</td><td>A car starts from rest. The table below shows the car’s speed each second after it starts.

<table><tr><th>Time (s)</th><th>Speed (m/s)</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>2</td></tr><tr><td>2</td><td>4</td></tr><tr><td>3</td><td>6</td></tr><tr><td>4</td><td>7</td></tr><tr><td>5</td><td>8</td></tr><tr><td>6</td><td>9</td></tr></table>
Calculate the :
a acceleration during the first 3 s
b acceleration during the final 3 s
c average acceleration for the 6 s.
Justify your answers with full working.</td><td></td><td>6</td></tr>
<tr><td>8</td><td>a Predict which way passengers standing in a train move when the train comes to a sudden stop.
b Explain why passengers move in this way.</td><td></td><td>4</td></tr>
<tr><td>9</td><td>‘An object has zero acceleration. The object must therefore be at rest.’ State whether or not this statement is correct. Justify your answer.</td><td></td><td>2</td></tr>
</table>

10	The brakes of a 1.5 tonne car exert a stopping force of 3200 N. **Calculate**: **a** the deceleration (negative acceleration) of the car **b** how long it would take to stop if the initial speed was 20 m/s. **Justify** your answers with full working.		4
11	**Propose** why a rocket fired horizontally would accelerate faster than the same rocket fired vertically.		2
12	**State** which has the greatest weight on Earth: a kilogram of cotton wool or a kilogram of lead? **Explain** your choice.		2
13	An astronaut lands on an unexplored planet. The mass of the astronaut and spacesuit is 130 kg. His weight on the planet is 1338 N. **Calculate**: **a** the value of the acceleration due to gravity on this planet **b** the mass of the astronaut (and spacesuit) on Earth. **Justify** your answers with full working.		3

14	**Identify** the name and symbol of the units usually used to measure: **a** speed **b** acceleration **c** force **d** energy.		4
15	**Calculate** the work done when: **a** a force of 7 N moves an object through a distance of 5 metres **b** a 5 kg object is lifted from a height of 10 metres to a height of 15 metres. **Justify** your answers with full working.		4
16	**a** **Describe** the effect of doubling the compression of a spring on the elastic potential energy stored in the spring. **b** **Describe** the effect of doubling the spring constant on the elastic potential energy stored in a spring. **c** **State** the units used to measure the spring constant of a material. **d** **Identify** which has a higher spring constant, a stiff material or a very elastic material.		4

17	**a** **Calculate** the efficiency if a ball dropped from a height of 1.5 m returns to a height of 1.2 m after bouncing. **Justify** your answer with full working. **b** **Explain** what is meant by the statement: 'Squash balls are incredibly inefficient'.		5
18	A ten pin bowling ball of mass 5 kg is dropped from a height of 12 metres. **Calculate**: **a** the potential energy of the mass before it was dropped **b** the speed of the ball as it reaches the ground. (Assume that all the potential energy of the object is converted to kinetic energy.) **Justify** your answer with full working.		4

7: Electricity, electromagnetism and communications technology

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 102 marks

Section A—Multiple choice (20 marks)

1	Resistance in a circuit is the: **A** ability of a substance to reduce the flow of current **B** energy available to push current through a circuit **C** flow of charge **D** power generated by the circuit.		1
2	In the water pump circuit analogy, the voltage is equated to: **A** water flow rate **B** resistance to flow **C** the waterwheel **D** water pressure.		1
3	In a parallel circuit, what is shared between the resistors? **A** voltage only **B** current only **C** voltage and current **D** none of the above		1
4	The law that describes the relationship between voltage, current and resistance is called: **A** Law of electricity **B** Newton's fourth law **C** Ohm's law **D** Coulomb's law.		1
5	The slope of a voltage versus current graph represents the: **A** resistance of the circuit **B** acceleration of the current **C** voltage change with time **D** magnetic strength of the circuit.		1

6	The total resistance of a series circuit with three resistors is given by the equation: **A** $R = R_1 + R_2 + R_3$ **B** $R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ **C** $\frac{1}{R} = R_1 + R_2 + R_3$ **D** $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$		1
7	Which of the following would *not* increase the strength of the magnetic field generated by a coiled current-carrying wire? **A** placing an iron core within the coil **B** winding more wire around the coil **C** using a larger current in the wire **D** running the current in the opposite direction through the wire		1
8	The magnetic field around a straight current-carrying wire is: **A** circular **B** to the left **C** to the right **D** non-existent.		1
9	Two types of wave may be generated using a slinky. For which type (or types) do the particles in the slinky move in the same direction as the wave? **A** transverse only **B** longitudinal only **C** transverse and longitudinal **D** neither transverse nor longitudinal		1
10	All electromagnetic waves have the same: **A** speed **B** frequency **C** energy **D** wavelength.		1

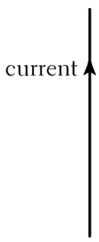
11	Which of the following waves has the longest wavelength? **A** X-rays **B** gamma rays **C** microwaves **D** blue light waves		1
12	Which of the following types of wave is generated when fast-moving electrons collide with a metal target? **A** X-rays **B** gamma rays **C** ultraviolet waves **D** red light waves		1
13	Australian television stations transmit: **A** sound using AM, and video using FM **B** sound using FM, and video using AM **C** sound and video using FM **D** sound and video using AM.		1
14	The wavelength of one band of red light is 660 nanometres. This is equivalent to: **A** 660 000 000 millimetres **B** 660 000 000 metres **C** 0.000 000 660 metres **D** 0.000 000 660 millimetres.		1
15	In Morse code, the shortest codes are used for: **A** the vowels only **B** full stops and commas **C** the numbers 0 to 9 **D** the most commonly used letters.		1
16	The number 19 in binary form would be represented by: **A** 10011 **B** 10010 **C** 01111 **D** 10100		1

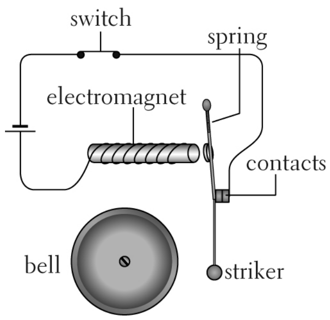
17	A coherent light is one in which all the waves are of the same: **A** speed but different frequencies **B** speed but different wavelengths **C** wavelength and speed **D** wavelength but different frequencies.		1
18	Which types of wave do *not* usually pass through the ionosphere? **A** visible light **B** long radio waves **C** microwaves **D** ultraviolet radiation		1
19	The volt is a unit used to measure: **A** resistance **B** current **C** potential difference **D** capacitance.		1
20	The symbol MΩ stands for: **A** megaohms **B** millifarads **C** macrocoulombs **D** microamperes.		1

7: Electricity, electromagnetism and communications technology

Section B—Written answers (82 marks)

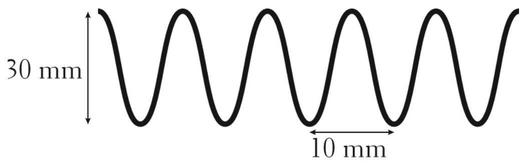
1	Draw a circuit consisting of three resistors in: **a** series **b** parallel.		4
2	**Calculate** the total resistance of three resistors of values 5, 10 and 20 Ω in: **a** series **b** parallel.		7

3	**Define** Ohm's law.		2
4	**Calculate**: **a** the voltage if a resistor of 5 Ω has a current of 0.1 A flowing through it **b** the current in a 100 Ω resistor in an electric jug if it is connected to 240 V **c** the resistance of a fan if it uses a current of 12 A and 240 V.		6
5	An electric current flows through a straight wire as shown in the diagram below. Sketch the shape of the magnetic field produced by this current, and **identify** the direction of the field.  		3

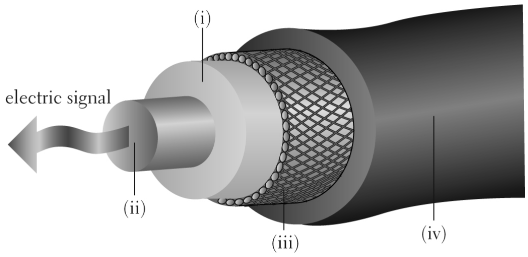
6	With the aid of a clearly labelled diagram, **explain** how a solenoid is constructed.		3
7	The diagram below shows an electric bell.  **Explain** how the bell works when the switch is pressed.		5

8	Electricity generated at power stations travels through transmission lines before reaching your home. **Explain** why: **a** step-up transformers are used during this transmission **b** step-down transformers are used during this transmission.		4
9	Complete the following table **identifying** the properties of waves.		6

Name	**Description**
Frequency	
	Distance between compressions in a longitudinal wave
Amplitude of a transverse wave	

10	The series of waves shown below was produced in 20 seconds.  **Calculate** the: **a** frequency **b** wavelength **c** amplitude of the waves.		3
11	**Define** the meaning of each of the following abbreviations. **a** AM (when referring to radio stations) **b** FDM (in telephone systems) **c** B-ISDN (the likely future communications network)		3
12	**Identify** one use of each of the following types of electromagnetic wave. **a** ultraviolet radiation **b** infra-red rays **c** gamma rays		3

13	**a** **State** *two* advantages of using higher frequencies to transmit messages from FM stations. **b** **State** *one* disadvantage of the use of higher frequencies.		3
14	**Explain** the basic difference between an analogue signal and a digital signal.		2
15	**Identify** *two* advantages of digital transmissions over analogue signals.		2
16	**Identify** *two* uses of microwaves in the communications network.		2

17	Copper wire provides one form of link in today's communications network. **Identify** *three* other means by which links are provided.		3
18	The diagram below shows a coaxial cable. **a** Complete the labelling of the diagram by **naming** parts (i) to (iv).  **b** One layer of the coaxial cable reduces attenuation. **Explain** what is meant by 'attenuation'.		5
19	**Identify** the type of component in an electrical circuit that: **a** measures potential difference **b** may be thought of as a charge pump **c** is used to control current and voltage.		3

20	**Name** the major discovery or invention associated with each of the following names. **a** Alexander Bell **b** William Shockley **c** Guglielmo Marconi **d** Hans Oersted		4
21	Each of the following incorrect statements may be corrected by replacing one word. For each statement, **identify** this word and give the required replacement word. Statement **a** has been completed as an example. **a** The first device that used electrical impulses sent along a wire to transmit messages was the telephone. **Answer** *Replace telephone with telegraph.* **b** Light consists of electromagnetic waves where the electric and magnetic fields are parallel to each other. **c** The magnetic field produced around a straight current-carrying wire is elliptical. **d** When a magnet is moved in and out of a coil of wire, a continuous direct current is produced in the wire. **e** An electric motor converts electrical energy to potential energy. **f** Mobile phones use infra-red waves to transmit digital signals within a network of regions called cells.		5

22	Complete each of the statements below by inserting the word *increases* or *decreases* in the appropriate space. **a** For electromagnetic waves, as the frequency increases, the wavelength __________. **b** The resistance of a thermistor _________ as its temperature increases. **c** The size of the current induced in a wire ___________ if the magnet is moved more quickly. **d** In the visible light spectrum, moving from red light to blue light, the frequency __________.		4

Chapter 8: Global issues

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 57 marks

Section A—Multiple choice (15 marks)

1	When changes are made to science they must provide what? **A** speculation **B** proposals **C** evidence **D** nothing		1
2	What is the problem with making more cars like the Hydrogen-7? **A** There isn't enough hydrogen. **B** There isn't any hydrogen. **C** There are very few hydrogen refuelling stations. **D** The car doesn't work.		1
3	People have different sets of what that cause some debates? **A** ethics **B** values **C** ideas **D** money		1
4	Which of the following is not an issue being debated globally currently? **A** use of genetically modified plants **B** building nuclear power plants **C** human influence on global warming **D** radiation therapy for cancer		1
5	Isotopes are atoms: **A** with the same mass number, but different atomic numbers **B** that are unstable and undergo radioactive decay **C** with the same atomic number, but different mass numbers **D** that have unequal numbers of protons and electrons.		1

6	A radiation dose of 250 000 μSv would, in the short term, be likely to cause: **A** no biological effect **B** cell damage **C** radiation sickness **D** severe radiation sickness and possible death within a month.		1
7	The intake of toxins accumulated from what you eat is called: **A** trioaccumulation **B** bioaccumulation **C** biomagnification **D** toxin poisoning.		1
8	What is a carcinogen? **A** a cancer-causing agent **B** a dioxin **C** a cancer **D** a herbicide		1
9	What is blue-green algae? **A** tiny snakes **B** tiny poisonous aquatic plants **C** tiny poisonous land plants **D** tiny fish		1
10	Stem cells have the ability to change when taken from: **A** an adult **B** a child **C** an embryo **D** a blastocyst.		1
11	Cloning is the process where: **A** the clone is nothing like the original DNA **B** the clone is identical to the original DNA **C** nothing is possible **D** animals are made to replace other animals.		1

12	IVF generally uses a process where multiple eggs are fertilised. What usually happens to them? (Note all of the answers are possible, despite current issues. Which answer is the most common?) **A** They are all implanted in the woman at once. **B** They are frozen to perhaps be used later. **C** They are destroyed. **D** They are used for stem cell research.		1
13	An increase in the level of which of the following gases would be *least* likely to have an impact on the greenhouse effect? **A** carbon dioxide **B** methane **C** chlorofluorocarbons **D** nitrogen		1
14	The approximate percentage of the world's greenhouse gases produced by Australia is: **A** 0.5% **B** 1.5% **C** 5.0% **D** 10%		1
15	Which of the following is a non-renewable source of energy? **A** tidal **B** solar **C** natural gas **D** geothermal		1

Section B—Written answers (42 marks)

1	Carbon dioxide is a major greenhouse gas. Complete the following table showing other greenhouse gases by **identifying**: **a** *two* major greenhouse gases (other than CO_2) **b** the formula of each gas **c** *one* source of each gas.		6
2	**Explain** why deforestation by burning can be said to have a 'double effect' on the carbon dioxide level in the atmosphere.		2

a **Greenhouse gas**	**b** **Formula**	**c** **Source**

3	**Outline** the triple bottom line and **explain** how it is different from the bottom line.		4
4	**Specify** at least two reasons why nuclear power is nowadays being increasingly considered as an alternative energy source to coal.		2
5	**Specify** one disadvantage of nuclear power plants.		1
6	Through the use of a simple food chain, **explain** how bioaccumulation occurs and how the toxin is biomagnified.		2
7	**State** where lead-based paints can be found and **explain** why they are bad.		3

8	**Define** DDT and **explain** why it is no longer used in Australia.		3
9	**Define** the following abbreviations. **a** GMO **b** PSP **c** IVF		3
10	Identical twins sometimes look a little different. **Explain** whether this means they have different DNA.		2
11	**Compare** allotransplants with xenotransplants.		2
12	**Identify**: **a** *one* process that adds carbon dioxide to the atmosphere, and write a chemical equation for the process. **b** *one* process which removes carbon dioxide from the atmosphere, and write a chemical equation for the process.		5

13	**Recall**: **a** the amount by which the Earth's average surface temperature has increased over the past 100 years **b** the amount by which the Earth's average surface temperature is expected to increase during the next 100 years. **c** **Propose** *two* likely consequences of this expected temperature rise.		4
14	Stem cell research using embryos harvests live 6–8-day-old embryos. The issues around this occur because this embryo is human and is the same as any embryo that would have been fertilised inside a woman except that it has been done artificially. **Discuss** the issues involved with stem cell research.		3

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 97 marks

Section A—Multiple choice (23 marks)

1	The substances formed after a chemical reaction are called the: **A** reactants **B** reaction **C** products **D** final chemicals.	C	1
2	An element consists of: **A** one type of atom **B** two or more atoms **C** a group of electrons **D** none of the above.	A	1
3	Ions are charged particles. A positive ion is one that has: **A** gained protons **B** gained neutrons **C** lost electrons **D** lost neutrons.	C	1
4	A substance that has covalent bonding: **A** shares electrons **B** shares protons **C** loses or gains electrons **D** loses or gains protons.	A	1
5	In all chemical reactions: **A** new atoms are formed **B** matter is created **C** mass is lost **D** new compounds are formed by rearranging atoms rather than by creating matter.	D	1

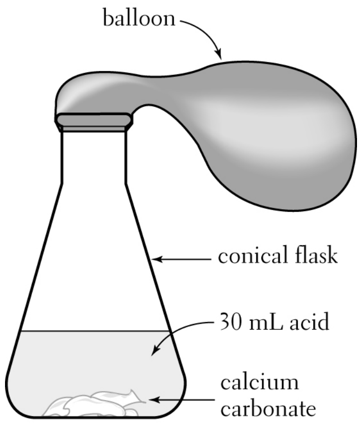
6	Given that the symbol for iron is Fe, and the formula for the chloride ion is Cl^-, the formula for iron(II) chloride is: **A** FeCl **B** $FeCl_2$ **C** Fe_2Cl **D** Fe_3Cl_4.	B	1
7	The Law of Conservation of Mass states that in a chemical reaction: **A** the mass of products is less than the mass of the reactants **B** the mass of products is more than the mass of the reactants **C** the mass of each chemical changes slightly **D** the mass of products is equal to the mass of the reactants.	D	1
8	Magnesium burns in air according to the equation: $w\,Mg + x\,O_2 \rightarrow y\,MgO$ The values of *w, x* and *y* needed (in order) to balance this equation are: **A** 2, 1, 2 **B** 1, 2, 1 **C** 2, 1, 1 **D** 1, 2, 2.	A	1
9	Chemical equations also include the state of the substances. In the equation: $Hg_{(l)} + S_{(s)} \rightarrow HgS_{(s)}$ list the state of mercury sulfide. **A** liquid **B** gas **C** aqueous **D** solid	D	1
10	A method used to increase the yield of a reaction is to: **A** lower the temperature **B** leave the reaction alone **C** use a catalyst **D** add more products.	C	1

11	Moving through the activity series for metals from potassium (K) to copper (Cu) the metals become more: **A** likely to be found as native metals **B** reactive **C** expensive to extract from their ores **D** likely to donate electrons.	A	1
12	An acid reacting with a metal hydroxide to produce a salt and water is an example of a: **A** combustion reaction **B** displacement reaction **C** neutralisation reaction **D** decomposition reaction.	C	1
13	A combustion reaction: **A** always has carbon dioxide as a product **B** always has water as a product **C** always has oxygen as a reactant **D** is always endothermic.	C	1
14	The equation for the overall reaction in photosynthesis is: $energy + 6CO_{2(g)} + 6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq)} + 6O_{2(g)}$. Photosynthesis is: **A** an endothermic process **B** an exothermic process **C** a combustion reaction **D** an acid–base reaction.	A	1
15	Magnesium is dissolved in acid. Its equation is $Mg + 2HCl \rightarrow$________$+ H_2$. The missing chemical in the reaction is: **A** MgCl **B** Mg2Cl **C** $MgCl_2$ **D** 2MgCl.	C	1

16	Which of the following best represents a chemical reaction? **A** products → reactants **B** reactants → products **C** chemicals → water **D** reactants → chemicals	B	1
17	In the chemical reaction iron + sulfur → iron sulfide: **A** iron and sulfur are products **B** iron sulfide is the product **C** iron, sulfur and iron sulfide are products **D** sulfide is the product.	B	1
18	Which of the following types of radiation travels slowest? **A** gamma **B** ultraviolet **C** beta **D** alpha	D	1
19	Isotopes are atoms: **A** with the same mass number, but different atomic numbers **B** which are unstable and undergo radioactive decay **C** with the same atomic number, but different mass numbers **D** which have unequal numbers of protons and electrons.	C	1
20	Aluminium decays according to the equation shown below. $^{28}_{13}\mathrm{Al} \rightarrow ^{28}_{14}\mathrm{Si} + X$ The particle *X* in the above equation is: **A** an electron **B** a neutron **C** an alpha particle **D** a proton.	A	1

21	Am-241 has a half-life of 460 years. How long would it take a 1000 g sample of Am-241 to decay so that the sample contained only 31.25 g of Am-241? **A** 1380 years **B** 1840 years **C** 2300 years **D** 2760 years	C	1
22	Which type of radiation is chemically identical to a helium nucleus? **A** alpha **B** beta **C** gamma **D** X-ray	A	1
23	A radiation dose of 250 000 μSv would, in the short term, be likely to cause: **A** no biological effect **B** cell damage **C** radiation sickness **D** severe radiation sickness and possible death within a month.	B	1

Section B—Written answers (74 marks)

<table>
<tr>
<td>1</td>
<td>An experiment was conducted as shown in the diagram below.


$CaCO_{3(s)}$ was added to $HCl_{(aq)}$. The flask, contents and balloon were weighed before and after the reaction. The products of the reaction are a gas and a soluble salt.
a Write a balanced equation (including states) for the reaction occurring in the flask.
b Would you expect the mass after the reaction to be greater than, less than or equal to the mass before reaction? Justify your choice.</td>
<td>a $CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O$
b The mass should be the same before and after the reaction. The Law of Conservation of Mass states that mass is neither created nor destroyed during a chemical reaction.
or
The mass would be slightly less because some gas might have been lost when the balloon was being attached to the flask, as the reaction was beginning.</td>
<td>5</td>
</tr>
</table>

2	Balance the following equations. **a** $\_Li_{(s)} + \_H_2O_{(l)} \rightarrow \_LiOH_{(aq)} + \_H_{2(g)}$ **b** $\_Cu(NO_3)_{2(s)} \rightarrow \_CuO_{(s)} + \_NO_{2(g)} + \_O_{2(g)}$	**a** $2Li_{(s)} + 2H_2O_{(l)} \rightarrow 2LiOH_{(aq)} + H_{2(g)}$ **b** $2Cu(NO_3)_{2(s)} \rightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$	6
3	Write a balanced formula equation, including states, for each of the reactions described below. **a** When aqueous solutions of lead(II) nitrate, $Pb(NO_3)_2$, and potassium iodide, KI, are mixed, the yellow solid lead(II) iodide precipitates from the solution, while the soluble salt, potassium nitrate, remains in solution. **b** An aqueous solution of ethanol, C_2H_5OH, is produced when a glucose, $C_6H_{12}O_6$, solution reacts in the presence of a yeast catalyst. Gaseous carbon dioxide is also produced.	**a** $Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$ **b** $C_6H_{12}O_{6(aq)} \rightarrow 2C_2H_5OH_{(aq)} + 2CO_{2(g)}$	8
4	**a** **Identify** the catalyst used during the contact process for sulfuric acid production. **b** **Explain** why a catalyst is used. **c** **Explain** why several catalyst beds are used, rather than just one.	**a** vanadium(V) oxide (V_2O_5) **b** to increase the rate of the reaction between sulfur dioxide and oxygen in the converter **c** to give the gases more chance of reacting	3

5	The equations below represent three of the reactions occurring during the contact process for sulfuric acid production. I $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$ II $H_2S_2O_{7(l)} + H_2O_{(l)} \rightarrow 2H_2SO_{4(l)}$ III $SO_{3(g)} + H_2SO_{4(l)} \rightarrow H_2S_2O_{7(l)}$ **a** **Identify** which of these reactions (I to III) occurs in the: **i)** absorber **ii)** converter. **b** **Identify** the reactions (I to III) that : **i)** are exothermic **ii)** require a catalyst.	**a** **i)** III **ii)** I **b** **i)** I, II and III **ii)** I	6
6	**Recall** *three* ways in which the rate of a reaction may be increased.	Any three of: • higher temperature • more concentrated reactants • higher pressure for gases • larger surface area • use of a catalyst.	3
7	**a** Write a balanced equation for the corrosion of aluminium (Al) in air to form aluminium oxide (Al_2O_3). **b** Aluminium is more reactive than iron. **Explain** why aluminium window frames do not corrode as quickly as iron window frames.	**a** $4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_{3(s)}$ **b** Aluminium oxide forms a layer impervious to water and oxygen, stopping further corrosion from occurring. Iron oxide is permeable to oxygen and water, so corrosion continues.	4

8	A student wrote the equation below to represent the rusting of iron. $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ **Identify:** **a** the substance required for rusting that is *not* shown in this equation **b** *two* conditions that would speed up the rate of rusting of an iron garden chair	**a** water **b** high temperatures and the presence of salts	3
9	**Explain** why iron objects found in each of the following locations show little sign of rusting. **a** outer space **b** the desert **c** deep in the ocean	**a** No oxygen is available. **b** Little water is available. **c** Little dissolved oxygen is available deep in the ocean.	3
10	Uranium (U) is element number 92. Thorium (Th) is element number 90. Uranuim-238 undergoes alpha decay to form thorium-234 and an alpha particle. **a** **Clarify** what the number 238 tells us about a uranium-238 atom. **b** **Describe** the composition of an alpha particle. **c** **Recall** the nuclear equation for the alpha decay of uranium-238.	**a** It is the mass number. This is the total number of protons and neutrons in the atom's nucleus. **b** A combination of two protons and two neutrons. **c** ${}^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}\alpha$	6

11	Hydrogen has the symbol ${}^{1}_{1}H$. Deuterium is a stable isotope of hydrogen with one neutron per atom. Tritium is a radioisotope of hydrogen containing two neutrons per atom. **a** **Identify** the symbols for deuterium and tritium. **b** Two deuterium nuclei may be joined to form a helium nucleus. **Construct** a nuclear equation for this reaction. **c** **Identify** the name given to the type of nuclear reaction described in part **b**.	**a** ${}^{2}_{1}H$ and ${}^{3}_{1}H$, respectively **b** $2{}^{2}_{1}H \rightarrow {}^{4}_{2}He + \text{energy}$ **c** nuclear fusion	5
12	Three types of radiation emitted during nuclear reactions are alpha, beta and gamma radiation. **Identify** which of these three types of radiation: **a** travels the fastest **b** consists of particles with the same mass as an electron **c** consists of electromagnetic waves **d** can penetrate a 1 mm-thick sheet of aluminium **e** can be stopped by a thick sheet of paper.	**a** gamma **b** beta **c** gamma **d** gamma **e** alpha	5
13	**a** **Explain** what is meant by the ‘half-life’ of a radioisotope. **b** Carbon-14 has a half-life of 5730 years. A fossil is found to contain one-eighth of the amount of carbon-14 in a living specimen. **Predict** the age of the fossil.	**a** The time taken for half of the atoms in a sample of a radioisotope to decay. **b** Three half-lives are needed to decay to one-eighth of the original amount. Therefore, 3 × 5730 = 17 190 years.	3

14	**Identify:** **a** *one* source of each of the following types of environmental radiation: **i)** terrestrial radiation **ii)** cosmic rays **iii)** artificially produced radiation. **b** **State** from which of the sources listed in part **a** do we receive the largest percentage of annual radiation.	**a** For example: **i)** radioactive radon gas produced by the decay of uranium in rocks underground **ii)** radiation from collapsing stars **iii)** radiation from waste products from a nuclear reactor. **b** terrestrial	4
15	**Describe** *two* uses of nuclear radiation in medicine and/or industry.	For example, any two of: • radiotherapy to destroy cancer cells • use of radioactive tracers to diagnose thyroid conditions • measuring the thickness of metal by measuring the amount of radiation transmitted • sterilisation of medical and surgical equipment • use of radioactive tracers to study the uptake of nutrients in food chains.	4
16	Carbon-14 dating is used to estimate the age of fossils. **Explain** why the percentage of radioactive carbon-14 decreases in dead organisms, but remains constant in living organisms.	Carbon-14 is continuously decaying, decreasing its percentage level. In living organisms it is replenished, so a constant percentage of carbon-14 remains. In dead organisms, the carbon-14 is not replaced.	3
17	Radioactive uranium-238 is found in many rocks. The age of rocks containing fossils may be measured by comparing the levels of uranium-238 and lead in the rock. **Propose** a reason why this form of radioactive dating, rather than carbon-14 dating, is used for rocks from the dinosaur era.	The half-life of uranium-238 is much greater than that of carbon-14. The dinosaur era dates to 65 million years ago and beyond. After 46 000 years (approximately 8 half-lives) the level of carbon-14 in a sample is very low, so carbon-14 dating is usually used for 'younger' rocks.	3

2: Materials

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 68 marks

Section A—Multiple choice (21 marks)

1	Which of the following best describes the structure of metals? A lattice of: **A** alternating positive and negative ions **B** positive ions surrounded by freely moving electrons **C** molecules held together by covalent bonds **D** atoms held together by covalent bonds.	B	1
2	Which of the following is *not* a property of most metals? **A** malleable **B** good electrical conductors **C** poor thermal conductors **D** shiny appearance	C	1
3	An alloy of iron and carbon which contains 4% carbon is likely to be: **A** weaker and more malleable than pure iron **B** weaker and more brittle than pure iron **C** stronger and more malleable than pure iron **D** stronger and more brittle than pure iron.	D	1
4	Which of the following alloys does *not* contain tin (Sn)? **A** brass **B** bronze **C** solder **D** dental amalgam	A	1
5	What is the percentage of pure gold in a 12-carat gold bracelet? **A** 25% **B** 50% **C** 75% **D** 100%	B	1

6	Which of the following metals is *not* naturally found as a pure element? **A** platinum **B** silver **C** gold **D** sodium	D	1
7	During the process of froth flotation, waste material is separated from the ore. This waste material is called: **A** the overburden **B** slag **C** gangue **D** a mineral.	C	1
8	Moving through the activity series for metals from potassium (K) to copper (Cu), the metals become more: **A** likely to be found as native metals **B** reactive **C** expensive to extract from their ores **D** likely to donate electrons.	A	1
9	Which of the following equations represents the process occurring at the positive electrode during the extraction of magnesium by electrolysis of molten magnesium chloride? **A** $Mg^{2+} + 2e^- \rightarrow Mg$ **B** $Mg \rightarrow Mg^{2+} + 2e^-$ **C** $2Cl^- \rightarrow Cl_2 + 2e^-$ **D** $Cl_2 + 2e^- \rightarrow 2Cl^-$	C	1
10	Which of the following metals would usually be extracted from its ores by smelting? **A** potassium **B** calcium **C** copper **D** aluminium	C	1

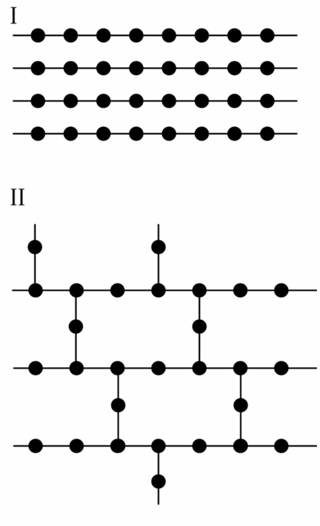
11	Most of the coke added to a blast furnace reacts: **A** with oxygen and carbon dioxide to form carbon monoxide **B** directly with iron ore (Fe_2O_3) to produce iron **C** with sand in the ore to produce slag **D** with limestone ($CaCO_3$) to produce calcium oxide.	A	1
12	Nails and roofing materials are commonly made of galvanised iron. Galvanised iron is iron dipped in molten: **A** tin **B** chromium **C** aluminium **D** zinc	D	1
13	Which of the following is a property of all thermoplastic materials? **A** scratch resistance **B** softens easily when heated **C** brittle and rigid **D** chars when heated	B	1
14	Which of the following plastics must be manufactured and moulded at the same time? **A** polyethene **B** polyvinylchloride (PVC) **C** acrylic **D** bakelite	D	1
15	Which of the following synthetic fibres is based on the natural polymer cellulose? **A** rayon **B** nylon **C** lycra **D** polyester	A	1

16	Monofilaments: **A** only occur in natural fibres **B** are made from polymers that are the same length as the fibre **C** are extremely flexible but can tear easily **D** are made from many short polymers which overlap each other along the fibre length.	B	1
17	Sulfuric acid is *not* used: **A** in car batteries **B** to process metals **C** in the refining of petroleum **D** as a fertiliser.	D	1
18	The chemistry of carbon compounds is called: **A** organic **B** inorganic **C** alcoholic **D** covalent.	A	1
19	How many electrons are shared when two atoms have a double bond between them? **A** 2 **B** 4 **C** 6 **D** 8	B	1
20	Alkenes are hydrocarbons that: **A** have only single carbon-carbon bonds **B** contain one double carbon-carbon bond **C** have the general formula C_nH_{2n-2} **D** contain the hydroxy (OH) functional group.	B	1
21	Which of the following is a naturally occurring fibre? **A** elastane **B** fibreglass **C** kevlar **D** coir	D	1

Section B—Written answers (47 marks)

1	**Identify** the metal from the list below to answer the questions that follow. *mercury, zinc, lead, copper, tin, aluminium* Name one metal which is: **a** more reactive than iron and is used as a coating to protect roofing iron **b** less reactive than iron and is used as a coating to protect iron cans **c** a liquid at room temperature **d** used to make cooking utensils and has a low density **e** an excellent electrical conductor and is used for wiring.	**a** zinc **b** tin **c** mercury **d** aluminium **e** copper	5
2	**Explain:** **a** why jewellery is not usually made of pure gold. **Identify:** **b** one metal that is often added to pure gold to make jewellery **c** the percentage of gold that is found in Australian 'gold' coins.	**a** Pure gold is soft. It would break with the normal strains of everyday use. **b** silver or copper **c** 0%	3
3	**Identify** *four* factors that would need to be considered when deciding whether it is worthwhile mining an area for a particular metal.	For example: • How much ore is there and how concentrated is it? • Is the site close to an available labour force? • Who owns/controls the land and will compensation be required? • What environmental damage will be caused and how can it be minimised?	4

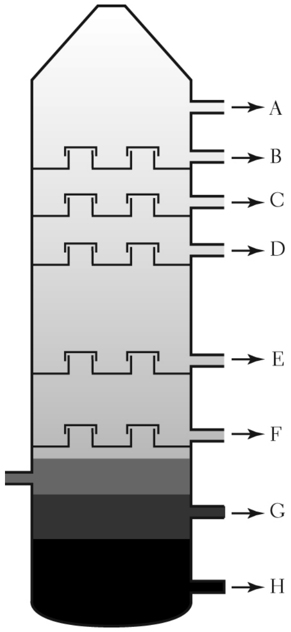
4	**Identify:** **a** the type of mining used for ores found close to the surface **b** *two* problems associated with this type of mining.	**a** open-cut mining **b** Any two of: • destruction of land • pooling of water • unsightliness • repair of the land after mining ceases.	3
5	The temperature near the bottom of a blast furnace is approximately 1600°C. **Explain** why it is important that this area has such a high temperature.	If the temperature was lower, the iron produced in the furnace reaction would solidify and be very difficult to separate from other solids. The molten iron is easily removed from the furnace.	2
6	**Identify:** **a** *four* properties of plastics which make them useful **b** *two* disadvantages of plastics.	**a** Any four of: • thermal and electrical insulators • strong and lightweight • easily moulded into different shapes • do not react with water or oxygen • can be coloured • can be treated to resist deterioration in sunlight. **b** non-biodegradable and burn easily to produce toxic fumes	6

7	The diagrams below show the structures of two types of materials. **Identify** the thermosetting plastic. **Explain** your choice. 	II. Thermosetting plastics have strong cross-linking bonds between the polymer chains, creating a giant molecular structure. Thermoplastics have very weak bonding between the polymer chains.	3
8	**Identify** the type of moulding process that is commonly used to manufacture: **a** plastic toys and bottle caps **b** plastic straws and pipes **c** plastic bottles **d** synthetic fibres.	**a** injection **b** extrusion **c** blow **d** extrusion	4

 ISBN 9781442515413

9	**a** **Identify** which fibres (natural or synthetic): **i)** have rough surfaces **ii)** are used for wash-and-wear fabrics. **Describe:** **b** one advantage of fibres with rough surfaces **c** one disadvantage of fibres with rough surfaces.	**a** **i)** natural **ii)** synthetic **b** They can absorb and hold water. This is useful on a hot day, when they absorb sweat. **c** They can absorb and hold dirt. They therefore tend to stain easily.	6
10	**Explain:** **a** why it is unwise to tumble-dry and iron most synthetic fibres **b** why it is unwise to wear synthetic fabrics on a very hot day.	**a** Synthetic fibres are thermoplastic and will melt if heated. **b** Synthetic fabrics do not absorb sweat (water). The sweat therefore stays on the skin, producing a wet and clammy feel.	4

 ISBN 9781442515413

11	The diagram below shows a fractionating tower used for the processing of crude oil.  **a** **Identify** what crude oil is formed from. **b** **Identify** the type of chemical compounds from which crude oil is composed. **c** Eight fractions (A to H) are labelled on the diagram. **Identify**: **i)** the fraction containing the smallest molecules **ii)** the fraction with the highest boiling point range **iii)** one fraction that is used primarily as fuel for transport **iv)** the fraction used to make bitumen for roads.	**a** the remains of plants and animals that lived millions of years ago **b** hydrocarbons (alkanes) **c** **i)** A **ii)** H **iii)** B, C or F **iv)** H	7

3: Genetics

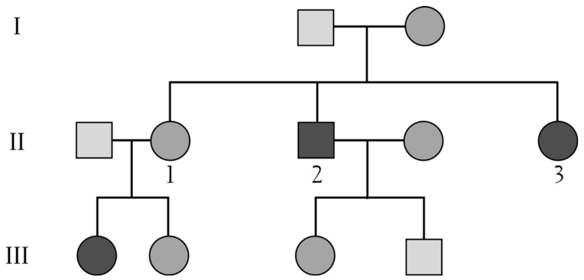
Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 84 marks

Section A—Multiple choice (14 marks)

1	Gametes are: **A** normal cells, such as muscle and brain cells **B** sex cells, sperm or eggs (ova) **C** another name for chromosomes **D** part of a strand of DNA.	B	1
2	Gametes of a fruit fly have four chromosomes. The diploid number for the fruit fly is: **A** 2 **B** 4 **C** 6 **D** 8.	D	1
3	How many chromosomes are in the gametes (sperm or ova) of a human? **A** 23 **B** 100 **C** 46 **D** 92	A	1
4	How many chromosomes are in the 'normal' cells (e.g. muscle cells, brain cells, blood cells) of a human? **A** 23 **B** 100 **C** 46 **D** 92	C	1

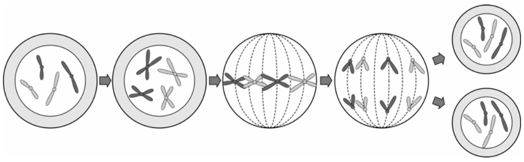
5	When a cell with three pairs of chromosomes undergoes meiosis, how many types of gametes are possible? **A** 3 **B** 4 **C** 6 **D** 8	D	1
6	In rabbits, the gene for long hair (*h*) is recessive to the gene for short hair (*H*). When a short-haired female was mated with a long-haired male, the offspring consisted of five short-haired and three long-haired rabbits. The genotypes of the parent rabbits must be: **A** female (*hh*), male (*HH*) **B** female (*HH*), male (*hh*) **C** female (*Hh*), male (*hh*) **D** female (*Hh*), male (*HH*)	C	1
7	The Rh blood grouping system is controlled by one gene with two alleles. The gene for Rh-positive blood is dominant over the gene for Rh-negative blood. Two people homozygous for Rh-positive blood produce a child. What is the probability that the child will have Rh-positive blood? **A** 0 per cent **B** 25 per cent **C** 50 per cent **D** 100 per cent	D	1
8	Which of the following characteristics in humans is most likely to show continuous variation? **A** skin colour **B** albinism **C** night blindness **D** blood group	A	1

9	Below is a pedigree showing the inheritance of a disease caused by a recessive gene.  Which of the numbered people in generation II is a female homozygous for the disease? **A** 1 **B** 2 **C** 3 **D** cannot be determined from the information provided	C	1
10	An X-linked or sex-linked disease in humans is one that: **A** only affects females **B** only affects males **C** is caused by a gene carried on the X chromosome **D** affects the sex organs of the female.	C	1
11	The term 'replication' refers to the: **A** use of a section of DNA to code for an amino acid sequence **B** copying of a section of DNA **C** appearance of a characteristic that a section of DNA codes for **D** change in a DNA sequence caused by the action of a mutagen.	B	1
12	A plasmid is a: **A** circular piece of DNA found in a bacterial cell **B** molecule containing DNA from two organisms **C** plant or animal with a new gene **D** small piece of DNA with a base sequence identical to part of a gene.	A	1

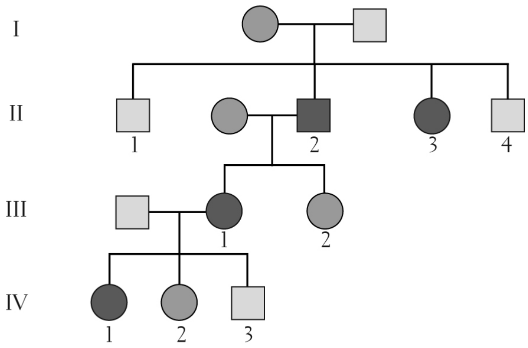
13	Which of the following is true for *both* mitosis and meiosis? **A** occurs in all body cells **B** involves the replication of DNA **C** produces cells with the same number of chromosomes as the parent cell **D** produces four daughter cells per division	B	1
14	The structure of DNA may be described as a twisted ladder. What forms the uprights of the ladder? **A** alternating sugar and phosphate units **B** nitrogen bases **C** amino acids **D** protein	A	1

Section B—Written answers (70 marks)

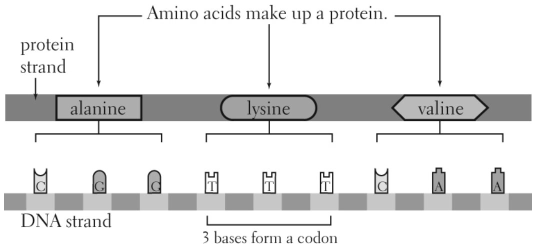
1	In terms of chromosomes, **explain** why a sperm or an ovum (egg) cannot possibly produce a new human on its own.	A sperm cell has only 23 chromosomes, as does an ovum. Human cells (apart from gametes) contain 46 chromosomes. Hence, a sperm cell needs to meet an ovum to give the new cell the 46 chromosomes needed.	2
2	Use the alleles *M* and *m* in examples to **demonstrate** how different genotypes can give rise to the same phenotypes.	*MM*, *Mm* and *mM* would have the same phenotype; *mm* has a different phenotype.	3

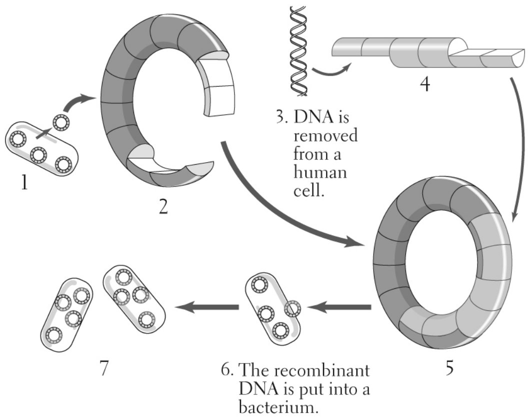
3	The diagrams below show the stages occurring during a cell division.  **a** **State** whether the cell division shown is mitosis or meiosis. **b** **Justify** your answer for part **a**. **c** **Name** one type of cell that might undergo the type of cell division shown above.	**a** mitosis **b** The daughter cells are identical to the parent cell. **c** skin cells (or any other non-gamete-producing cells)	3
4	Match the following with the term that best describes them: *G* homozygous *Gg* allele *GG* phenotype black hair heterozygous	*G* allele *Gg* heterozygous *GG* homozygous black hair phenotype	4
5	With the aid of examples, **explain** what is meant by each of the following terms. **a** alleles **b** diploid cell **c** homozygous	**a** alternate forms of the same gene; for example, the gene for eye colour may code for blue eyes or brown eyes **b** a cell containing two of each type of chromosome; for example, human skin cells contain 23 pairs of chromosomes **c** having only one type of gene for a particular trait; for example, genotype *bb* for blue eyes	6

6	In shorthorn cattle, the gene for white coat (*W*) is codominant with the gene for red coat (*R*). The heterozygous organism has a roan coat. **a** **Predict** the genotype of a cow with a: **i** white coat **ii** red coat. **b** A farmer wants to ensure that all his cattle have roan coats. **Explain** which type of cattle should be mated together.	**a** **i** *WW* **ii** *RR* **b** White cattle (*WW*) should be mated with red cattle (*RR*) to ensure that all offspring have the genotype *RW* (roan coat).	4
7	**a** In terms of chromosomes, **explain** the difference between a male and a female. **b** **Explain** why you would expect half the children born in the world to be female.	**a** Males have one X and one Y chromosome. Females have two X chromosomes. **b** Each sperm cell has an equal chance of carrying an X or a Y chromosome. Each zygote therefore has an equal chance of receiving an X or a Y chromosome. Therefore, each child born has an equal chance of being a female (XX) or a male (XY).	4

8	The pedigree below shows the inheritance of a disease caused by a recessive gene (g). Those with the dominant gene (G) do not show the disease.  **Identify:** **a** the genotype of an individual i) with the disease ii) heterozygous and without the disease **b** the genotypes of each of the following individuals i) Generation I female ii) Generation II number 3 iii) Generation III male iv) Generation IV number 2. **c** **Justify** your answer to question **b**, part **i)**.	**a** i) gg ii) Gg **b** i) Gg ii) gg iii)Gg iv)Gg **c** The female does not show the disease and is therefore either GG or Gg. She has produced a son and a daughter with the disease. They must have the genotype gg. Therefore, she must have contributed a g allele.	8
9	Most of the proteins made by cells are enzymes. **Outline** the function of enzymes.	They are biological catalysts that direct the chemical activities of cells.	2

10	Suppose you could clone your pet guinea pig. **Predict** whether the clone would be identical to your pet. **Explain** your answer.	The clone would be genetically identical and would therefore have the same features. It may, however, develop differences due to environmental factors, such as diet.	3
11	**a** **State** what the letters 'DNA' stand for. **b** **State** what the letters 'A', 'C', 'T' and 'G' stand for in a DNA base sequence.	**a** deoxyribonucleic acid **b** adenine, cytosine, thymine and guanine, respectively	5
12	Haemophilia is an X-linked recessive disease. The symbols used to show the relevant genes are X^S for the normal gene on the X chromosome, and X^s for the recessive gene on the X chromosome. **a** **State** the possible genotypes of a: **i** haemophiliac male **ii** non-haemophiliac male **iii** non-haemophiliac female. **b** A female may be a 'carrier' of the disease. **i** **Clarify** what is meant by the term 'carrier'. **ii** **State** the genotype of a 'carrier'.	**a** **i** X^sY **ii** X^SY **iii** X^SX^s or X^SX^S **b** **i** She has the gene for the disease but does not show the disease. **ii** X^SX^s	6

13	With the aid of a labelled diagram, **explain** how the base sequence of DNA directs the formation of a protein strand.	Each set of three bases (a codon) codes for an amino acid. Amino acids are joined together to form a protein strand. 	5
14	**Explain** the meaning of gene: **a** expression **b** technology.	**a** The appearance in an organism of the characteristic for which the gene codes. **b** The manipulation of the DNA within an organism.	2
15	**a Define** the term 'mutation'. **b State** *two* examples of mutagens.	**a** A spontaneous change in a gene or chromosome that may produce a change in the characteristic for which it codes. **b** For example: • X-rays • benzene.	3

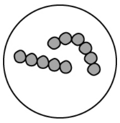
16	**Propose** *three* arguments: **a** for the use of genetically modified foods **b** against the use of genetically modified foods.	Examples: **a** • increased food production due to better disease management • reduced use of pesticides due to increased pest resistance • more nutritious and cheaper foods. **b** • plants with inbuilt pesticides may kill non-pest insects • creation of 'superweeds' • increased costs to farmers due to multinational companies owning rights to GM crops.	6
17	The diagram below shows the stages involved in gene technology using recombinant DNA. **Explain** what is happening in: **a** stage 2 **b** stage 4 **c** stage 5 **d** stage 7. 	**a** Stage 2: plasmids are cut using an enzyme. **b** Stage 4: DNA is cut using an enzyme to isolate a gene. **c** Stage 5: human gene is inserted into the plasmid to form recombinant DNA. **d** Stage 7: bacterial cells grow and divide to produce many copies of the introduced gene.	4

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 99 marks

Section A—Multiple choice (20 marks)

1	Which of the following nutrients supplies the least amount of energy per gram? **A** carbohydrates **B** protein **C** fats **D** minerals	D	1
2	Which of the following nutrients is not digested? **A** fat **B** carbohydrate **C** fibre **D** protein	C	1
3	Carbohydrate-containing foods are now ranked with a GI number. GI stands for: **A** glycemic index **B** glucose index **C** gluten index **D** gross index.	A	1
4	The study of disease is called: **A** forensic science **B** pathology **C** psychology **D** physiology.	B	1
5	Which of the following is an infectious disease? **A** obesity **B** mumps **C** haemophilia **D** diabetes	B	1

6	The pathogen for a particular infectious disease is the organism which: **A** suffers from the disease **B** carries the disease-causing organism from host to host **C** acts as a host of the parasite causing the disease **D** causes the disease.	D	1
7	The bacteria shown below would be described as:  **A** cocci **B** diplococci **C** streptococci **D** bacilli.	C	1
8	Which of the following pathogens is usually the smallest? **A** protozoan **B** fluke **C** virus **D** bacterium	C	1
9	A communicable human disease is one which: **A** is infectious and is easily transmitted from person to person **B** is inherited **C** is caused by an environmental factor **D** affects large numbers of people in a given population.	A	1
10	An antibody is a: **A** drug produced to treat bacterial infections **B** special chemical produced by the body in response to the presence of a foreign substance **C** foreign substance that causes the body to produce antigens **D** type of white blood cell that can destroy some pathogens.	B	1

11	Which of the following is a natural method of disease control used by the human body? **A** antibiotics **B** immunisation by inoculation with a vaccine containing live organisms **C** immunisation by inoculation with a vaccine containing antibodies **D** leucocytes	D	1
12	The sketch below shows a person with symptoms of a common disease. Which of the following diseases is the person likely to be suffering from?  **A** mumps **B** influenza **C** measles **D** botulism	C	1
13	Malaria is caused by: **A** poor diet **B** parasitic worms **C** a defect in the circulatory system **D** a pathogen passed on during mosquito bites.	D	1
14	Which of the following is *not* true of HIV? **A** can be passed from person to person via saliva **B** does not survive well outside the body **C** destroys T4 lymphocyte cells **D** is diagnosed by a blood test	A	1
15	Which of the following is a symptom of a disease? **A** bacteria **B** a blood test **C** a fever **D** an epidemic	C	1

16	The virulence of an infectious disease is a measure of: **A** the amount of damage the disease does to the host **B** how many people in a population suffer from the disease **C** how long the symptoms of the disease take to appear in the host after infection **D** the ease with which the disease is transmitted from person to person.	A	1
17	Which of the following diseases is *not* caused by a virus? **A** AIDS **B** chickenpox **C** measles **D** ringworm	D	1
18	Which of the following diseases is *not* directly related to the heart or blood vessels? **A** angina **B** hypertension **C** arteriosclerosis **D** diabetes	D	1
19	A tumour with cells that are rapidly dividing is called: **A** permanent **B** malignant **C** divided **D** benign	B	1
20	HIV is a type of retrovirus. This means that the virus: **A** originated in a non-human organism **B** is transmitted by body fluids **C** incorporates its DNA into the host cell's DNA **D** does not survive well outside the body.	C	1

Section B—Written answers (79 marks)

1	**Identify** the *three* basic requirements for good health.	good nutrition, a healthy mind, adequate exercise	3
2	**a** **Define** the term 'nutrient'. **b** **Identify** *two* types of energy-providing nutrients.	**a** Any substance that can be taken in by an organism and used as either an energy source or to build living tissue. **b** Any two of: fats, carbohydrates and proteins.	4
3	**a** **Define** what is meant by a 'psychosomatic' illness. **b** **Identify** an illness that is: **i)** psychosomatic **ii)** not psychosomatic.	**a** An illness caused by a poor mental state. **b** For example: **i)** anorexia nervosa **ii)** measles.	3
4	**List** what the Aboriginal traditional diet consisted of.	plants, seeds, nuts, fruits, honey, animals that they hunted	2
5	**Explain** the concern of transmitting European diseases to Aboriginal people.	Diseases such as influenza, tuberculosis and smallpox were not present in the Aboriginal community before European settlement. These diseases were therefore particularly harsh on Aboriginal communities, as they had no resistance to them. These diseases killed at least half of the Aboriginal population.	2

6	**State** whether or not each of the following statements is true. Use examples to **justify** your answers. **a** 'All bacteria are harmful and cause disease.' **b** 'All infectious diseases are caused by microscopic parasites.'	**a** Not true. Many bacteria are helpful and do not cause disease; e.g. some bacteria decompose waste and some aid digestion. **b** Not true. Some infectious diseases are caused by macroscopic parasites, such as flukes and tapeworms.	6
7	**Define** each of the following terms and give an example of each: **a** an infectious disease **b** a contagious disease **c** an environmental disease **d** a genetic disorder.	**a** A disease where the agent of the disease can be passed from one person to another; e.g. the common cold. **b** An infectious disease which is transmitted by direct contact; e.g. syphilis. **c** A disease caused by an environmental factor; e.g. asbestosis caused by repeated exposure to asbestos dust. **d** A disorder caused by abnormalities in one or more genes; e.g. Down syndrome.	8

8	Using a particular disease as an example (e.g. lymphatic filariasis), **explain** what is meant by each of the following terms when describing the disease: **a** the pathogen **b** a symptom **c** a vector **d** a method of artificial control.	**a** The micro-organism causing the disease; e.g. a worm causes lymphatic filariasis. **b** A sign of the presence of the disease; e.g. blockage of the lymphatic system in the legs, resulting in gross swelling of the limb. **c** An organism that carries the pathogen from one host to the next; e.g. a mosquito carries the worm embryo from one person to the next. **d** A non-natural method of treating the disease; e.g. use of drugs to kill the parasite within the blood of people with lymphatic filariasis.	8
9	**Identify** *two* differences between bacteria and viruses.	For example: Bacteria are cells, viruses are not. Bacteria reproduce by binary fission, viruses reproduce by directing a host cell to make more virus particles.	4
10	**List** the following organisms in order of size from smallest to largest. *protozoan, tapeworm, virus, bacterium*	Virus, bacterium, protozoan, tapeworm	2

11	**a** **Explain** what is meant by the term ‘opportunistic pathogens’. **b** **Identify** an example of a situation in which an opportunistic pathogen may cause infection.	**a** These are organisms not usually associated with infection, but they can cause infection if conditions are ideal and/or if the host’s immune system is not working properly. **b** For example: Thrush (caused by a fungus) can occur when the normal vaginal bacteria have been destroyed. AIDS sufferers are prone to fungal infections due to reduced functioning of the immune system.	4
12	**Account** for the fact that a person is unlikely to suffer from measles as an adult if they had measles as a child.	The person has an acquired immunity to measles. When they had measles as a child, their body produced antibodies in response to the presence of the measles virus (the antigen). These antibodies are specific to the measles virus. If exposed again to the virus, the body ‘knows how’ to make the antibodies and can protect against the viral infection.	4
13	**a** **Describe** the difference between active and passive immunity produced by vaccination. **b** **Identify** which lasts longer—active or passive immunity.	**a** Active immunity—the person’s body cells are stimulated to make their own antibodies. Passive immunity—antibodies produced from another organism are injected into the person. **b** active immunity	5

14	**Explain** why it is difficult to produce immunity to the common cold.	There are many strains of the common cold virus, and new strains emerge frequently. It is therefore difficult to produce enough vaccines to give immunity to all strains.	3
15	**Account** for the following two possibilities. **a** A child has a genetic disease when there is no history of the disease in the family. **b** Two people with a genetic disease produce a child without the disease.	**a** A mutation may have occurred in the gametes or in the zygote that formed the child. Alternatively, it may have been carried for an infinite length of time without surfacing. **b** A dominant gene (D) may cause the disease. Two heterozygous (Dd) parents may produce a child with two recessive genes (dd). The child will therefore not show the disease.	5
16	**a** **Describe** *two* examples of diseases that may be directly linked to diet. **b** **Explain** how a disease like diabetes mellitus may be described as both genetic and diet-related.	**a** For example: anaemia due to lack of iron in the diet obesity due to overeating. **b** Some people seem genetically predisposed to diabetes (Type I). The disease may develop when the person becomes overweight (Type II diabetes).	6

17	**Define** the following terms. **a** arteriosclerosis **b** hypertension **c** coronary heart disease **d** malignant tumour **e** benign tumour	**a** hardening of the arteries **b** persistent high blood pressure **c** anything that reduces blood flow to the heart **d** an abnormal, uncontrollable growth **e** an abnormal growth where the cells are not dividing rapidly	5
18	**a** **Identify** *three* factors that might contribute to cancer. **b** **Explain** how a disease such as cancer may be described as both genetic and environmental.	**a** For example, any three of the following: exposure to carcinogens such as benzene cigarette smoking poor diet genetic predisposition. **b** Some people seem genetically predisposed to cancer. The disease may develop when the person is exposed to certain environmental factors.	5

5: Evolution

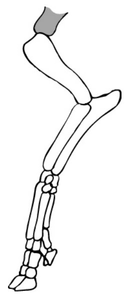
Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 67 marks

Section A—Multiple choice (12 marks)

1	Which of the following ideas is most closely associated with Jean Baptiste Lamarck's theory? **A** sudden speciation followed by long periods of stability **B** evolution by natural selection **C** evolution by inheritance of acquired characteristics **D** evolution as a result of a change in the frequency of certain genes in a population	C	1
2	Who developed the theory of natural selection while on board HMS *Beagle* in the Galapagos Islands? **A** Snoopy the beagle **B** Jean Baptiste Lamarck **C** Alfred Russell Wallace **D** Charles Darwin	D	1
3	Alfred Russell Wallace and Charles Darwin were the first to: **A** explain the source of the natural variation occurring within a species **B** challenge the idea of the 'fixity of species' **C** propose the idea of natural selection to explain how organisms evolve **D** suggest that characteristics acquired during a lifetime could be passed on to offspring.	C	1
4	Which type of evolution best explains the observation that the South American anteater and the African aardvark have several similarities but are not genetically closely related? **A** divergent evolution **B** convergent evolution **C** parallel evolution **D** punctuated equilibrium	B	1

5	Which of the following organisms is genetically most similar to *Homo sapiens*? **A** chimpanzee **B** monkey **C** gorilla **D** virus	A	1
6	Flying squirrels of North America and Australia's gliding possums have structures that look similar but have come from different ancestors. These similarities are known as: **A** homologous structures **B** analogous structures **C** vestigial organs **D** examples of adaptive radiation.	B	1
7	Which of the following is *not* an inherited characteristic? **A** the long neck of a giraffe **B** a person's blue eyes **C** a person's acquired immunity to the measles virus **D** the ability of a spider to spin a web	C	1
8	Which of the following statements concerning reproductive isolation and geographic isolation of two populations is correct? **A** Reproductive isolation of two populations always occurs before their geographic isolation. **B** Two populations that are geographically isolated must be two different species. **C** Subspecies form when two populations are reproductively isolated. **D** Speciation occurs when two populations become reproductively isolated.	D	1

9	The pentadactyl limb shown is modified for:  **A** walking **B** tearing **C** grasping **D** flying.	A	1
10	When the myxoma virus was first introduced into Australia, 90 per cent of rabbits in certain areas died, and less than 1 per cent of infected rabbits survived. Ten years later, only 25 per cent of rabbits in the same areas died, and 40 per cent of infected rabbits survived. Natural selection for which favourable characteristics explains these changes? **A** high resistance in the rabbits and high virulence for the virus **B** high resistance in the rabbits and low virulence for the virus **C** low resistance in the rabbits and high virulence for the virus **D** low resistance in the rabbits and low virulence for the virus	B	1
11	Fossilisation is most likely to occur under: **A** anaerobic conditions in sedimentary rock in a lake **B** anaerobic conditions in sedimentary rock on land **C** anaerobic conditions in igneous rock in a lake **D** aerobic conditions in sedimentary rock on land.	A	1
12	Which of the following is *not* an essential requirement for natural selection to occur? **A** genetic variation among the members of a species **B** variation in the characteristics of members of a species **C** sexual reproduction by members of a species **D** more offspring being produced by each generation	C	1

 ISBN 9781442515413

Section B—Written answers (55 marks)

1	Organisms living in the desert are adapted to the hot, dry conditions. **a** **Explain** what is meant by the phrase 'adapted to'. **b** **Produce** *two* examples of adaptations likely to be found in desert organisms.	**a** They possess characteristics or adaptations that aid their survival in the desert. **b** Cacti have the ability to store water and spikes to protect this storage. Some desert organisms produce highly concentrated urine to minimise water loss, have large ears to radiate heat and have nocturnal habits.	6
2	In hospitals, populations of bacteria resistant to certain antibiotics may develop because this resistance has been 'selected for' in previous generations. **Explain** carefully what is meant by 'selected for' in the statement above.	Some bacteria would have shown a natural (genetic) resistance to the antibiotic. These resistant bacteria survived the initial exposure to the antibiotic. The others did not. Those that survived are said to be 'selected'. Offspring of the surviving bacteria inherit the resistance. If selection is continuous over several generations, the percentage of the population with the resistance rises. The resistance is 'selected for'.	3

<table>
<tr>
<td>3</td>
<td>Complete the following table showing adaptations and their survival value.

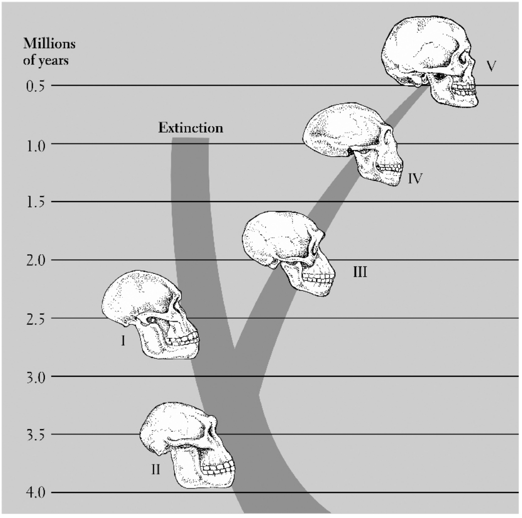
<table>
<tr><th>Adaptation</th><th>Survival value</th></tr>
<tr><td>production of large quantities of dilute urine by freshwater fish</td><td></td></tr>
<tr><td>blubber found in marine mammals</td><td></td></tr>
<tr><td></td><td>enables an intestinal parasite to remain attached to its host</td></tr>
</table>
</td>
<td>
<table>
<tr><th>Adaptation</th><th>Survival value</th></tr>
<tr><td>production of large quantities of dilute urine by freshwater fish</td><td>removes excess water that moves into the fish by diffusion</td></tr>
<tr><td>blubber found in marine mammals</td><td>provides insulation against heat loss</td></tr>
<tr><td>hooks or suckers</td><td>enables an intestinal parasite to remain attached to its host</td></tr>
</table>
</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Describe two ways in which a population may become geographically isolated to form two populations.</td>
<td>For example:
• an earthquake
• sand blocking an estuary.</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>a Explain the term ‘reproductively isolated groups’.

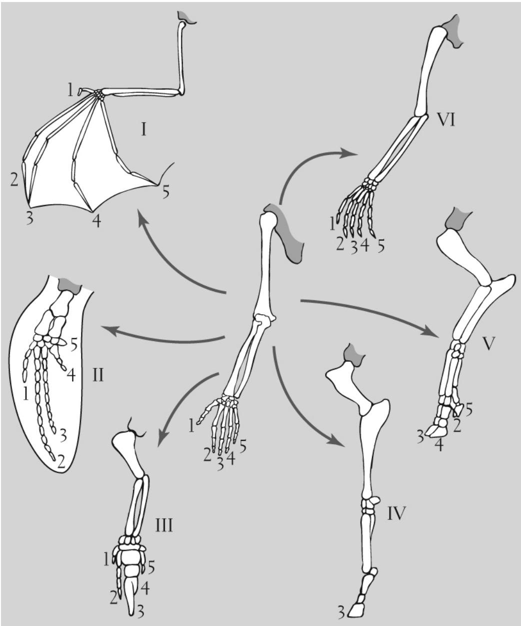
b Describe two ways in which two populations of a species may become reproductively isolated.</td>
<td>a Members of each group cannot successfully interbreed with members of another group.

b For example:
• changed colour patterns so that mates are not recognised
• seasonal differences in mating times.</td>
<td>4</td>
</tr>
</table>

6	**State** *two* reasons why individuals in a species may have differences in appearance.	• Genetic variation leads to differences in appearance. • Different environmental conditions (e.g. diet) lead to differences in appearance.	2
7	**Select** the appropriate term (from the *two* underlined alternatives) to correctly complete each of the following statements. **a** Life on Earth is thought to have begun around 3500 / 4500 million years ago. **b** Dinosaurs became extinct around 248 / 65 million years ago. **c** Trilobites were characteristic organisms of the Cenozoic / Palaeozoic era. **d** The earliest known land organisms were vascular plants / reptiles. **e** The first clear representation of the genus *Homo* is *Homo erectus / Homo habilis*. **f** *Homo sapiens* is thought to have first appeared around 4 / 0.2 million years ago.	**a** 3500 **b** 65 **c** Palaeozoic **d** vascular plants **e** *Homo habilis* **f** 0.2	6

8	Darwin observed 14 species of finches during his travels around the Galapagos Islands. **Identify** *two* possible explanations for the existence of these 14 species.	• The 14 species were created with small differences. • One common ancestral species gave rise to 14 species by the process of isolation and natural selection.	2
9	Place the following events in the order in which they occurred. **a** Neo-Darwinism is formulated. **b** Darwin studies medicine. **c** Lamarck proposes his theory of evolution. **d** Darwin travels on HMS *Beagle.* **e** Wallace presents a paper on the theory of evolution by natural selection. **f** Georges Buffon questions the idea of the 'fixity of species'. **g** Darwin publishes *The Origin of Species.* **h** Mendel's work on genetics is first recognised.	**f, c, b, d, e, g, h, a**	4

10	The diagram below shows a possible family tree for humans.  **Identify** the labelled species (I to V) as: **a** *Homo habilis* **b** *Australopithecus afarensis* **c** *Homo erectus* **d** *Homo sapiens* **e** *Australopithecus africanus.*	**a** III **b** II **c** IV **d** V **e** I	5

11	The diagram below shows several pentadactyl limbs.  **a** **Define** the term 'pentadactyl limb'. **b** **Explain** the similarities of these limbs. **c** Using the numerals I to VI, **identify** which limb is modified for: **i** running **ii** tearing.	**a** having five digits **b** The similarity of the limbs (they have the same basic structure) suggests a common ancestor. **c** **i** IV **ii** III	5
12	The group of flightless birds, known as ratites, occur in Australia (cassowary and emu), New Zealand (kiwi), South America (rhea) and Africa (ostrich). **Explain** the distribution of these related species.	The ancestral ratite lived on Gondwana, the southern supercontinent. When Gondwana split to form the continents, the ratites on each continent evolved in isolation, giving rise to the different forms.	3

13	**a** **State** *two* anatomical changes between *Homo sapiens* and *Australopithecus afarensis*. **b** **State** *two* non-anatomical changes between *Homo sapiens* and *Australopithecus afarensis*.	For example: **a** • more upright stance • larger brain. **b** • increased use of tools • development of written language.	4
14	Humans can be said to be undergoing a cultural evolution. **a** **Explain** what this means. **b** **Produce** an example of cultural evolution taking place.	**a** Humans have an accumulation of learning and knowledge. This stored experience is passed from generation to generation, and affects survival. **b** Answers should include any of the different aspects of culture (art, mythology, traditions, cuisine etc.) or aspects of technology (farming practice, sanitation etc.).	2
15	The theory of evolution is an explanation for the existence and diversity of life on Earth. **State** *two* alternative theories to account for life on Earth.	• The creation of life on Earth by supernatural means (by a god or gods). • Life coming from an extraterrestrial source.	2

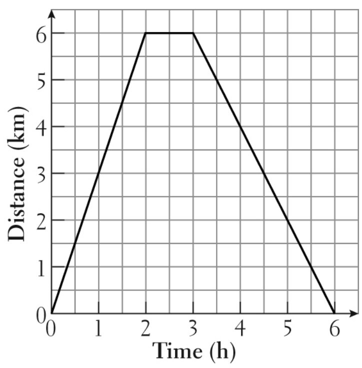
Chapter 6: Motion

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 94 marks

Section A—Multiple choice (22 marks)

1	The base unit of distance is: **A** second **B** kilometre **C** metre **D** millimetre.	C	1
2	What distance would an ant, walking at a speed of 6 millimetres per second, cover in 30 minutes? **A** 0.18 m **B** 8.9 m **C** 10.8 m **D** 180 m	C	1
3	A racehorse runs a race that starts and finishes at the same point. If the race was 1000 metres, what was the displacement of the horse when it finished? **A** 1000 metres **B** 500 metres **C** 10 metres **D** 0	D	1
4	A car travelled at 80 km/h over a distance of 540 km. On the return journey the car's speed was 100 km/h. What was the average speed of the car for the 1080 km round trip? **A** 85 km/h **B** 89 km/h **C** 90 km/h **D** 95 km/h	B	1

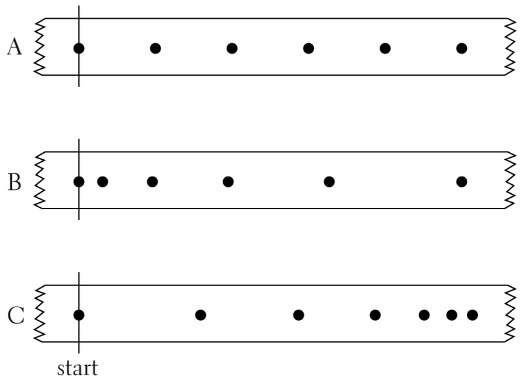
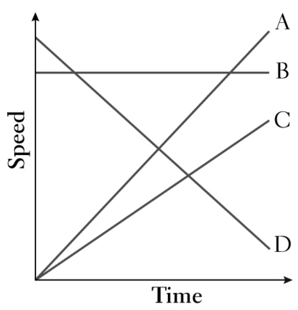
5	A train travelling at 5 m/s accelerates to reach a speed of 8 m/s in 2.5 seconds. The average acceleration of the train was: **A** 1.2 m/s^2 **B** 2.0 m/s^2 **C** 3.2 m/s^2 **D** 7.5 m/s^2.	A	1
6	The school bus slows from 60 km/h (16.7m/s) to 40 km/h (11.1 m/s) in the school zone in 8 seconds. The average deceleration of the bus was: **A** 5.6 m/s^2 **B** 2.5 m/s^2 **C** 44.8 m/s^2 **D** 0.7 m/s^2.	D	1
7	Shown below is a displacement–time graph for a journey. Which of the following statements concerning this journey is correct?  **A** The speed for the first two hours of the journey was 6 km/h. **B** Total displacement for the journey was 6 km. **C** The average speed for the journey was 60 km/h. **D** A one-hour rest break was made during the journey.	D	1

8	Which of the following is best explained by Newton's Third Law? **A** Unbelted passengers will be thrown forward when a car stops suddenly. **B** A gun recoils when a shot is fired. **C** The acceleration of an object when a force is applied depends on the mass of the object. **D** The weight of an object varies from planet to planet.	B	1
9	Which of the following is a non-contact force? **A** air resistance **B** electrostatic repulsion between like charges **C** thrust caused by expulsion of gases from a jet **D** buoyancy	B	1
10	A 90 N force is applied to a 65 kg mass. The mass will accelerate at: **A** 0.72 m/s^2 **B** 1.2 m/s^2 **C** 1.4 m/s^2 **D** 5.9 m/s^2.	C	1
11	A man exerts a force of 500 N on a 50 kg crate. The crate accelerates at 9 m/s^2. What is the friction force on the crate? **A** 50 N **B** 100 N **C** 150 N **D** 200 N	A	1
12	A motoring magazine states that a Honda Accord can increase its speed from 30 to 60 km/h in 5 s. The acceleration of the car is closest to: **A** 2 m/s^2 **B** 6 m/s^2 **C** 12 m/s^2 **D** 22 m/s^2.	A	1

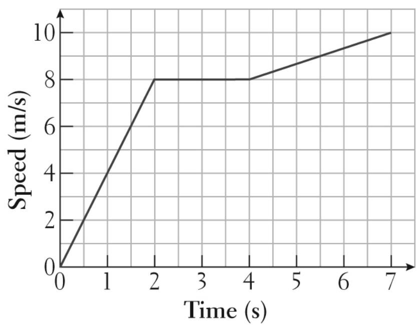
13	A person with a mass of 55 kg has a weight of 1360 N on planet X. The acceleration due to gravity on planet X is: **A** less than that on Earth **B** the same as that on Earth **C** greater than that on Earth **D** unrelated to the data given and cannot be determined.	C	1
14	Which of the following statements concerning falling objects is *incorrect*? **A** Gravity is the rate of acceleration at which objects fall in a vacuum. **B** The acceleration of an object falling in air will be less than if the object is falling in a vacuum. **C** The terminal velocity of a falling object depends on the shape of the object. **D** In a vacuum, heavier objects fall faster than lighter objects.	D	1
15	Which of the following quantities is measured in joules? **A** terminal velocity of a falling object **B** the weight of a person on the Moon **C** the force required to move an object **D** the work done when a force moves an object	D	1
16	A bullet has a speed of 850 m/s when it leaves the muzzle of a rifle. What is the kinetic energy of the bullet if it has a mass of 40 g? **A** 17 J **B** 14 450 J **C** 17 000 J **D** 14 450 000 J	B	1
17	Which of the following has the largest amount of potential energy? **A** a spring (spring constant 25 N/m) compressed by 0.5 m **B** a slinky (spring constant 5 N/m) extended by 1.5 m **C** a 30 g ball held at 12 m above the ground **D** a 2 kg object on a table 0.8 m above the ground	D	1

18	The tendency of a body to resist change in its motion is called: **A** inertia **B** weight **C** friction **D** gravitational potential.	A	1
19	A bird has a potential energy of 110 J at a height of 100 m. The potential energy of the bird at a height of 30 metres: **A** cannot be determined unless the bird's mass is known **B** is 27 J **C** is 33 J **D** is 367 J.	C	1
20	Which of the following best describes the energy changes occurring when an object falls from a position above the Earth's surface? **A** gravitational potential → kinetic → heat **B** elastic potential → kinetic → heat **C** gravitational potential → heat → kinetic **D** elastic potential → heat → kinetic	A	1
21	Which of the following changes doubles the value of the energy type listed in parentheses? **A** doubling the compression of a spring (elastic potential) **B** halving the height from which a ball is dropped (gravitational potential) **C** doubling the speed of a moving object (kinetic energy) **D** doubling the distance an object is shifted by a given force (work done)	D	1
22	Power is the rate at which energy is supplied. What power is needed to lift a 40 kilogram mass through a height of 10 metres in 5 seconds? **A** 80 J/s **B** 784 J/s **C** 3920 J/s **D** 19 600 J/s	B	1

Section B—Written answers (72 marks)

1	**Calculate** the average speed (in m/s) of **a** a man who runs 1500 metres in 3.8 minutes **b** an antelope that runs 20 kilometres in 15 minutes. **Justify** your answers with full working.	**a** $v = s/t$ $v = 1500/\ 3.8 \times 60$ $= 6.6$ m/s **b** $v = s/t$ $= 20 \times 1000/\ 15 \times 60$ $= 22.2$ m/s	6
2	**a** **Describe** the type of motion represented by each of the ticker-tapes.  **a** **Identify** the graph that represents: **i)** deceleration **ii)** constant speed. 	**a** A = constant speed B = acceleration C = deceleration **b** **i)** D **ii)** B	5

3	**Calculate** the distance (in km) travelled by: **a** the Earth moving at a speed of 30 000 m/s around the Sun for one day **b** a man walking at a speed of 1 m/s for 45 minutes. **Justify** your answers with full working.	**a** $s = vt$ $= 30\,000 \times 24 \times 60 \times 60$ $= 2.59 \times 10^9$ m $= 2.59 \times 10^6$ km **b** $1 \times 45 \times 60 = 2700$ m $= 2.7$ km	4
4	A ball is dropped from the top of a building. It takes 4.0 seconds to reach the ground. **a** **Calculate** the speed of the ball as it hits the ground. **b** **Identify** the assumption you made in your calculation for part **a**.	**a** Using $a = (v - u) / t$ where $a = 9.8$ m/s^2 gives a speed (v) of 39 m/s. **b** Any air resistance has been neglected.	3
5	**Explain** the effect that each of the following changes (made separately) has on the acceleration of an object. **a** The force acting on the object is tripled. **b** The mass of the object is halved, while a constant force is applied.	**a** Acceleration is tripled. **b** Acceleration is doubled.	2

6	Using the speed–time graph shown below, **calculate** the: **a** distance travelled in the first 3 seconds. **b** total distance travelled **c** acceleration in the time interval from 4 seconds to 7 seconds.  **Justify** your answers with full working.	**a** The area under the graph is equal to the distance travelled. Area = area of triangle 0 to 2 seconds + area of rectangle 2 seconds to 3 seconds Area = 8 + 8 Distance travelled in first 3 seconds is 16 m. **b** Area = area of triangle 0 to 2 seconds + area of rectangle 2 seconds to 4 seconds + area of trapezium 4 to 7 seconds Area = 8 + 16 + 27 = 51 Total distance travelled is 51 metres. **c** Acceleration is the slope or gradient of a v–t graph Slope = vertical rise / horizontal run = 2/3 = 0.67 The acceleration in the time interval from 4 seconds to 7 seconds is 0.67 m/s^2.	8

<table>
<tr><td>7</td><td>A car starts from rest. The table below shows the car’s speed each second after it starts.

<table><tr><th>Time (s)</th><th>Speed (m/s)</th></tr>
<tr><td>0</td><td>0</td></tr>
<tr><td>1</td><td>2</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>6</td></tr>
<tr><td>4</td><td>7</td></tr>
<tr><td>5</td><td>8</td></tr>
<tr><td>6</td><td>9</td></tr></table>

Calculate the :
a acceleration during the first 3 s
b acceleration during the final 3 s
c average acceleration for the 6 s.
Justify your answers with full working.</td>
<td>a $a = (v - u)/t$
$= (6 - 0)/3$
$= 2 \text{ m/s}^2$
b $a = (v - u)/t$
$= (9 - 6)/3$
$= 1 \text{ m/s}^2$
c $a = (v - u)/t$
$= (9 - 0)/6$
$= 1.5 \text{ m/s}^2$</td>
<td>6</td></tr>
<tr><td>8</td><td>a Predict which way passengers standing in a train move when the train comes to a sudden stop.
b Explain why passengers move in this way.</td>
<td>a Passengers are thrown forwards.
b Newton’s First Law states that anything that is moving will keep moving in the same direction at the same speed unless a force changes it. This continued movement is called inertia. The passengers simply keep going as they were (same speed, same direction) before the train stopped.</td>
<td>4</td></tr>
<tr><td>9</td><td>‘An object has zero acceleration. The object must therefore be at rest.’ State whether or not this statement is correct. Justify your answer.</td>
<td>No. The object may also be moving at a constant speed.</td>
<td>2</td></tr>
</table>

10	The brakes of a 1.5 tonne car exert a stopping force of 3200 N. **Calculate**: **a** the deceleration (negative acceleration) of the car **b** how long it would take to stop if the initial speed was 20 m/s. **Justify** your answers with full working.	**a** Using $F = ma$ $a = F/m$ $= 3200/1500$ $= 2.1\ m/s^2$. The car has a deceleration of $2.1\ m/s^2$ or an acceleration of $–2.1\ m/s^2$. **b** Using $t = (v – u)/a$ $= (0 – 20)/–2.1$ $= –20/–2.1$ $= 9.5$ s The car will take 9.5 seconds to stop.	4
11	**Propose** why a rocket fired horizontally would accelerate faster than the same rocket fired vertically.	When fired vertically, the weight (downward force) of the rocket will reduce the effective upward force and so reduce the acceleration due to the force.	2
12	**State** which has the greatest weight on Earth: a kilogram of cotton wool or a kilogram of lead? **Explain** your choice.	Both have the same weight ($W = mg$) because they have the same mass (m) and are subject to the same acceleration due to gravity (g = 9.8 m/s2).	2
13	An astronaut lands on an unexplored planet. The mass of the astronaut and spacesuit is 130 kg. His weight on the planet is 1338 N. **Calculate**: **a** the value of the acceleration due to gravity on this planet **b** the mass of the astronaut (and spacesuit) on Earth. **Justify** your answers with full working.	**a** $F = ma$ $a = F/m$ $= 1338/130$ $= 10.3\ m/s^2$ **b** 130 kg	3

14	**Identify** the name and symbol of the units usually used to measure: **a** speed **b** acceleration **c** force **d** energy.	**a** metres per second (m/s) **b** metres per second squared (m/s^2) **c** newton (N) **d** joules (J)	4
15	**Calculate** the work done when: **a** a force of 7 N moves an object through a distance of 5 metres **b** a 5 kg object is lifted from a height of 10 metres to a height of 15 metres. **Justify** your answers with full working.	**a** Work $= Fs$ $= 7 \times 5$ $= 35$ J **b** Work is done against the weight force. $W = Fs$ $= 5 \times 9.8 \times 5$ $= 245$ J	4
16	**a** **Describe** the effect of doubling the compression of a spring on the elastic potential energy stored in the spring. **b** **Describe** the effect of doubling the spring constant on the elastic potential energy stored in a spring. **c** **State** the units used to measure the spring constant of a material. **d** **Identify** which has a higher spring constant, a stiff material or a very elastic material.	**a** EPE is multiplied by a factor of 4. **b** EPE is doubled. **c** N/m **d** the stiff material	4

17	**a** **Calculate** the efficiency if a ball dropped from a height of 1.5 m returns to a height of 1.2 m after bouncing. **Justify** your answer with full working. **b** **Explain** what is meant by the statement: 'Squash balls are incredibly inefficient'.	**a** GPE before $= mgh$ $= mg \times 1.5$ GPE after $= mgh$ $= mg \times 1.2$ %Eff = (GPE after)/(GPE before) × 100 $= mg \times 1.2 / mg \times 1.5$ $= 0.8 \times 100$ $= 80\%$ **b** Squash balls have very little bounce. Most of their energy is lost as heat, resulting in the ball becoming hot.	5
18	A ten pin bowling ball of mass 5 kg is dropped from a height of 12 metres. **Calculate**: **a** the potential energy of the mass before it was dropped **b** the speed of the ball as it reaches the ground. (Assume that all the potential energy of the object is converted to kinetic energy.) **Justify** your answer with full working.	**a** $GPE = mgh$ $= 5 \times 9.8 \times 12$ $= 588$ J **b** $KE = \frac{1}{2}mv^2$ $v^2 = 2\,KE/\mathrm{m}$ $= 2 \times 588/5$ $= 235.2$ $v = \sqrt{235.2}$ $= 15.3$ m/s	4

7: Electricity, electromagnetism and communications technology

Name: ________________________ Class: __________ Date: _______

Instructions: Write answers in the right-hand column. Score: __________ / 102 marks

Section A—Multiple choice (20 marks)

1	Resistance in a circuit is the: **A** ability of a substance to reduce the flow of current **B** energy available to push current through a circuit **C** flow of charge **D** power generated by the circuit.	A	1
2	In the water pump circuit analogy, the voltage is equated to: **A** water flow rate **B** resistance to flow **C** the waterwheel **D** water pressure.	D	1
3	In a parallel circuit, what is shared between the resistors? **A** voltage only **B** current only **C** voltage and current **D** none of the above	B	1
4	The law that describes the relationship between voltage, current and resistance is called: **A** Law of electricity **B** Newton's fourth law **C** Ohm's law **D** Coulomb's law.	C	1
5	The slope of a voltage versus current graph represents the: **A** resistance of the circuit **B** acceleration of the current **C** voltage change with time **D** magnetic strength of the circuit.	A	1

6	The total resistance of a series circuit with three resistors is given by the equation: **A** $R = R_1 + R_2 + R_3$ **B** $R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ **C** $\frac{1}{R} = R_1 + R_2 + R_3$ **D** $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	A	1
7	Which of the following would *not* increase the strength of the magnetic field generated by a coiled current-carrying wire? **A** placing an iron core within the coil **B** winding more wire around the coil **C** using a larger current in the wire **D** running the current in the opposite direction through the wire	D	1
8	The magnetic field around a straight current-carrying wire is: **A** circular **B** to the left **C** to the right **D** non-existent.	A	1
9	Two types of wave may be generated using a slinky. For which type (or types) do the particles in the slinky move in the same direction as the wave? **A** transverse only **B** longitudinal only **C** transverse and longitudinal **D** neither transverse nor longitudinal	B	1
10	All electromagnetic waves have the same: **A** speed **B** frequency **C** energy **D** wavelength.	A	1

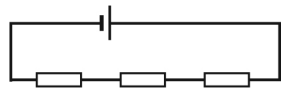
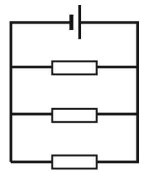
11	Which of the following waves has the longest wavelength? **A** X-rays **B** gamma rays **C** microwaves **D** blue light waves	C	1
12	Which of the following types of wave is generated when fast-moving electrons collide with a metal target? **A** X-rays **B** gamma rays **C** ultraviolet waves **D** red light waves	A	1
13	Australian television stations transmit: **A** sound using AM, and video using FM **B** sound using FM, and video using AM **C** sound and video using FM **D** sound and video using AM.	B	1
14	The wavelength of one band of red light is 660 nanometres. This is equivalent to: **A** 660 000 000 millimetres **B** 660 000 000 metres **C** 0.000 000 660 metres **D** 0.000 000 660 millimetres.	C	1
15	In Morse code, the shortest codes are used for: **A** the vowels only **B** full stops and commas **C** the numbers 0 to 9 **D** the most commonly used letters.	D	1
16	The number 19 in binary form would be represented by: **A** 10011 **B** 10010 **C** 01111 **D** 10100	A	1

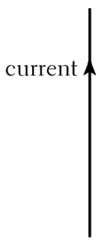
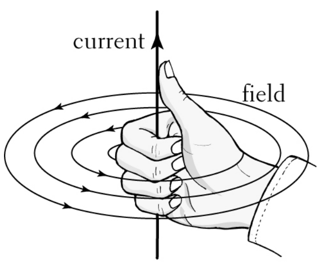
7: Electricity, electromagnetism and communications technology

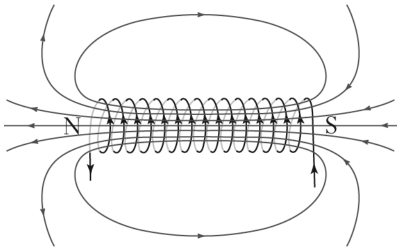
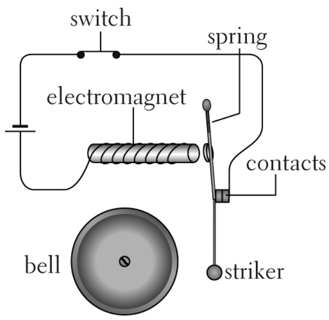
17	A coherent light is one in which all the waves are of the same: **A** speed but different frequencies **B** speed but different wavelengths **C** wavelength and speed **D** wavelength but different frequencies.	C	1
18	Which types of wave do *not* usually pass through the ionosphere? **A** visible light **B** long radio waves **C** microwaves **D** ultraviolet radiation	B	1
19	The volt is a unit used to measure: **A** resistance **B** current **C** potential difference **D** capacitance.	C	1
20	The symbol MΩ stands for: **A** megaohms **B** millifarads **C** macrocoulombs **D** microamperes.	A	1

7: Electricity, electromagnetism and communications technology

Section B—Written answers (82 marks)

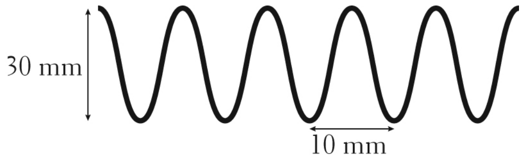
1	Draw a circuit consisting of three resistors in: **a** series **b** parallel.	**a**  **b** 	4
2	**Calculate** the total resistance of three resistors of values 5, 10 and 20 Ω in: **a** series **b** parallel.	**a** $R = R_1 + R_2 + R_3$ $R = 5 + 10 + 20$ $= 35\ \Omega$ **b** $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R} = \frac{1}{5} + \frac{1}{10} + \frac{1}{20}$ $\frac{1}{R} = \frac{7}{20}$ $R = 2.9\ \Omega$ (1 dp)	7

3	**Define** Ohm's law.	Ohm's law describes the relationship between the current, voltage and resistance in a circuit. The following answers should be accepted. • Voltage is directly proportional to current. • Voltage = current divided by resistance • $V = IR$	2
4	**Calculate**: **a** the voltage if a resistor of 5 Ω has a current of 0.1 A flowing through it **b** the current in a 100 Ω resistor in an electric jug if it is connected to 240 V **c** the resistance of a fan if it uses a current of 12 A and 240 V.	**a** $V = IR$ $= 5 \times 0.1 = 0.5$ V **b** $I = V/R$ $= 240/100 = 2.4$ A **c** $R = V/I$ $= 240/12 = 20$ Ω	6
5	An electric current flows through a straight wire as shown in the diagram below. Sketch the shape of the magnetic field produced by this current, and **identify** the direction of the field. 		3

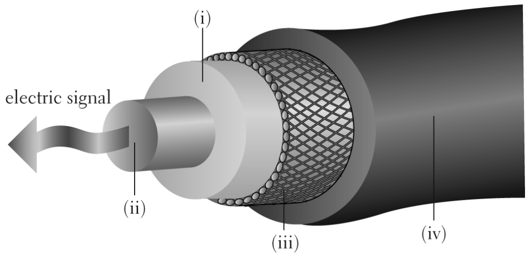
6	With the aid of a clearly labelled diagram, **explain** how a solenoid is constructed.	Several loops of current-carrying wire are placed together. 	3
7	The diagram below shows an electric bell.  **Explain** how the bell works when the switch is pressed.	When the switch is pressed, the electromagnet effect begins and attracts the striker, causing it to sound the bell. At the same time, the circuit is broken as the contacts move apart. Current no longer flows and the electromagnet effect stops. The striker returns to its rest position, the contacts touch and the cycle begins again.	5

7: Electricity, electromagnetism and communications technology

<table>
<tr>
<td>8</td>
<td>Electricity generated at power stations travels through transmission lines before reaching your home. Explain why:
a step-up transformers are used during this transmission
b step-down transformers are used during this transmission.</td>
<td>a Step-up transformers are used to boost voltages because the power loss in transmission lines is smaller for higher voltages.
b Step-down transformers are used to reduce voltages (to 240 volts) because high voltages are extremely dangerous.</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Complete the following table identifying the properties of waves.
<table>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>Frequency</td><td></td></tr>
<tr><td></td><td>Distance between compressions in a longitudinal wave</td></tr>
<tr><td>Amplitude of a transverse wave</td><td></td></tr>
</table>
</td>
<td>
<table>
<tr><th>Name</th><th>Description</th></tr>
<tr><td>Frequency</td><td>Number of waves generated per second (measured in hertz)</td></tr>
<tr><td>Wavelength</td><td>Distance between compressions in a longitudinal wave</td></tr>
<tr><td>Amplitude of a transverse wave</td><td>The height of crests above the mean position of a series of waves</td></tr>
</table>
</td>
<td>6</td>
</tr>
</table>

10	The series of waves shown below was produced in 20 seconds.  **Calculate** the: **a** frequency **b** wavelength **c** amplitude of the waves.	**a** 5 waves per 20 sec = $\frac{5}{20}$ = 0.25 Hz **b** 10 mm **c** 15 mm	3
11	**Define** the meaning of each of the following abbreviations. **a** AM (when referring to radio stations) **b** FDM (in telephone systems) **c** B-ISDN (the likely future communications network)	**a** amplitude modulation **b** frequency division multiplexing **c** broadband integrated services digital network	3
12	**Identify** one use of each of the following types of electromagnetic wave. **a** ultraviolet radiation **b** infra-red rays **c** gamma rays	For example: **a** to kill bacteria in air-conditioning systems **b** remote control devices **c** to destroy cancer cells.	3

13	**a** **State** *two* advantages of using higher frequencies to transmit messages from FM stations. **b** **State** *one* disadvantage of the use of higher frequencies.	**a** • Higher frequencies are less affected by interference. • Higher frequencies provide better quality sound. **b** They have less range.	3
14	**Explain** the basic difference between an analogue signal and a digital signal.	In analogue signals, smoothly varying sound waves are converted to smoothly varying electrical signals. In digital signals, each message is converted into a signal consisting of bits.	2
15	**Identify** *two* advantages of digital transmissions over analogue signals.	For example: • Digital transmissions are easier to manipulate. • Digital transmissions contain the complete code for reconstructing the message and so are unlikely to be misunderstood (analogue wave signals may easily be distorted).	2
16	**Identify** *two* uses of microwaves in the communications network.	For example: • to transmit signals within the mobile phone network • to link to satellites for long-distance communication.	2

17	Copper wire provides one form of link in today's communications network. **Identify** *three* other means by which links are provided.	• coaxial cable • fibre-optic cable • radio waves	3
18	The diagram below shows a coaxial cable. **a** Complete the labelling of the diagram by **naming** parts (i) to (iv).  **b** One layer of the coaxial cable reduces attenuation. **Explain** what is meant by 'attenuation'.	**a** (i) insulation (ii) copper core (iii) copper wire braiding (iv) plastic sheath **b** loss of signal strength	5
19	**Identify** the type of component in an electrical circuit that: **a** measures potential difference **b** may be thought of as a charge pump **c** is used to control current and voltage.	**a** voltmeter **b** battery **c** resistor	3

20	**Name** the major discovery or invention associated with each of the following names. **a** Alexander Bell **b** William Shockley **c** Guglielmo Marconi **d** Hans Oersted	**a** telephone **b** transistor **c** radio **d** electricity can cause magnetism	4
21	Each of the following incorrect statements may be corrected by replacing one word. For each statement, **identify** this word and give the required replacement word. Statement **a** has been completed as an example. **a** The first device that used electrical impulses sent along a wire to transmit messages was the telephone. **Answer** *Replace telephone with telegraph.* **b** Light consists of electromagnetic waves where the electric and magnetic fields are parallel to each other. **c** The magnetic field produced around a straight current-carrying wire is elliptical. **d** When a magnet is moved in and out of a coil of wire, a continuous direct current is produced in the wire. **e** An electric motor converts electrical energy to potential energy. **f** Mobile phones use infra-red waves to transmit digital signals within a network of regions called cells.	Replace: **a** *telephone with telegraph* **b** parallel with perpendicular **c** elliptical with circular **d** direct with alternating **e** potential with kinetic **f** infra-red with micro	5

22	Complete each of the statements below by inserting the word *increases* or *decreases* in the appropriate space. **a** For electromagnetic waves, as the frequency increases, the wavelength __________. **b** The resistance of a thermistor _________ as its temperature increases. **c** The size of the current induced in a wire ___________ if the magnet is moved more quickly. **d** In the visible light spectrum, moving from red light to blue light, the frequency __________.	**a** decreases **b** decreases **c** increases **d** increases	4

Chapter 8: Global issues

Name: _________________________ Class: ___________ Date: ________

Instructions: Write answers in the right-hand column. Score: ___________ / 57 marks

Section A—Multiple choice (15 marks)

1	When changes are made to science they must provide what? **A** speculation **B** proposals **C** evidence **D** nothing	C	1
2	What is the problem with making more cars like the Hydrogen-7? **A** There isn't enough hydrogen. **B** There isn't any hydrogen. **C** There are very few hydrogen refuelling stations. **D** The car doesn't work.	C	1
3	People have different sets of what that cause some debates? **A** ethics **B** values **C** ideas **D** money	B	1
4	Which of the following is not an issue being debated globally currently? **A** use of genetically modified plants **B** building nuclear power plants **C** human influence on global warming **D** radiation therapy for cancer	D	1
5	Isotopes are atoms: **A** with the same mass number, but different atomic numbers **B** that are unstable and undergo radioactive decay **C** with the same atomic number, but different mass numbers **D** that have unequal numbers of protons and electrons.	C	1

6	A radiation dose of 250 000 μSv would, in the short term, be likely to cause: **A** no biological effect **B** cell damage **C** radiation sickness **D** severe radiation sickness and possible death within a month.	B	1
7	The intake of toxins accumulated from what you eat is called: **A** trioaccumulation **B** bioaccumulation **C** biomagnification **D** toxin poisoning.	B	1
8	What is a carcinogen? **A** a cancer-causing agent **B** a dioxin **C** a cancer **D** a herbicide	A	1
9	What is blue-green algae? **A** tiny snakes **B** tiny poisonous aquatic plants **C** tiny poisonous land plants **D** tiny fish	B	1
10	Stem cells have the ability to change when taken from: **A** an adult **B** a child **C** an embryo **D** a blastocyst.	D	1
11	Cloning is the process where: **A** the clone is nothing like the original DNA **B** the clone is identical to the original DNA **C** nothing is possible **D** animals are made to replace other animals.	B	1

12	IVF generally uses a process where multiple eggs are fertilised. What usually happens to them? (Note all of the answers are possible, despite current issues. Which answer is the most common?) **A** They are all implanted in the woman at once. **B** They are frozen to perhaps be used later. **C** They are destroyed. **D** They are used for stem cell research.	B	1
13	An increase in the level of which of the following gases would be *least* likely to have an impact on the greenhouse effect? **A** carbon dioxide **B** methane **C** chlorofluorocarbons **D** nitrogen	D	1
14	The approximate percentage of the world's greenhouse gases produced by Australia is: **A** 0.5% **B** 1.5% **C** 5.0% **D** 10%	B	1
15	Which of the following is a non-renewable source of energy? **A** tidal **B** solar **C** natural gas **D** geothermal	C	1

Section B—Written answers (42 marks)

<table>
<tr>
<td>1</td>
<td>Carbon dioxide is a major greenhouse gas. Complete the following table showing other greenhouse gases by identifying:
a two major greenhouse gases (other than CO_2)
b the formula of each gas
c one source of each gas.
<table>
<tr><th>a
Greenhouse gas</th><th>b
Formula</th><th>c
Source</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td>
<td>For example:
<table>
<tr><th>a
Greenhouse gas</th><th>b
Formula</th><th>c
Source</th></tr>
<tr><td>Methane</td><td>CH4</td><td>Anaerobic breakdown of vegetation</td></tr>
<tr><td>Nitrous oxide</td><td>N_2O</td><td>Car exhausts</td></tr>
</table>
</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Explain why deforestation by burning can be said to have a ‘double effect’ on the carbon dioxide level in the atmosphere.</td>
<td>Burning forests adds carbon dioxide to the air.
Trees removed are no longer able to photosynthesise. This means they are no longer able to remove carbon dioxide from the air.</td>
<td>2</td>
</tr>
</table>

3	**Outline** the triple bottom line and **explain** how it is different from the bottom line.	The triple bottom line considers: cost, impact on society and impact on the environment, whereas the bottom line only considers the cost (economics).	4
4	**Specify** at least two reasons why nuclear power is nowadays being increasingly considered as an alternative energy source to coal.	Any two of: • Burning coal releases radioactive uranium to the atmosphere. • Coal burning releases greenhouse gases. • People die in coal mining. • Dangerous pollutants result from burning coal, such as mercury and acid rain.	2
5	**Specify** one disadvantage of nuclear power plants.	Potential for radioactive waste especially in accidents, plus the danger of accidents, such as melt-downs, occurring.	1
6	Through the use of a simple food chain, **explain** how bioaccumulation occurs and how the toxin is biomagnified.	Students may provide any food chain that shows two or three animals eating the previous animal, such that any toxin in the previous animal passes to the next animal and so on, thereby magnifying the toxin.	2
7	**State** where lead-based paints can be found and **explain** why they are bad.	Lead can be bioaccumulated in the body and cause problems with the central nervous system. This is potentially very bad in children and babies. It is therefore important that there is no lead in children's toys. It used to be found in leaded petrol but that has been reduced recently.	3

8	**Define** DDT and **explain** why it is no longer used in Australia.	dichloro-diphenyl-trichloroethane It was an effective pesticide for killing mosquitoes. However, it has been banned in Australia and many other countries as it is extremely detrimental to other animals, especially birds. It has contributed to the endangered status of many American birds.	3
9	**Define** the following abbreviations. **a** GMO **b** PSP **c** IVF	**a** genetically modified organism **b** paralytic shellfish poison **c** in-vitro fertilisation	3
10	Identical twins sometimes look a little different. **Explain** whether this means they have different DNA.	No, identical twins have identical DNA. Differences in personality and slight differences in looks often have something to do with influences other than DNA, such as environment, diet etc.	2
11	**Compare** allotransplants with xenotransplants.	Allotransplants are human to human transplants, whereas xenotransplants are animal to human transplants.	2
12	**Identify**: **a** *one* process that adds carbon dioxide to the atmosphere, and write a chemical equation for the process. **b** *one* process which removes carbon dioxide from the atmosphere, and write a chemical equation for the process.	For example: **a** combustion of coal $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ **b** photosynthesis $6CO_{2(g)} + 6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq)} + 6O_{2(g)}$	5

13	**Recall**: **a** the amount by which the Earth's average surface temperature has increased over the past 100 years **b** the amount by which the Earth's average surface temperature is expected to increase during the next 100 years. **c** **Propose** *two* likely consequences of this expected temperature rise.	**a** 0.5°C **b** between 1°C and 4°C **c** Any two of: • melting of land ice • raised sea levels causing flooding of low-lying coastlines • more storms, droughts, hurricanes, fires, floods and temperature extremes • some regions will be drier, some wetter, some cooler and most hotter.	4
14	Stem cell research using embryos harvests live 6–8-day-old embryos. The issues around this occur because this embryo is human and is the same as any embryo that would have been fertilised inside a woman except that it has been done artificially. **Discuss** the issues involved with stem cell research.	The creating and destroying of life (human life here) is seen by many as unethical. Even though a blastocyst created in this way would not be able to survive on its own because it cannot implant into a uterus, it was created by humans. Therefore, whether it is morally right to use blastocysts in this way is under much debate. Many people also do not realise what is actually involved in stem cell research.	3

Unit 1.1 Prac 1 Studying a reaction

Description of procedure/requirements

Chemicals required: **Class sets**: magnesium strips, 1 M sulfuric acid

Equipment: large beaker, small filter funnel, 100 mL measuring cylinder, cling wrap, gloves, lab coat, safety glasses

Procedure: Refer to Prac 1 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated sulfuric acid (H_2SO_4) (98%)	8 	Very corrosive	**R35 –** Causes severe burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30 –** Never add water to this product. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately	
Sulfuric acid 1 M (9.8%) H_2SO_4		Irritant	**R36/38 –** Irritating to eyes and skin.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Magnesium (Mg) ribbon	4.1	Highly flammable	**R11 –** Highly flammable. **R15 –** Contact with water liberates extremely flammable gases.	**S7/8 –** Keep container tightly closed and dry. **S43 –** In case of fire, use sand, never use water.	

Unit 1.1 Prac 1 Studying a reaction

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product Magnesium sulfate ($MgSO_4$) solution	**Product** Hydrogen (H_2) gas		

Other hazards and safety considerations

Minimise the volumes of acid provided in the class sets. Consider modifying this prac so smaller volumes of acid are used or the inverting of cylinders of acid is unnecessary. Gas syringes or gas collection apparatus connected with tubing to a stoppered flask may give suitable results. Ensure a spill kit suitable for acids is available. Prepare solutions according to standard laboratory safety procedures. Use a fume cupboard to make up acid solution. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result.** Conc. sulfuric acid spills on the skin – For all acid spills on the skin, irrigate with large quantities of water. Washing should be continued for at least 10 to 15 minutes. Risks minimised by wearing safety glasses, lab coat and gloves. In case of concentrated acid spill, absorb spill with earth, sand or other non-combustible material; dilute small amounts with water and neutralise with sodium carbonate or calcium hydroxide. Filter or strain to separate sand from liquid. Dispose of sand in the normal waste and the neutralised liquid may be poured down the sink. Small spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Test solutions may be disposed of down the drain with plenty of water. Any remaining diluted acid solutions may be stored for future use.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Unit 1.1 Prac 1 Studying a reaction

Notes:

To be a valid assessment, the MSDS expiry dates should be added and this risk assessment should be signed and dated.

This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 1.1 Prac 2 Conservation of mass

Description of procedure/requirements

Chemicals required: **Class sets**: solid calcium carbonate, 0.5 M hydrochloric acid

Equipment: electronic balance, 200 mL conical flask, balloon, spatula, 100 mL measuring cylinder, lab coat, safety glasses

Procedure: Refer to Prac 2 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated hydrochloric acid (HCl) 32%	8 	Corrosive	**R34 –** Causes burns. **R37 –** Irritating to respiratory system.	**S23 –** Do not breathe gas/fumes/vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S27 –** Take off immediately all contaminated clothing. **S37/39 –** Wear suitable gloves and eye protection. **S38 –** If insufficient ventilation, wear suitable respiratory equipment. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 1.1 Prac 2 Conservation of mass

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Calcium carbonate ($CaCO_3$) solid	0.5 M Hydrochloric acid (HCl) (1.85%)	**Product** Calcium chloride ($CaCl_2$) (aqueous)	**Product** Carbon dioxide (CO_2) gas

Other hazards and safety considerations

Prepare solutions according to standard laboratory safety procedures. Use a fume cupboard to make up acid solution. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result.** Risks minimised by wearing safety glasses, lab coat and gloves. In case of concentrated acid spill, absorb spill with earth, sand or other non-combustible material; dilute small amounts with water and neutralise with sodium carbonate or calcium hydroxide. Filter or strain to separate sand from liquid. Dispose of sand in the normal waste and the neutralised liquid may be poured down the sink. Small spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide container for the waste solution. Collect waste and neutralise with sodium bicarbonate before flushing to the sewer with plenty of water. Any remaining diluted acid solutions may be stored for future use.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Unit 1.1	**Prac 2**	**Conservation of mass**

Notes:

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Unit 1.1 Prac 3 Rates of reactions 1

Description of procedure/requirements

Chemicals required: Class sets: magnesium strips, 1 M hydrochloric acid, hydrogen peroxide (H_2O_2) 20 volume (6%), manganese dioxide
Equipment: ice, stopwatch, spatula, 4 test tubes, test tube rack, 10 mL measuring cylinder, two 100 mL beakers
Procedure: Refer to Prac 3 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated hydrochloric acid (HCl) 32%	8 	Corrosive	**R34 –** Causes burns. **R37 –** Irritating to respiratory system.	**S23 –** Do not breathe gas/fumes/vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S27 –** Take off immediately all contaminated clothing. **S37/39 –** Wear suitable gloves and eye protection. **S38 –** If insufficient ventilation, wear suitable respiratory equipment. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	
35% (120 volume) or 30% (100 volume) Hydrogen peroxide (H_2O_2) liquid	5.1/ 8	Corrosive Oxidising	**R34** – Causes burns. **R8** – Contact with combustible material may cause fire.	**S3** – Keep in a cool place. **S28** – After contact with skin, wash immediately with plenty of soap-suds. **S36/39** – Wear suitable protective clothing and eye/face protection. **S45** – In case of accident or if you feel unwell seek medical advice immediately	

Unit 1.1 Prac 3 Rates of reactions 1

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
20 volume (6%) Hydrogen peroxide (H_2O_2)	None allocated	Irritant	**R36/38** – Irritating to eyes and skin.	**S28** – After contact with skin, wash immediately with plenty of water. **S3** – Keep in a cool place. **S36/39** – Wear suitable protective clothing and eye/face protection. **S45** – In case of accident or if you feel unwell seek medical advice immediately	
Manganese dioxide powder (MnO_2)	None allocated	Harmful	**R20/22** – Harmful by inhalation and if swallowed.	**S25** – Avoid contact with eyes.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Magnesium (Mg) ribbon	4.1	Highly flammable	**R11 –** Highly flammable. **R15 –** Contact with water liberates extremely flammable gases.	**S7/8 –** Keep container tightly closed and dry. **S43 –** In case of fire, use sand, never use water.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

1 M hydrochloric acid (HCl) (3.7%)	**Product** Magnesium chloride ($MgCl_2$) solution	**Product** Hydrogen (H_2) gas	**Product** Oxygen (O_2) gas
Product Water (H_2O)			

Unit 1.1 Prac 3 Rates of reactions 1

Other hazards and safety considerations

30% Hydrogen peroxide is corrosive and a strong oxidising agent; 20 volumes (6%) is a suitable concentration for hydrogen peroxide (H_2O_2). Prepare chemicals according to laboratory precautions. Use a fume cupboard to make up acid solution. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result.** In case of concentrated acid spill, absorb spill with earth, sand or other non-combustible material; dilute small amounts with water and neutralise with sodium carbonate or calcium hydroxide. Filter or strain to separate sand from liquid. Dispose of sand in the normal waste and the neutralised liquid may be poured down the sink. For small 30% hydrogen peroxide spills, soak spill up with sand or dry earth, collect earth using a non-combustible tool and rinse with plenty of water. Dispose of earth in the normal rubbish. Manganese dioxide spills should be swept up immediately, carefully avoiding inhalation and contact with skin and eyes. Risks are minimised by wearing safety glasses, gloves and lab coat. Wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of inhalation, move to fresh air and consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide a container for manganese dioxide waste. Manganese dioxide is insoluble in water and cannot be washed down the drain. Reclaim unconsumed manganese dioxide by allowing waste to settle, then decanting supernatant to the drain with plenty of water. Place reclaimed manganese dioxide into a hazardous waste container for disposal via a chemical waste company. The other test solutions may be disposed of down the drain with plenty of water. Any remaining diluted acid solutions may be stored for future use.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.1 Prac 3 Rates of reactions 1

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Unit 1.1 Prac 4 Rates of reactions 2

Description of procedure/requirements

Chemicals required: **Class sets**: marble chips (large and small), powdered calcium carbonate, dilute hydrochloric acid (2 M) (7%)
Equipment: stopwatch, spatula, 4 test tubes, test tube rack, 10 mL measuring cylinder, electronic balance
Procedure: Refer to Prac 4 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated hydrochloric acid (HCl) 32%	8 	Corrosive	**R34 –** Causes burns. **R37 –** Irritating to respiratory system.	**S23 –** Do not breathe gas/fumes/vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S27 –** Take off immediately all contaminated clothing. **S37/39 –** Wear suitable gloves and eye protection. **S38 –** If insufficient ventilation, wear suitable respiratory equipment. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 1.1 Prac 4 Rates of reactions 2

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

2.0 M hydrochloric acid (7%)	Marble chips ($CaCO_3$) solid	**Product** Calcium chloride ($CaCl_2$) (aqueous)	**Product** Carbon dioxide (CO_2) gas

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. Use a fume cupboard to make up acid solution. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result.** Risks minimised by wearing safety glasses, lab coat and gloves. In case of concentrated acid spill, absorb spill with earth, sand or other non-combustible material; dilute small amounts with water and neutralise with sodium carbonate or calcium hydroxide. Filter or strain to separate sand from liquid. Dispose of sand in the normal waste and the neutralised liquid may be poured down the sink. Small spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Strain unconsumed marble chips to wash with distilled water for future use. Filtrate may be washed down the drain using plenty of water.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 1.1 Prac 4 Rates of reactions 2

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Unit 1.1 Prac 5 Reaction rate—catalysts and enzymes

Description of procedure/requirements

Chemicals required: **Class sets**: hydrogen peroxide solution (H_2O_2) 20 volume (6%), manganese(IV) dioxide
Equipment: small piece of fresh liver, small piece of apple or potato, 4 test tubes, test-tube rack, wax taper, safety glasses
Procedure: Refer to Prac 5 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
35% (120 volume) or 30% (100 volume) Hydrogen peroxide (H_2O_2) liquid	5.1/ 8	Corrosive Oxidising	R34 – Causes burns. R8 – Contact with combustible material may cause fire.	**S3** – Keep in a cool place. **S28** – After contact with skin, wash immediately with plenty of soap suds. **S36/39** – Wear suitable protective clothing and eye/face protection. **S45** – In case of accident or if you feel unwell, seek medical advice immediately	
20 volume (6%) Hydrogen peroxide (H_2O_2)	None allocated	Irritant	**R36/38** – Irritating to eyes and skin.	**S28** – After contact with skin, wash immediately with plenty of water. **S3** – Keep in a cool place. **S36/39** – Wear suitable protective clothing and eye/face protection. **S45** – In case of accident or if you feel unwell, seek medical advice immediately	
Manganese dioxide powder (MnO_2)	None allocated	Harmful	**R20/22** – Harmful by inhalation and if swallowed.	**S25** – Avoid contact with eyes.	

Unit 1.1 Prac 5 Reaction rate—catalysts and enzymes

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product	**Product**		
Oxygen (O_2) gas	Water (H_2O)		

Other hazards and safety considerations

30% Hydrogen peroxide is corrosive and a strong oxidizing agent; 20 volumes (6%) is a suitable concentration for hydrogen peroxide H_2O_2). Prepare chemicals according to laboratory precautions. For small 30% hydrogen peroxide spills, soak spill up with sand or dry earth, collect earth using a non-combustible tool and rinse with plenty of water. Dispose of earth in the normal rubbish. Manganese dioxide spills should be swept up immediately carefully avoiding inhalation and contact with skin and eyes. Risks are minimised by wearing safety glasses, gloves and lab coat. Wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of inhalation, move to fresh air and consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Unit 1.1 Prac 5 Reaction rate—catalysts and enzymes

Disposal of wastes

Provide a container for manganese dioxide waste. Manganese dioxide is insoluble in water and cannot be washed down the drain. Reclaim unconsumed manganese dioxide by allowing waste to settle, then decanting the supernatant to the drain with plenty of water. Place reclaimed manganese dioxide into a hazardous waste container for disposal via chemical waste company. The other test solutions may be disposed of down the drain with plenty of water.

Assessor/s: ______________________________ Date: ___________________ Earliest MSDS expiry date: ___________________

Notes:

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Unit 1.2 Prac 1 Complete and incomplete combustion

Description of procedure/requirements

Chemicals required: Class sets: kerosene with wick, ethanol
Equipment: Pasteur pipette, lab coat, safety glasses, heatproof mat, watch-glass, candle
Procedure: Refer to Prac 1 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Kerosene liquid	3 	Flammable Harmful Dangerous for the environment	**R10** – Flammable. **R38** – Irritating to skin. **R51/53** – Toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment **R65** – Harmful: May cause lung damage if swallowed. **R66** – Repeated exposure may cause skin dryness or cracking. **R67** – Vapours may cause drowsiness and dizziness.	**S23** – Do not breathe vapour. **S24/25** – Avoid contact with skin and eyes. **S61** – Avoid release to the environment. Refer to special instructions/Material Safety Data Sheets. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	
Ethanol (C_2H_5OH)	3 	Highly flammable	**R11** – Highly flammable.	**S16** – Keep away from sources of ignition. No smoking.	

Unit 1.2 Prac 1 Complete and incomplete combustion

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Other hazards and safety considerations

To minimise the risk of students inhaling fumes/vapours, carry out this experiment in a fume cupboard or in a well-ventilated laboratory (windows open). Decant flammable liquids into class sets in a fume hood. In case of kerosene and ethanol spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult the **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel, heatproof mat, tongs to handle hot items, fume cupboard or good ventilation.
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

No waste is generated.

Unit 1.2 Prac 1 Complete and incomplete combustion

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Notes:

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Unit 1.2 Prac 2 Corrosion of iron

Description of procedure/requirements

Chemicals required: **Class sets**: magnesium ribbon, distilled water, 5 iron nails (not galvanised), copper wire, salt solution (sodium chloride)
Equipment: fine sandpaper or steel wool, 4 test tubes, test tube rack, Bunsen burner, heatproof mat, matches, 250 mL beaker, peg or tongs, marking pen
Procedure: Refer to Prac 2 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Magnesium (Mg) ribbon	4.1	Highly flammable	**R11 –** Highly flammable. **R15 –** Contact with water liberates extremely flammable gases.	**S7/8 –** Keep container tightly closed and dry. **S43 –** In case of fire, use sand, never use water.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Iron nails (Fe)	Copper wire (Cu)	Sodium chloride (NaCl)	Salt solution (sodium chloride)

Unit 1.2 Prac 2 Corrosion of iron

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. Minimise the length and amount of magnesium ribbon supplied in the class sets. Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide a container for the used metals. Iron nails and copper wire may be disposed of via the normal waste. Store the magnesium metal for disposal by a chemical waste company (magnesium is not suitable to be discarded via the school waste system).

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.2 Prac 3 Observing iron hydroxides

Description of procedure/requirements

Chemicals required: Class sets: 1 M sodium hydroxide (NaOH) (4%), 0.1 M iron(**II**) chloride ($FeCl_2$) solution, 0.1 M iron(**III**) chloride ($FeCl_3$) solution
Equipment: test tube rack, 2 test tubes, Pasteur pipette
Procedure: Refer to Prac 3 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Sodium hydroxide (NaOH) solid	8 	Very corrosive	**R35 –** Causes severe burns.	**S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing and gloves. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
1 M sodium hydroxide (NaOH) (4%)	8	Corrosive	**R34 –** Causes burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37 –** Wear suitable protective clothing and gloves. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Iron(**III**) chloride hexahydrate ($FeCl_3.6H_2O$) solid	None allocated	Harmful Irritant	**R22 –** Harmful if swallowed. **R36/38 –** Irritating to eyes and skin.	**S13 –** Keep away from food, drink and animal feeding stuffs. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S62 –** If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label. **S24/25 –** Avoid contact with skin and eyes. **S37/39 –** Wear suitable gloves and eye/face protection.	

Unit 1.2 Prac 3 Observing iron hydroxides

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Iron(II) chloride tetrahydrate ($FeCl_2.4H_2O$) solid	8	Corrosive Harmful Irritant	**R22 –** Harmful if swallowed. **R36/38 –** Irritating to eyes. and skin	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

0.1 M iron(III) chloride hexahydrate ($FeCl_3.6H_2O$) (2.7%)	0.1 M iron(II) chloride tetrahydrate ($FeCl_2.4H_2O$) (2%)	**Product** Iron(II) hydroxide (precipitate)	**Product** Iron(III) hydroxide (precipitate)
Product Sodium chloride (NaCl) solution			

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. Use a fume cupboard to make up sodium hydroxide solution. When preparing sodium hydroxide solution, add pellets to water in small amounts to avoid boiling and splattering. Dilute sodium hydroxide spill with water, then neutralise with a weak concentration of hydrochloric acid solution and pour down the sink using plenty of water. Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Unit 1.2 Prac 3 Observing iron hydroxides

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide a container for iron waste. Add dilute hydrochloric acid to the waste to neutralise and to dissolve the iron hydroxide precipitates before pouring down the drain with plenty of water.

Assessor/s: ______________________________ Date: ___________________ Earliest MSDS expiry date: ___________________

Notes:

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Unit 1.2 Prac 4 Anodised aluminium

Description of procedure/requirements

Chemicals required: **Class sets**: piece of aluminium, aluminium foil, 2 M sulfuric acid, detergent, fabric dye solution

Equipment: safety glasses, two 250 mL beakers, tongs, tissues, 12 V power pack with wires and alligator clips, retort stand, boss head and clamp, Bunsen burner or hot plate, tripod, gauze mat, bench mat, matches

Procedure: Refer to Prac 4 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated sulfuric acid (H_2SO_4) (98%)	 8	Very corrosive	**R35 –** Causes severe burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30 –** Never add water to this product. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Sulfuric acid 2 M (19.6%) H_2SO_4	 8	Very corrosive	**R35 –** Causes severe burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30 –** Never add water to this product. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 1.2 Prac 4 Anodised aluminium

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Aluminium	Aluminium foil	Detergent	Fabric dye solution (Check MSDS/instructions)

Other hazards and safety considerations

Ensure that power supplies are in safe working order. Minimise the quantity and volume of acid provided in the class sets. Prepare solutions according to laboratory precautions. Use fume cupboard to prepare acid solutions. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result**. Con sulfuric acid spills on skin--for acid spills on the skin is, irrigation with large quantities of water: Washing should be continued for at least ten to fifteen minutes. Seek immediate medical advice. Small spills of sulfuric-Cover with DRY earth, sand or other non-combustible material followed by plastic sheet to minimize spreading. Use clean non-sparking tools to collect material and place it into loosely-covered plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie long hair back Wipe bench/wash hands on completion of prac				

Disposal of wastes

Provide a container to collect sulfuric acid waste. Neutralise sulfuric acid with sodium carbonate, adjusting the pH to 6–10. Dilute the neutralised solution with water and dispose of down the sink. Aluminium metal and foil may be placed in the normal waste. Dye solution may be stored for future use.

Assessor/ s: ______________________________ **Date:** ____________________ **Earliest MSDS expiry date:** ____________________

Unit 1.2 Prac 4 Anodised aluminium

Notes

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Unit 2.1 Prac 1 Metallic crystals

Description of procedure/requirements

Chemicals required: **Class sets**: thick copper wire, 0.1 M silver nitrate solution
Equipment: 250 mL glass beaker, spatula, microscope slide, microscope, gloves, safety glasses, lab coat
Procedure: Refer to Prac 1 Unit 2.1

HAZARDOUS as classified by ASCC

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Silver nitrate ($AgNO_3$) solid	5.1	Corrosive Dangerous to the environment	**R34 –** Causes burns. **R50 –** Very toxic to aquatic organisms. **R53 –** May cause long-term adverse effects in the aquatic environment.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately. **S60 –** This material and its container must be disposed of as hazardous waste. **S61 –** Avoid release to the environment. Refer to special instructions/Material Safety Data Sheets.	

NOT hazardous as classified by ASCC

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (with NO allocated Dangerous goods class)

0.1 M silver nitrate ($AgNO_3$) (1.7%)	Sodium thiosulfate 4% (silver nitrate spill clean-up)	Copper (Cu)	**Product** Silver (Ag)

Unit 2.1 Prac 1 Metallic crystals

Other hazards and safety considerations

Prepare solutions according to recipes and standard laboratory safety procedures. Consider providing the silver nitrate in stoppered flasks. (This will minimise student contact with the silver nitrate and the risk of spills.) Silver nitrate stains: spills can be decolourised with sodium thiosulfate 4%.

Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Collect prac waste for disposal. After separating the silver by filtration it can be stored for later disposal via a chemical waste company. The unreacted copper wire may be placed in the normal waste while the filtrate can be placed in the copper waste bottle.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.2 Prac 2 Froth flotation

Description of procedure/requirements

Chemicals required: Class sets: a mixture of sand and iron filings (5 parts sand to 1 part iron filings), kerosene, detergent
Equipment: spatula, large test tube, water, rubber stopper to fit test tube
Procedure: Refer to Prac 2 Unit 2.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Kerosene liquid	3 	Flammable Harmful Dangerous for the environment	**R10 –** Flammable. **R38 –** Irritating to skin. **R51/53 –** Toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment. **R65 –** Harmful: May cause lung damage if swallowed. **R66 –** Repeated exposure may cause skin dryness or cracking. **R67 –** Vapours may cause drowsiness and dizziness.	**S23 –** Do not breathe vapour. **S24/25 –** Avoid contact with skin and eyes. **S61 –** Avoid release to the environment. Refer to special instructions/Material Safety Data Sheets. **S62 –** If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 2.2 Prac 2 Froth flotation

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Sand	Iron filings	Detergent	

Other hazards and safety considerations

To minimise the risk of students inhaling fumes/vapours, perform this experiment in a fume cupboard. Risks also minimised by wearing safety glasses, lab coat, gloves and working in a well-ventilated laboratory (windows open) and using only small quantities of chemicals. In case of kerosene spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or inhalation, consult your local **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

In a fume cupboard, filter or strain the reaction mixture to separate the sand and iron filings from the kerosene mixture. Place kerosene mixture into a hazardous waste container for disposal via a chemical waste company. Sand and iron filings may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.2 Prac 2 Froth flotation

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Unit 2.2 Prac 3 Extracting copper by electrolysis

Description of procedure/requirements

Chemicals required: **Class sets**: 1 M sulfuric acid, black copper(II) oxide

Equipment: spatula, 50 mL beaker, glass stirring rod, Bunsen burner, tripod, gauze mat, heatproof mat, matches, 12 V power pack, globe, electrodes, connecting leads, filter paper or paper towel

Procedure: Refer to Prac 3 Unit 2.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated sulfuric acid (H_2SO_4) (98%)		Very corrosive	**R35** – Causes severe burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30 –** Never add water to this product. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Sulfuric acid 1 M (9.8%) H_2SO_4		Irritant	**R36/38 –** Irritating to eyes and skin.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30** – Never add water to this product. **S37 –** Wear suitable gloves. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Copper(II) oxide (CuO) solid	None allocated	Harmful	**R22 –** Harmful if swallowed.	**S22 –** Do not breathe dust.	

Unit 2.2 Prac 3 Extracting copper by electrolysis

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product	**Product**		
Acidic copper(II) sulfate ($CuSO_4.5H_2O$) (weak solution)	Copper deposits (Cu) solid		

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. Use a fume cupboard to prepare acid solutions. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result**. Use constant stirring (sulfuric acid is much denser than water, and if you do not stir when adding acid to water, a layer of concentrated acid may form at the bottom of the beaker, creating a substantial temperature gradient where acid and water meet). For acid spills on the skin, irrigate with large quantities of water: Washing should be continued for at least ten to fifteen minutes. Seek immediate medical advice. For small spills of sulfuric acid, cover with dry earth, sand or other non-combustible material followed by plastic sheet to minimise spreading. Use clean non-sparking tools to collect material and place it into loosely covered plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	**Glasses**	**Gloves**	**Fume cupboard**	**Other**
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide a container for the acidic copper waste. Collect the waste and neutralise with sodium carbonate as necessary and place in the copper waste bottle for disposal by a chemical waste company. Washed electrodes may be stored for future use.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Unit 2.2	**Prac 3**	**Extracting copper by electrolysis**

Notes:

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Unit 2.2 Prac 4 Extracting copper by roasting

Description of procedure/requirements

Chemicals required: **Class sets**: black copper oxide, charcoal
Equipment: crucible with cover, ring stand, clay triangle, Bunsen burner, spatula, filter paper, watch-glass, balance, tongs
Procedure: Refer to Prac 4 Unit 2.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Copper(II) oxide (CuO) solid	None allocated	Harmful	**R22 –** Harmful if swallowed.	**S22 –** Do not breathe dust.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Charcoal (C)	**Product** Copper (Cu)	**Product** Carbon dioxide (CO_2) gas	

Other hazards and safety considerations

Prepare chemicals as per laboratory precautions. Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Unit 2.2 Prac 4 Extracting copper by roasting

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Waste may be placed in the normal waste, as no hazardous waste is generated.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.3 Prac 1 Identifying plastics

Description of procedure/requirements

Chemicals required: Class sets: turpentine, nail polish remover, dilute hydrochloric acid (HCl), detergent, methylated spirits

Equipment: labelled pieces of polythene (each about 2 × 1 cm), polystyrene, PVC, Perspex, nylon, 'mystery' plastics, dissection board or heatproof mat, scissors, 250 mL beaker, tongs, access to methylated spirits burner set up in fume hood

Procedure: Refer to Prac 1 Unit 2.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Concentrated hydrochloric acid (HCl) (32%)	8 	Corrosive	**R34 –** Causes burns. **R37–** Irritating to respiratory system.	**S23 –** Do not breathe gas/fumes/vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S27 –** Take off immediately all contaminated clothing. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S37/39 –** Wear suitable gloves and eye protection. **S38 –** If insufficient ventilation, wear suitable respiratory equipment. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	
Methylated spirits	3 	Flammable	**R11 –** Highly flammable.	**S7 –** Keep container tightly closed. **S16** – Keep away from sources of ignition – no smoking.	

Unit 2.3 Prac 1 Identifying plastics

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Mineral turpentine	3 	Flammable Harmful Dangerous for the environment	**R10 –** Flammable. **R51/53 –** Toxic to aquatic organisms; may cause long-term adverse effects on the aquatic environment. **R65 –** Harmful: May cause lung damage if swallowed. **R66 –** Repeated exposure may cause skin dryness or cracking. **R67 –** Vapours may cause drowsiness and dizziness.	**S23 –** Do not breathe vapour. **S24 –** Avoid contact with skin. **S61 –** Avoid release to the environment. **S62 –** If swallowed, do not induce vomiting: seek medical advice immediately and show container or label.	

OT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Nail polish remover	3 	Flammable	**R11 –** Highly flammable.	**S7 –** Keep container tightly closed. **S16 –** Keep away from sources of ignition – no smoking. **S23 –** Do not breathe gas/fumes/vapour/spray. **S51 –** Use only in well-ventilated areas.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

1 M hydrochloric acid (HCl) (3.7%)	Plastic samples	Detergent	

Unit 2.3	**Prac 1**	**Identifying plastics**

Other hazards and safety considerations

To minimise the risk of students inhaling fumes/vapours, carry out this experiment in a fume cupboard. Decant flammable liquids into class sets in a fume hood. Use fume cupboard to prepare acid solutions. Prepare solutions according to standard laboratory safety procedures. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result**. In case of concentrated acid spill, absorb spill with earth, sand or other non-combustible material; dilute small amounts with water and neutralise with sodium carbonate or calcium hydroxide. Filter or strain to separate sand from liquid. Dispose of sand in the normal waste and the neutralised liquid may be poured down the sink. Small spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of methylated spirit or turpentine spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult the **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Collect waste from classroom. In a fume cupboard, place turpentine waste into an organic waste container for later disposal via a chemical waste company. Methylated spirits may be stored away for future use. Cooled plastic samples may be disposed of in the normal rubbish. Detergent solution may be poured down the drain.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 2.3 Prac 1 Identifying plastics

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Unit 2.3 Prac 2 Making casein plastic

Description of procedure/requirements

Chemicals required: Class sets: full-cream milk, vinegar, borax (for the extension)
Equipment: Bunsen burner, heatproof mat, tripod and gauze mat, matches, 100 mL measuring cylinder, two 250 mL beakers, thermometer, glass stirring rod elastic band, coarse cloth for straining, paper towel or filter paper, assorted moulds (such as bottle caps, moulded chocolate trays), fine sandpaper, tongs
Procedure: Refer to Prac 2 Unit 2.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Borax (sodium tetraborate) ($Na_2B_4O_7 \cdot 10H_2O$)	6.1	Toxic	**R60 –** May impair fertility. **R61 –** May cause harm to the unborn child.	**S45 –** In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). **S53 –** Avoid exposure-obtain special instructions before use.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Full-cream milk	Vinegar	**Product** Casein	

Unit 2.3 Prac 2 Making casein plastic

Other hazards and safety considerations

Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		
Tie back long hair back. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Casein waste may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.4 Prac 1 Making nylon: teacher demonstration

Description of procedure/requirements

Chemicals required: Class sets: 1,6-diaminohexane, anhydrous sodium carbonate, sebacoyl chloride or adipoyl chloride, cyclohexane
Equipment: fume hood, two 250 mL beakers, tweezers, glass stirring rod
Procedure: Refer to Prac 1 Unit 2.4

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
1,6-diaminohexane ($C_6H_{16}N_2$) solid	8  Corrosive	Harmful Corrosive	**R21/22 –** Harmful in contact with skin and if swallowed. **R34 –** Causes burns. **R37 –** Irritating to respiratory system.	**S22 –** Do not breathe dust. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. **S45 –** In case of accident, or if you feel unwell, seek medical advice immediately.	
Sodium carbonate anhydrous (Na_2CO_3) solid	None allocated	Irritant	**R36 –** Irritating to eyes.	**S22 –** Do not breathe dust. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.	
Sebacoyl chloride ($ClOC(CH_2)_8COCl$) liquid	8 	Corrosive Harmful	**R20/21/22 –** Harmful by inhalation and in contact with skin and if swallowed. **R34 –** Causes burns.	**S23 –** Do not breathe gas, fumes, vapour or spray. **S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. **S45 –** In case of accident, or if you feel unwell, seek medical advice immediately.	

Unit 2.4 Prac 1 Making nylon: teacher demonstration

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Adipoyl chloride (can be used instead of sebacoyl chloride)	8 	Corrosive	**R34 –** Causes burns. **R14 –** Reacts violently with water.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S23 –** Do not breathe gas, fumes, vapour or spray. **S24/25 –** Avoid contact with skin and eyes. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Cyclohexane (C6H12) liquid	3 	Highly flammable Harmful Dangerous for the environment	**R11 –** Highly flammable. **R20 –** Harmful by inhalation. **R38 –** Irritating to skin. **R50/53 –** Very toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment. **R65 –** Harmful: may cause lung damage if swallowed. **R67 –** Vapours may cause drowsiness and dizziness	**S9 –** Keep container in a well-ventilated place. **S16 –** Keep away from sources of ignition. No smoking. **S24/25 –** Avoid contact with skin and eyes. **S33 –** Take precautionary measures against static discharges. **S37/39** Wear suitable gloves and eye/face protection. **S51** Use only in well ventilated areas. **S60** This material and its container must be disposed of as hazardous waste. **S61 –** Avoid release to the environment. Refer to special instructions and material safety data sheet. **S62 –** If swallowed, do not induce vomiting; seek medical advice immediately and show the container or label.	
Product Hydrogen chloride gas >5%	2.3 Toxic gas 8 Corrosive	Toxic Corrosive	**R23 –** Toxic by inhalation. **R35 –** Causes severe burns.	**S9 –** Keep container in a well-ventilated place. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and contact a doctor or poisons information centre. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. In case of accident, or if you feel unwell, seek medical advice immediately.	

Unit 2.4 Prac 1 Making nylon: teacher demonstration

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product Nylon			

Other hazards and safety considerations

This demonstration should be carried out in a fume cupboard. Suggestion: Eliminate the presence of the concentrated chemicals in the class environment and supply freshly prepared solutions (**1:** 2.2 g of 1,6-diaminohexane and 5 g of anhydrous sodium carbonate in 50 mL of water. **2:** 2 mL of sebacoyl chloride or adipoyl chloride in 50 mL of cyclohexane). Prepare sebacoyl chloride in hexane, 1,6 diaminohexane solutions in a fume cupboard. Do not breathe vapour. Avoid contact with eyes, skin and clothing. Avoid prolonged or repeated exposure. In case of cyclohexane spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Nylon samples can be rinsed in methylated spirits and dried in a fume cupboard. Have some prepared samples that can be passed around to students. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide waste container for organic waste. Collect waste from classroom fume cupboard. In a fume cupboard, place sebacoyl chloride in cyclohexane and 1,6 diaminohexane waste into an organic waste container for later disposal via a chemical waste company. Nylon waste may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Unit 2.4 Prac 1 Making nylon: teacher demonstration

Notes:

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Unit 2.4 Prac 1 Making nylon: teacher demonstration

Description of procedure/requirements

Chemicals required: Class sets: 1,6-diaminohexane, anhydrous sodium carbonate, sebacoyl chloride or adipoyl chloride, cyclohexane
Equipment: fume hood, two 250 mL beakers, tweezers, glass stirring rod
Procedure: Refer to Prac 1 Unit 2.4

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
1,6-diaminohexane ($C_6H_{16}N_2$) solid	8  Corrosive	Harmful Corrosive	**R21/22 –** Harmful in contact with skin and if swallowed. **R34 –** Causes burns. **R37 –** Irritating to respiratory system.	**S22 –** Do not breathe dust. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. **S45 –** In case of accident, or if you feel unwell, seek medical advice immediately.	
Sodium carbonate anhydrous (Na_2CO_3) solid	None allocated	Irritant	**R36 –** Irritating to eyes.	**S22 –** Do not breathe dust. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.	
Sebacoyl chloride ($ClOC(CH_2)_8COCl$) liquid	8 	Corrosive Harmful	**R20/21/22 –** Harmful by inhalation and in contact with skin and if swallowed. **R34 –** Causes burns.	**S23 –** Do not breathe gas, fumes, vapour or spray. **S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. **S45 –** In case of accident, or if you feel unwell, seek medical advice immediately.	

Unit 2.4 Prac 1 Making nylon: teacher demonstration

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Adipoyl chloride (can be used instead of sebacoyl chloride)	8  	Corrosive	**R34 –** Causes burns. **R14 –** Reacts violently with water.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S23 –** Do not breathe gas, fumes, vapour or spray. **S24/25 –** Avoid contact with skin and eyes. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Cyclohexane ($C6H12$) liquid	3  	Highly flammable Harmful Dangerous for the environment	**R11 –** Highly flammable. **R20 –** Harmful by inhalation. **R38 –** Irritating to skin. **R50/53 –** Very toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment. **R65 –** Harmful: may cause lung damage if swallowed. **R67** Vapours may cause drowsiness and dizziness	**S9 –** Keep container in a well-ventilated place. **S16 –** Keep away from sources of ignition. No smoking. **S24/25 –** Avoid contact with skin and eyes. **S33 –** Take precautionary measures against static discharges. **S37/39 –** Wear suitable gloves and eye/face protection. **S51 –** Use only in well ventilated areas. **S60 –** This material and its container must be disposed of as hazardous waste. **S61 –** Avoid release to the environment. Refer to special instructions and material safety data sheet. **S62 –** If swallowed, do not induce vomiting; seek medical advice immediately and show the container or label.	

Unit 2.4	**Prac 1**	**Making nylon: teacher demonstration**

Reactant substance	**Dangerous good**	**Hazard category**	**Risk phrases**	**Safety phrases**	**MSDS issue**
Product Hydrogen chloride gas >5%	2.3 Toxic gas 8 Corrosive	Toxic Corrosive	**R23 –** Toxic by inhalation. **R35 –** Causes severe burns.	**S9 –** Keep container in a well-ventilated place. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and contact a doctor or poisons information centre. **S36/37/39 –** Wear suitable protective clothing, gloves and eye/face protection. In case of accident, or if you feel unwell, seek medical advice immediately.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	**Dangerous good**	**Hazard category**	**Risk phrases**	**Safety phrases**	**MSDS issue**

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product Nylon			

Other hazards and safety considerations

This demonstration should be performed in a fume cupboard. Suggestion: Eliminate the presence of the concentrated chemicals in the class environment and supply freshly prepared solutions (**1:** 2.2 g of 1,6-diaminohexane and 5 g of anhydrous sodium carbonate in 50 mL of water. **2:** 2 mL of sebacoyl chloride or adipoyl chloride in 50 mL of cyclohexane). Prepare sebacoyl chloride in hexane, 1,6 diaminohexane solution in a fume cupboard. Do not breathe vapour. Avoid contact with eyes, skin and clothing. Avoid prolonged or repeated exposure. In case of cyclohexane spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Nylon samples can be rinsed in methylated spirits and dried in a fume cupboard. Have some prepared samples that can be passed around to students. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation,

Unit 2.4	**Prac 1**	**Making nylon: teacher demonstration**

move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place any remaining sebacoyl chloride and 1,6 diaminohexane waste into the container provided and leave in the fume cupboard for laboratory technician to collect. **Do not pour any liquids down the drain.** Nylon waste may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date: ___________________** **Earliest MSDS expiry date: ___________________**

Notes:

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Unit 3.3	**Prac 2**	**Extracting DNA**

Description of procedure/requirements

Chemicals required: **Class sets**: ice-cold 95% ethanol, meat tenderiser, non-roasted fresh wheatgerm, dishwashing detergent
Equipment: 250 mL beaker, 15 mL test tube, test-tube rack, measuring cylinders (10 mL and 100 mL), thermometer, stirring rod, water bath, compound microscope
Procedure: Refer to Prac 2 Unit 3.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Ethanol (C_2H_5OH) and 95% ethanol	3 	Highly flammable	**R11 –** Highly flammable.	**S16 –** Keep away from sources of ignition. No smoking.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Meat tenderiser	Dishwashing detergent	Wheatgerm	

Other hazards and safety considerations

Use spirit thermometers rather than mercury thermometers. Do not use flammable liquids (ethanol) near ignition sources. Decant ethanol into class sets in a fume hood. Consider keeping one bottle of ice-cold ethanol in the fume hood for students to take turns using it. In case of ethanol spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal

Unit 3.3 Prac 2 Extracting DNA

or plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Other spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide a waste container for organic waste. Solid waste may be disposed of in the normal waste.

Assessor/s: ______________________________ Date: ___________________ Earliest MSDS expiry date: ___________________

Notes:

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This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 4.1 Prac 1 Orange juice and vitamin C

Description of procedure/requirements

Chemicals required: **Class sets**: starch suspension, iodine solution, vitamin C solution (dissolve vitamin C tablet or powder in 50 mL of water), three different brands of fresh orange juice, sodium thiosulfate 4%

Equipment: 4 test tubes, test tube rack, 200 mL beaker, stirring rod, dropper, lab coat, safety glasses, gloves

Procedure: Refer to Prac 1 Unit 4.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Iodine (I_2) (Iodine crystals)	None Allocated	Harmful Dangerous for the environment	**R20/21 –** Harmful by inhalation and in contact with skin. **R50 –** Very toxic to aquatic organisms.	**S23 –** Do not breathe gas/fumes/vapour/spray. **S25 –** Avoid contact with eyes. **S61 –** Avoid release to the environment. Refer to special instructions/Material Safety Data Sheets.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 4.1 Prac 1 Orange juice and vitamin C

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Potassium iodide (KI) Solid (to prepare iodine solution)	Iodine solution (iodine/potassium iodide solution)	Starch and starch suspension	Vitamin C tablet or powder
Vitamin C solution	Sodium thiosulfate ($Na_2S_2O_3$) solid	4% Sodium thiosulfate (for iodine spills)	

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. Use fume cupboard to make up iodine solution. Dispense iodine solution into amber bottles. Small spills of iodine can be reacted with a 4% sodium thiosulfate solution, and then washed down the drain using plenty of water and avoiding contact with skin and eyes. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of inhalation or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Any remaining iodine solution may be stored away for future use or disposed of via the sink after reacting with a weak solution of sodium thiosulfate. Waste can be flushed to the sewer with plenty of water.

Assessor/s: ______________________ **Date:** ______________ **Earliest MSDS expiry date:** ______________

Unit 4.1 Prac 1 Orange juice and vitamin C

Notes:

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Unit 4.4 Prac 1 Modelling the transmission of disease

Description of procedure/requirements

Chemicals required: one bottle of 0.1 M sodium hydroxide, one bottle of 0.1 M hydrochloric acid, class set of phenolphthalein indicator
Equipment: one test tube per person, one eye-dropper (Pasteur pipette) per person
Procedure: Refer to Prac 1 Unit 4.4

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Sodium hydroxide (NaOH) solid	8 	Very corrosive	**R35 –** Causes severe burns.	**S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37/39 –** Wear suitable protective clothing and gloves. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Concentrated hydrochloric acid (HCl) 32%	8 	Corrosive	**R34 –** Causes burns. **R37 – I**rritating to respiratory system.	**S23 –** Do not breathe gas/fumes/vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S27 –** Take off immediately all contaminated clothing. **S37/39 –** Wear suitable gloves and eye protection. **S38 –** If insufficient ventilation, wear suitable respiratory equipment. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	

Unit 4.4 Prac 1 Modelling the transmission of disease

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Ethanol (C_2H_5OH)	3 	Highly flammable	**R11 –** Highly flammable	**S16 –** Keep away from sources of ignition. No smoking.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Phenolphthalein indicator	3 	Highly flammable	**R11 –** Highly flammable.	**S7 –** Keep container tightly closed. **S16 –** Keep away from sources of ignition. No smoking. **S23 –** Do not breathe vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S33 –** Take precautionary measures against static discharges.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

0.1 M sodium hydroxide (NaOH) (0.4%)	0.1 M hydrochloric acid (HCl) (0.37%)	Phenolphthalein powder	

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. Use fume cupboard to make up sodium hydroxide solution and hydrochloric acid solution. When preparing sodium hydroxide solution, add pellets to water in small amounts to avoid boiling and splattering. Dilute sodium hydroxide spill with water, then neutralise with a weak concentration of hydrochloric acid solution and pour down the sink using plenty of water. When diluting acids, acids should always be slowly added to the water in small amounts. **Never use hot water and never add water to the acid, as uncontrolled boiling may result.** In case of concentrated acid spill, absorb spill with earth, sand or other non-combustible material; dilute small amounts with water and neutralise with sodium carbonate

Unit 4.4	**Prac 1**	**Modelling the transmission of disease**

or calcium hydroxide. Filter or strain to separate sand from liquid. Dispose of sand in the normal waste and the neutralised liquid may be poured down the sink. Small spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. In case of ethanol spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Provide a waste container. Collect waste, neutralise to a pH of between 6 and 9 and discard to the sewer with plenty of water.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Notes:

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Unit 5.3 Prac 2 Constructing fossils

Description of procedure/requirements

Chemicals required: **Class sets**: detergent, sodium hypochlorite 5% solution (bleach), sodium hypochlorite 0.5% solution (bleach)
Equipment: chicken or rabbit carcass, cooking implements (e.g. saucepan, hotplate), bench mat, plaster, mud or clay, 250 mL beaker, forceps, scalpel
Procedure: Refer to Prac 2 Unit 5.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Bleach solution 5%	Detergent	Bleach solution 0.5%	

Other hazards and safety considerations

Prepare solutions according to laboratory precautions. To disinfect all work areas, use a commercial bleach with 5% available chlorine as it is an effective broad-spectrum germicide and can be diluted up to 1:10 (0.5%) for safe use in the classroom without losing its effectiveness. It is NOT classified as hazardous by NOHSC criteria. However, care should be taken to not breathe in vapours. Animal tissue should be handled with care and should be treated as a potential source of infection. Cuts, sores or broken skin should be covered. Gloves may be worn. Instruct students to wash any animal blood/tissue off skin immediately using antibacterial hand wash. Instruct students to cut away from themselves and to keep fingers out of cutting path. Disinfect all work areas with a bleach

Unit 5.3	**Prac 2**	**Constructing fossils**

solution of 0.5%. Safety goggles, lab coat and gloves should also be worn to avoid contact with skin and eyes. In case of inhalation or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Liquid waste may be poured down the drain. Animal waste may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.1 Prac 1 Studying a reaction

Description of procedure/requirements

Chemicals required: **Class sets**: magnesium strips, 1 M sulfuric acid

Equipment: large beaker, small filter funnel, 100 mL measuring cylinder, cling wrap, gloves, lab coat, safety glasses

Procedure: Refer to Prac 1 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
1 M sulfuric acid (9.8%) H_2SO_4		Irritant	**R36/38 –** Irritating to eyes and skin.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Magnesium (Mg) ribbon	4.1	Highly flammable	**R11 –** Highly flammable. **R15 –** Contact with water liberates extremely flammable gases.	**S7/8 –** Keep container tightly closed and dry. **S43 –** In case of fire, use sand, never use water.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product	Product		
Magnesium sulfate ($MgSO_4$) solution	Hydrogen (H_2) gas		

Unit 1.1 Prac 1 Studying a reaction

Other hazards and safety considerations

Dilute small acid spills with water and neutralise with sodium carbonate, wipe up immediately using paper towel, avoiding contact with skin and eyes. Risks minimised by wearing safety glasses, lab coat and gloves. Students instructed to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Test solutions may be disposed of down the drain with plenty of water. Leave any remaining dilute acid solution for the laboratory technician to store for future use.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.1	**Prac 2**	**Conservation of mass**

Description of procedure/requirements

Chemicals required: **Class sets**: solid calcium carbonate, 0.5 M hydrochloric acid
Equipment: electronic balance, 200 mL conical flask, balloon, spatula, 100 mL measuring cylinder, lab coat, safety glasses
Procedure: Refer to Prac 2 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Calcium carbonate ($CaCO_3$) solid	0.5 M hydrochloric acid (HCl) (1.85%)	**Product** Calcium chloride ($CaCl_2$) (aqueous)	**Product** Carbon dioxide (CO_2) gas

Other hazards and safety considerations

Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Unit 1.1 Prac 2 Conservation of mass

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place the waste solutions in the container provided for the laboratory technician to collect.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.1 Prac 3 Rates of reactions 1

Description of procedure/requirements

Chemicals required: Class sets: magnesium strips, 1 M hydrochloric acid, hydrogen peroxide (H_2O_2) 20 volume (6%), manganese dioxide
Equipment: ice, stopwatch, spatula, 4 test tubes, test tube rack, 10 mL measuring cylinder, two 100 mL beakers
Procedure: Refer to Prac 3 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
20 volume (6%) Hydrogen peroxide (H_2O_2)	None allocated	Irritant	**R36/38 –** Irritating to eyes and skin.	**S3 –** Keep in a cool place. **S28 –** After contact with skin, wash immediately with plenty of water. **S36/39 –** Wear suitable protective clothing and eye/face protection. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Manganese dioxide powder (MnO_2)	None allocated	Harmful	**R20/22 –** Harmful by inhalation and if swallowed.	**S25 –** Avoid contact with eyes.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Magnesium (Mg) ribbon	4.1	Highly flammable	**R11 –** Highly flammable. **R15 –** Contact with water liberates extremely flammable gases.	**S7/8 –** Keep container tightly closed and dry. **S43 –** In case of fire, use sand, never use water.	

Unit 1.1 Prac 3 Rates of reactions 1

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

1 M hydrochloric acid (HCl) (3.7%)	**Product** Magnesium chloride ($MgCl_2$) solution	**Product** Hydrogen (H_2) gas	**Product** Oxygen (O_2) gas
Product Water (H_2O)			

Other hazards and safety considerations

Risks minimised by wearing safety glasses, lab coat and gloves. In case of hydrogen peroxide and hydrochloric acid spill, dilute spill with water and wipe up with paper towel. In case of manganese dioxide spill, sweep up with dustpan and place spill into a hazardous waste container. Instruct students to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Pour manganese dioxide test samples into the waste container provided. Manganese dioxide is insoluble in water and cannot be washed down the drain. The other waste can be washed down the drain with plenty of water.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Unit 1.1 Prac 3 Rates of reactions 1

Notes:

To be a valid assessment, the MSDS expiry dates should be added and this risk assessment should be signed and dated.

This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 1.1 Prac 4 Rates of reactions 2

Description of procedure/requirements

Chemicals required: **Class sets**: marble chips (large and small), powdered calcium carbonate, dilute hydrochloric acid (2 M) (7%)
Equipment: stopwatch, spatula, 4 test tubes, test-tube rack, 10 mL measuring cylinder, electronic balance
Procedure: Refer to Prac 4 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

2.0 M hydrochloric acid (7%)	Marble chips ($CaCO_3$) solid	**Product** Calcium chloride ($CaCl_2$) (aqueous)	**Product** Carbon dioxide (CO_2) gas

Other hazards and safety considerations

Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Unit 1.1 Prac 4 Rates of reactions 2

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

If the marble chips have been completely consumed in the reaction, then the product calcium chloride may be disposed of down the sink using plenty of water. If there are unconsumed marble chips remaining in the product, leave for the laboratory technician to filter and recycle.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.1 Prac 5 Reaction rate—effect of catalysts and enzymes

Description of procedure/requirements

Chemicals required: **Class sets**: hydrogen peroxide solution (H_2O_2) 20 volume (6%), manganese(IV) dioxide
Equipment: small piece of fresh liver, small piece of apple or potato, 4 test tubes, test tube rack, wax taper, safety glasses
Procedure: Refer to Prac 5 Unit 1.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
20 volume (6%) Hydrogen peroxide (H_2O_2)	None allocated	Irritant	**R36/38 –** Irritating to eyes and skin.	**S3 –** Keep in a cool place. **S28 –** After contact with skin, wash immediately with plenty of water. **S36/39 –** Wear suitable protective clothing and eye/face protection. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately	
Manganese dioxide powder (MnO_2)	None allocated	Harmful	**R20/22 –** Harmful by inhalation and if swallowed.	**S25 –** Avoid contact with eyes.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 1.1 Prac 5 Reaction rate—effect of catalysts and enzymes

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product Oxygen (O_2) gas	Product Water (H_2O)		

Other hazards and safety considerations

Risks minimised by wearing safety glasses, lab coat and gloves. Beware of flames. In case of hydrogen peroxide spill, dilute spill with water and wipe up with paper towel. In case of manganese dioxide spill, sweep up with dustpan and place spill into a hazardous waste container. Instruct students to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Pour manganese dioxide test samples into the waste container provided. Manganese dioxide is insoluble in water and cannot be washed down the drain. The residue from the liver and apple or potato may be disposed of in the normal waste. The other waste can be washed down the drain with plenty of water.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 1.1 Prac 5 Reaction rate—effect of catalysts and enzymes

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Unit 1.2 Prac 1 Complete and incomplete combustion

Description of procedure/requirements

Chemicals required: Class sets: kerosene with wick, ethanol

Equipment: Pasteur pipette, lab coat, safety glasses, heatproof mat, watch-glass, candle

Procedure: Refer to Prac 1 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Kerosene liquid	3 	Flammable Harmful Dangerous for the environment	**R10 –** Flammable. **R38 –** Irritating to skin. **R51/53 –** Toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment. **R65 –** Harmful: May cause lung damage if swallowed. **R66 –** Repeated exposure may cause skin dryness or cracking. **R67 –** Vapours may cause drowsiness and dizziness.	**S23 –** Do not breathe vapour. **S24/25 –** Avoid contact with skin and eyes. **S61 –** Avoid release to the environment. Refer to special instructions/Material Safety Data Sheets. **S62 –** If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	
Ethanol (C_2H_5OH)	3 	Highly flammable	**R11 –** Highly flammable.	**S16 –** Keep away from sources of ignition. No smoking.	

Unit 1.2 Prac 1 Complete and incomplete combustion

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Other hazards and safety considerations

To minimise the risk of students inhaling fumes/vapours, carry out this experiment in a fume cupboard or in a well-ventilated laboratory (windows open). Beware of hot objects. In case of kerosene and ethanol spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Students instructed to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel, heatproof mat, tongs to handle hot items, fume cupboard or good ventilation.
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

No waste is generated.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

 ISBN 9781442515413

Unit 1.2 Prac 1 Complete and incomplete combustion

Notes:

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This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 1.2 Prac 2 Corrosion of iron

Description of procedure/requirements

Chemicals required: **Class sets**: magnesium ribbon, distilled water, 5 iron nails (not galvanised), copper wire, salt solution (sodium chloride)
Equipment: fine sandpaper or steel wool, 4 test tubes, test tube rack, Bunsen burner, heatproof mat, matches, 250 mL beaker, peg or tongs, marking pen
Procedure: Refer to Prac 2 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Magnesium (Mg) ribbon	4.1	Highly flammable	**R11 –** Highly flammable. **R15 –** Contact with water liberates extremely flammable gases.	**S7/8 –** Keep container tightly closed and dry. **S43 –** In case of fire, use sand, never use water.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Iron nails (Fe)	Copper wire (Cu)	Sodium chloride (NaCl)	Salt solution (sodium chloride)

Unit 1.2 Prac 2 Corrosion of iron

Other hazards and safety considerations

Risks minimised by using short lengths of magnesium ribbon. Risks also minimised by wearing safety glasses, lab coat and gloves. Students instructed to wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or inhalation, consult your local **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place metal waste in the container provided. Salt solution may be disposed of down the drain.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Notes:

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Unit 1.2 Prac 3 Observing iron hydroxides

Description of procedure/requirements

Chemicals required: Class sets: 1 M sodium hydroxide (NaOH) (4%), 0.1 M iron(II) chloride ($FeCl_2$) solution, 0.1 M iron(III) chloride ($FeCl_3$) solution
Equipment: test tube rack, 2 test tubes, Pasteur pipette
Procedure: Refer to Prac 3 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
1 M sodium hydroxide (NaOH) (4%)	8	Corrosive	**R34 –** Causes burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37 –** Wear suitable protective clothing and gloves. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

0.1 M iron(III) chloride hexahydrate ($FeCl_3.6H_2O$) (2.7%)	0.1 M iron(II) chloride tetrahydrate ($FeCl_2.4H_2O$) (2%)	**Product** Iron(II) hydroxide (precipitate)	**Product** Iron(III) hydroxide (precipitate)
Product Sodium chloride (NaCl) solution			

Unit 1.2 Prac 3 Observing iron hydroxides

Other hazards and safety considerations

Risks minimised by wearing safety glasses, lab coat and gloves. In case of sodium hydroxide spill, dilute spill with water and wipe up with paper towel. Students instructed to wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place the waste in the container provided for the laboratory technician to collect.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 1.2 Prac 4 Anodised aluminium

Description of procedure/requirements

Chemicals required: **Class sets**: piece of aluminium, aluminium foil, 2 M sulfuric acid, detergent, fabric dye solution

Equipment: safety glasses, two 250 mL beakers, tongs, tissues, 12 V power pack with wires and alligator clips, retort stand, boss head and clamp, Bunsen burner or hot plate, tripod, gauze mat, bench mat, matches

Procedure: Refer to Prac 4 Unit 1.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Sulfuric acid 2 M (19.6%) H_2SO_4	 8	Very corrosive	**R35 –** Causes severe burns.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30 –** Never add water to this product. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Aluminium	Aluminium foil	Detergent	Fabric dye solution (Check MSDS/instructions)

Unit 1.2 Prac 4 Anodised aluminium

Other hazards and safety considerations

Beware of hot objects. Risks minimised by providing the minimum quantity and volume of acid. Risks also minimised by wearing safety glasses, lab coat and gloves. Dilute small spills with water; wipe up using paper towel, avoiding contact with skin and eyes. Students instructed to wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place sulfuric acid waste into the container provided. The laboratory technician will collect and neutralise the solution before disposing of down the sink. Aluminium metal and foil may be placed in the normal waste. Dye solution may be stored for future use.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.1 Prac 1 Metallic crystals

Description of procedure/requirements

Chemicals required: **Class sets**: thick copper wire, 0.1 M silver nitrate solution
Equipment: 250 mL glass beaker, spatula, microscope slide, microscope, gloves, safety glasses, lab coat
Procedure: Refer to Prac 1 Unit 2.1

HAZARDOUS as classified by ASCC

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (with NO allocated Dangerous goods class)

0.1 M silver nitrate ($AgNO_3$) (1.7%)	Sodium thiosulfate 4% (silver nitrate spill clean-up)	Copper (Cu)	**Product** Silver (Ag)

Other hazards and safety considerations

Suggestion: Consider providing the silver nitrate in stoppered 100 mL conical flasks. (This will minimise student contact with the silver nitrate and the risk of spills.) Silver nitrate stains: spills can be decolourised with sodium thiosulfate 4%.

Risks minimised by wearing safety glasses, lab coat and gloves. Instruct students to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Unit 2.1	**Prac 1**	**Metallic crystals**

Protective measures

Lab coat	**Glasses**	**Gloves**	**Fume cupboard**	**Other**
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Places the waste solutions and the copper wires in the containers provided to be collected by the lab tech.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.2 Prac 2 Froth flotation

Description of procedure/requirements

Chemicals required: Class sets: a mixture of sand and iron filings (5 parts sand to 1 part iron filings), kerosene, detergent
Equipment: spatula, large test tube, water, rubber stopper to fit test tube
Procedure: Refer to Prac 2 Unit 2.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Kerosene liquid	3 	Flammable Harmful Dangerous for the environment	**R10 –** Flammable. **R38 –** Irritating to skin. **R51/53 –** Toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment. **R65 –** Harmful: May cause lung damage if swallowed. **R66 –** Repeated exposure may cause skin dryness or cracking. **R67 –** Vapours may cause drowsiness and dizziness.	**S23 –** Do not breathe vapour. **S24/25 –** Avoid contact with skin and eyes. **S61 –** Avoid release to the environment. Refer to special instructions/Material Safety Data Sheets. **S62 –** If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 2.2 Prac 2 Froth flotation

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Sand	Iron filings	Detergent	

Other hazards and safety considerations

To minimise the risk of students inhaling fumes/vapours, carry out this experiment in a fume cupboard. Risks also minimised by wearing safety glasses, lab coat, gloves and working in a well-ventilated laboratory (windows open) and using only small quantities of chemicals. In case of kerosene spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Students instructed to wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or inhalation, consult your local **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	**Glasses**	**Gloves**	**Fume cupboard**	**Other**
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place test samples into the container provided in the fume cupboard for the laboratory technician to dispose of. Alternatively, leave the test tubes stoppered and put aside for collection. **Do not pour kerosene down the drain.**

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Notes:

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This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 2.2	**Prac 2**	**Froth flotation**

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Unit 2.2 Prac 3 Extracting copper by electrolysis

Description of procedure/requirements

Chemicals required: **Class sets**: 1 M sulfuric acid, black copper(II) oxide

Equipment: spatula, 50 mL beaker, glass stirring rod, Bunsen burner, tripod, gauze mat, heatproof mat, matches, 12 V power pack, globe, electrodes, connecting leads, filter paper or paper towel

Procedure: Refer to Prac 3 Unit 2.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Sulfuric acid 1 M (9.8%) H_2SO_4		Irritant	**R36/38 –** Irritating to eyes and skin.	**S26 –** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S30 –** Never add water to this product. **S37 –** Wear suitable gloves. **S45 –** In case of accident or if you feel unwell, seek medical advice immediately.	
Copper(II) oxide (CuO) solid	None allocated	Harmful, irritant	**R22 –** Harmful if swallowed.	**S22 –** Do not breathe dust.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

Unit 2.2	**Prac 3**	**Extracting copper by electrolysis**

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Product	**Product**		
Acidic copper(II) sulfate ($CuSO_4.5H_2O$) (weak solution)	Copper deposits (Cu)		

Other hazards and safety considerations

Beware of hot objects. Dilute small acid spills with water and neutralise with sodium carbonate. Wipe up immediately using paper towel, avoiding contact with skin and eyes. Risks minimised by wearing safety glasses, lab coat and gloves. Students instructed to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	**Glasses**	**Gloves**	**Fume cupboard**	**Other**
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place copper sulfate waste into the container provided. The laboratory technician will collect and neutralise the copper sulfate waste with a weak solution of sodium hydroxide and pour into a hazardous waste container for disposal via a chemical waste company.

Assessor/s: ______________________ **Date:** ______________ **Earliest MSDS expiry date:** ______________

Notes:

To be a valid assessment, the MSDS expiry dates should be added and this risk assessment should be signed and dated.

This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 2.2	Prac 3	Extracting copper by electrolysis

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Unit 2.2 Prac 4 Extracting copper by roasting

Description of procedure/requirements

Chemicals required: **Class sets**: black copper oxide, charcoal
Equipment: crucible with cover, ring stand, clay triangle, Bunsen burner, spatula, filter paper, watch-glass, balance, tongs
Procedure: Refer to Prac 4 Unit 2.2

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Copper(II) oxide (CuO) solid	None allocated	Harmful	**R22 –** Harmful if swallowed.	**S22 –** Do not breathe dust.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Charcoal (C)	**Product** Copper (Cu)	**Product** Carbon dioxide (CO_2) gas	

Unit 2.2 Prac 4 Extracting copper by roasting

Other hazards and safety considerations

Refer to RA: Heating. Beware of flames/fire and hot items/burn risk. Instruct students to handle the hot crucible with tongs. Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Waste may be placed in the normal waste, as no hazardous waste is generated.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Notes:

To be a valid assessment, the MSDS expiry dates should be added and this risk assessment should be signed and dated.

This assessment is valid for 5 years from the earliest MSDS expiry date.

Unit 2.3 Prac 1 Identifying plastics

Description of procedure/requirements

Chemicals required: Class sets: turpentine, nail polish remover, dilute hydrochloric acid (HCl), detergent, methylated spirits

Equipment: labelled pieces of polythene (each about 2 × 1 cm), polystyrene, PVC, Perspex, nylon, 'mystery' plastics, dissection board or heatproof mat, scissors, 250 mL beaker, tongs, access to methylated spirits burner set-up in fume hood

Procedure: Refer to Prac 1 Unit 2.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Methylated spirits	3 	Flammable	**R11 –** Highly flammable.	**S7 –** Keep container tightly closed. **S16** – Keep away from sources of ignition – no smoking.	
Mineral turpentine	3 	Flammable Harmful Dangerous for the environment	**R10 –** Flammable. **R51/53 –** Toxic to aquatic organisms; may cause long-term adverse effects on the aquatic environment. **R65 –** Harmful: May cause lung damage if swallowed. **R66 –** Repeated exposure may cause skin dryness or cracking. **R67 –** Vapours may cause drowsiness and dizziness.	**S23 –** Do not breathe vapour. **S24 –** Avoid contact with skin. **S61 –** Avoid release to the environment. **S62 –** If swallowed, do not induce vomiting: seek medical advice immediately and show container or label.	

Unit 2.3 Prac 1 Identifying plastics

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Nail polish remover	3 	Flammable	**R11** – Highly flammable.	**S7** – Keep container tightly closed. **S16** – Keep away from sources of ignition – no smoking. **S23** – Do not breathe gas/fumes/vapour/spray. **S51** – Use only in well-ventilated areas.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

1 M hydrochloric acid (HCl) (3.7%)	Plastic samples	Detergent	

Other hazards and safety considerations

The burning of plastics using a meths burner should be carried out only in a fume cupboard. Risks also minimised by wearing safety glasses, lab coat, gloves and working in a well-ventilated laboratory (windows open) and using only small quantities of chemicals. In case of methylated spirit or turpentine spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. For diluted hydrochloric acid spill, dilute spill with water and wipe up using paper towel. Students instructed to wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or inhalation, consult your local **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Unit 2.3	**Prac 1**	**Identifying plastics**

Disposal of wastes

Leave turpentine and methylated spirit waste in the fume cupboard for the laboratory technician to dispose of. **Do not pour methylated spirits or turpentine down the drain.** Cooled plastic samples may be disposed of in the normal rubbish. Detergent solution may be poured down the drain.

Assessor/s: ______________________________ **Date: __________________** **Earliest MSDS expiry date: __________________**

Notes:

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Unit 2.3 Prac 2 Making casein plastic

Description of procedure/requirements

Chemicals required: Class sets: full-cream milk, vinegar, borax (for the extension)
Equipment: Bunsen burner, heatproof mat, tripod and gauze mat, matches, 100 mL measuring cylinder, two 250 mL beakers, thermometer, glass stirring rod elastic band, coarse cloth for straining, paper towel or filter paper, assorted moulds (such as bottle caps, moulded chocolate trays), fine sandpaper, tongs
Procedure: Refer to Prac 2 Unit 2.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Borax (sodium tetraborate) $Na_2B_4O_7{\cdot}10H_2O$	6.1	Toxic	**R60 –** May impair fertility. **R61 –** May cause harm to the unborn child.	**S45 –** In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). **S53 –** Avoid exposure-obtain special instructions before use.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Full-cream milk	Vinegar	**Product** Casein	

Unit 2.3 Prac 2 Making casein plastic

Other hazards and safety considerations

Beware of flames/fire and hot items/burn risk. Refer to RA Heating. Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Casein waste may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 2.5 Prac 1 Make soap

Description of procedure/requirements

Chemicals required: **Class sets**: olive oil or coconut oil, 6 M sodium hydroxide solution, saturated solution of sodium chloride, kerosene

Equipment: three test tubes, rubber stopper, 400 mL beaker, 100 mL beaker, 250 mL beaker, hot plate (preferably) or a Bunsen burner, heatproof mat, tripod, gauze mat, matches, filter paper or paper towel

Procedure: Refer to Prac 1 Unit 2.5

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
6 M Sodium hydroxide ($NaOH$) (24%)	8 	Very corrosive	**R35** – Causes severe burns.	**S26** – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. **S36/37–** Wear suitable protective clothing and gloves. **S45** – In case of accident or if you feel unwell, seek medical advice immediately.	
Kerosene Liquid	3 Flammable Liquid 	Harmful Irritant	**R10** – Flammable. **R38** – Irritating to skin. **R65** – Harmful: may cause lung damage if swallowed.	Highly flammable—Store and use in a well-ventilated area, away from naked flames, sparks and ignition sources. **S2** – Keep out of reach of children. **S24** – Avoid contact with skin. **S62** – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label. **S36/37–** Wear suitable protective clothing and gloves.	

Unit 2.5 Prac 1 Make soap

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Olive oil or coconut oil	Sodium chloride solid	Saturated sodium chloride solution	**Product** Soap

Other hazards and safety considerations

Beware of hot objects. **Extreme care should be exercised when handling 6 M sodium hydroxide solution. Wear gloves, safety glasses and lab coat at all times.** Risks minimised by dispensing small amounts of chemicals into dropping bottles. In case of a sodium hydroxide spill, neutralise with dilute hydrochloric acid, dilute with water, then wipe up spill using paper towel, avoiding contact with skin and eyes. Minimise the quantity and volume of sodium hydroxide provided in the class. (Consider providing one bottle of sodium hydroxide for the teacher to monitor and dispense.) Consider substituting a non-hazardous grease or oil for kerosene. In case of kerosene spill, eliminate all ignition sources; absorb spill with earth, sand or other non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Provide good ventilation or a fume cupboard when students are using kerosene. Minimise fumes by not allowing open containers of kerosene—replace lids or stopper test tubes. This prac could be carried out as a teacher demonstration. Students instructed to wash any chemical off skin immediately. In case of inhalation, remove students to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Unit 2.5 Prac 1 Make soap

Disposal of wastes

The liquid waste still contains a significant concentration of sodium hydroxide. Leave waste for the laboratory technician to collect and neutralise to a pH between 6 and 9 with a weak concentration of hydrochloric acid solution before disposing of via the sink with plenty of water. Soap and filter paper may be placed in the normal waste.

Assessor/s: ______________________________ **Date: ___________________** **Earliest MSDS expiry date: ___________________**

Notes:

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Unit 3.3 Prac 2 Extracting DNA

Description of procedure/requirements

Chemicals required: **Class sets**: ice-cold 95% ethanol, meat tenderiser, non-roasted fresh wheatgerm, dishwashing detergent

Equipment: 250 mL beaker, 15 mL test tube, test tube rack, measuring cylinders (10 mL and 100 mL), thermometer, stirring rod, water bath, compound microscope

Procedure: Refer to Prac 2 Unit 3.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Ethanol (C_2H_5OH) and 95% ethanol	3 	Highly flammable	**R11 –** Highly flammable.	**S16 –** Keep away from sources of ignition. No smoking.	

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous Goods class)

Meat tenderiser	Dishwashing detergent	Wheatgerm	

Other hazards and safety considerations

Use spirit thermometers rather than mercury thermometers. Do not use flammable liquids (ethanol) near ignition sources. Consider keeping one bottle of ice-cold ethanol in the fume hood for students to take turns using it. In case of ethanol spill, eliminate all ignition sources; absorb spill with earth, sand or other

Unit 3.3	**Prac 2**	**Extracting DNA**

non-combustible material. Use clean, non-sparking tools to collect material and place it in loosely covered metal or plastic containers for later disposal. Risks minimised by wearing safety glasses, lab coat and gloves. Other spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Instruct students to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes	Yes	Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Place the waste in the container provided for the laboratory technician to collect. Solid waste may be disposed of in the normal waste.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 4.1 Prac 1 Orange juice and vitamin C

Description of procedure/requirements

Chemicals required: **Class sets**: starch suspension, iodine solution, vitamin C solution (dissolve vitamin C tablet or powder in 50 mL of water), three different brands of fresh orange juice, sodium thiosulfate 4%

Equipment: 4 test tubes, test tube rack, 200 mL beaker, stirring rod, dropper, lab coat, safety glasses, gloves

Procedure: Refer to Prac 1 Unit 4.1

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Iodine solution (iodine/potassium iodide solution)	Starch and starch suspension	Vitamin C solution	4% Sodium thiosulfate (for iodine spills)

Unit 4.1 Prac 1 Orange juice and vitamin C

Other hazards and safety considerations

Small spills of iodine can be reacted with a 4% sodium thiosulfate solution, and then washed down the drain using plenty of water and avoiding contact with skin and eyes. Risks minimised by wearing safety glasses, lab coat and gloves. Spills should be wiped up immediately using paper towel and water, avoiding contact with skin and eyes. Instruct students to wash any chemical off skin immediately. In case of inhalation, move to fresh air. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Leave iodine solution in their bottles for the laboratory technician to store away. Waste can be flushed to the sewer with plenty of water.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

Notes:

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Unit 4.4 Prac 1 Modelling the transmission of disease

Description of procedure/requirements

Chemicals required: one bottle of 0.1 M sodium hydroxide, one bottle of 0.1 M hydrochloric acid, class set of phenolphthalein indicator
Equipment: one test tube per person, one eye-dropper (Pasteur pipette) per person
Procedure: Refer to Prac 1 Unit 4.4

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Phenolphthalein indicator	3 	Highly flammable	**R11 –** Highly flammable.	**S7 –** Keep container tightly closed. **S16 –** Keep away from sources of ignition. No smoking. **S23 –** Do not breathe vapour/spray. **S24/25 –** Avoid contact with skin and eyes. **S33 –** Take precautionary measures against static discharges.	

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

0.1 M sodium hydroxide (NaOH) (0.4%)	0.1 M hydrochloric acid (HCl) (0.37%)		

Unit 4.4	**Prac 1**	**Modelling the transmission of disease**

Other hazards and safety considerations

For diluted hydrochloric acid and sodium hydroxide spill, dilute spill with water and wipe up using paper towel. Students instructed to wash any chemical off skin immediately. In case of chemical in eye, an eye wash or safety shower should be used. In case of ingestion or inhalation, consult your local **Poisons Information Centre PH 131126** and seek medical assistance.

Protective measures

Lab coat	**Glasses**	**Gloves**	**Fume cupboard**	**Other**
Yes	Yes	Yes		Paper towel
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Leave waste for the laboratory technician to collect. The laboratory technician will neutralise waste before disposing of it down the sink.

Assessor/s: ______________________________ **Date:** ___________________ **Earliest MSDS expiry date:** ___________________

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Unit 5.3 Prac 2 Constructing fossils

Description of procedure/requirements

Chemicals required: **Class sets**: detergent, sodium hypochlorite 5% solution (bleach), sodium hypochlorite 0.5% solution (bleach)
Equipment: chicken or rabbit carcass, cooking implements (e.g. saucepan, hotplate), bench mat, plaster, mud or clay, 250 mL beaker, forceps, scalpel
Procedure: Refer to Prac 2 Unit 5.3

HAZARDOUS as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC)

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue

NOT hazardous as classified by ASCC (NOHSC) (with NO allocated Dangerous goods class)

Bleach solution 0.5%	Detergent		

Other hazards and safety considerations

Beware of hot objects. Animal tissue should be handled with care and should be treated as a potential source of infection. Cuts, sores or broken skin should be covered. Gloves may be worn. Instruct students to wash any animal blood/tissue off skin immediately using antibacterial hand wash. Instruct students to cut away from themselves and to keep fingers out of cutting path. Disinfect all work areas with a bleach solution of 0.5%. The bleach solution is NOT classified as hazardous by NOHSC criteria; however, care should be taken to not breathe in vapours. Safety goggles, lab coat and gloves should also be worn to avoid contact with skin and eyes. In case of inhalation or feeling unwell, consult **Poisons Information Centre PH 131126** and seek medical assistance.

Unit 5.3 Prac 2 Constructing fossils

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	Yes		
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Liquid waste may be poured down the drain. Animal waste may be disposed of in the normal rubbish.

Assessor/s: ______________________________ **Date:** __________________ **Earliest MSDS expiry date:** __________________

Notes:

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Heading

Apply to all pracs requiring the use of Bunsen burners and/or matches

Description of procedure/requirements

Lighting of, and use of, Bunsen burners and matches.

HAZARDOUS substance as classified by ASCC criteria

Reactant substance	Dangerous good	Hazard category	Risk phrases	Safety phrases	MSDS issue
Gas – mains supply (methane) gas	2 Flammable Gas 		**R12 –** Extremely flammable. **R20 –** Harmful by inhalation. **R33 –** Danger of cumulative effects.	**S44 –** If you feel unwell, contact a doctor or Poisons Information Centre immediately (PH 131126) (show the label if possible).	
Matches	4.1		Extremely flammable.	Wear suitable protective clothing and glasses. Store away from naked flames, sparks and ignition sources.	

Other hazards and safety considerations

Ensure the Bunsen burner is on a heatproof mat and the area is clear of flammable items.
Always use the safety flame when the Bunsen burner is lit, but not in use.
When heating test tubes, ensure they point away from people and equipment.
Use tongs or heatproof gloves to handle hot items. Place hot items on a heatproof mat to cool.
Beware of the scald risk associated with hot liquids. Where possible, allow to cool prior to moving.
In the case of a gas tap being inadvertently left on, remove ignition sources, ventilate the area and remove personnel as required.
Allow all equipment to cool prior to packing away.

Heating

Staff must be trained in location and use of firefighting equipment. Staff must know the location of safety cut-off switches, especially for the gas supply.

Protective measures

Lab coat	Glasses	Gloves	Fume cupboard	Other
Yes	Yes	—	—	
Tie back long hair. Wipe bench/wash hands on completion of prac.				

Disposal of wastes

Allow matches to cool on an inflammable surface prior to discarding in the bin.

Assessor/s: ______________________________ **Date: ___________________** **Earliest MSDS expiry date: ___________________**

Notes
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1: Chemical and nuclear reactions

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
1.1.1	Studying a reaction	magnesium strips 1 M sulfuric acid	**Product** magnesium sulfate ($MgSO_4$) solution **Product** hydrogen (H_2) gas (very small volume) *Equipment:* large beaker, small filter funnel, 100 mL measuring cylinder, cling wrap, gloves, lab coat, safety glasses	Minimise the volumes of acid provided in the class sets. **Hint**: Consider modifying this prac so smaller volumes of acid are used or the inverting of cylinders of acid is unnecessary. Gas syringes or gas collection apparatus connected with tubing to a stoppered flask may give suitable results. 1 M hydrochloric acid is less irritating to skin and eyes and will produce suitable results.	**Refer to Risk Assessment:** **RA 1.1.1: Studying a reaction** Lab coat/safety glasses. Gloves. Wash hands after prac. Wipe benches. Tie back long hair.
1.1.2	Conservation of mass	—	solid calcium carbonate, 0.5 M hydrochloric acid **Product** calcium chloride ($CaCl_2$) (aqueous) **Product** carbon dioxide (CO_2) gas *Equipment*: electronic balance, 200 mL conical flask, balloon, spatula, 100 mL measuring cylinder, lab coat, safety glasses	**Adaptation**: Calcium carbonate can be dispensed into a balloon (a tray will contain spills; alternatively, provide balloons containing calcium carbonate). The balloon is then carefully placed onto the flask containing the acid. Weigh the entire system. Allow the calcium carbonate from the balloon to drop into the flask. Reweigh. This method ensures a 'closed system' from the beginning of the reaction. **Hint**: Cling wrap makes a great temporary cover for balances to protect from acid spills.	**Refer to Risk Assessment:** **RA 1.1.2: Conservation of mass** Lab coat/safety glasses. Gloves. Wash hands after prac. Wipe benches. Tie back long hair.

1: Chemical and nuclear reactions

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
1.1.3	Rates of reactions 1	magnesium strips, hydrogen peroxide (H_2O_2) 20 volume (6%), manganese dioxide	1 M hydrochloric acid (3.7%) **Product** magnesium chloride ($MgCl_2$) solution **Product** hydrogen (H_2) gas (very small volume) **Product** oxygen (O_2) gas *<u>Equipment</u>:* ice, stopwatch, spatula, 4 test tubes, test tube rack, 10 mL measuring cylinder, two 100 mL beakers	**Note**: 20 volume (6%) is a suitable concentration for hydrogen peroxide (H_2O_2). Manganese dioxide is insoluble in water and cannot be washed down the drain.	**Refer to Risk Assessment:** **RA 1.1.3: Rates of reactions 1** Lab coat/safety glasses. Gloves. Wash hands after prac. Wipe benches. Tie back long hair.

1: Chemical and nuclear reactions

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
1.1.4	Rates of reactions 2	—	marble chips (large and small), powdered calcium carbonate, dilute hydrochloric acid (2 M) (7%) **Product** calcium chloride ($CaCl_2$) (aqueous) **Product** carbon dioxide (CO_2) gas *<u>Equipment</u>:* stopwatch, spatula, 4 test tubes, test tube rack, 10 mL measuring cylinder, electronic balance	**Note**: 2 M is a suitable concentration for the dilute hydrochloric acid. **Hint**: Cling wrap makes a great temporary cover for balances to protect from acid spills. Experiments designed by the students, should be assessed by the teacher before carrying them out	**Refer to Risk Assessment:** **RA 1.1.4: Rates of reactions 2** Lab coat/safety glasses. Gloves. Wash hands after prac. Wipe benches. Tie back long hair.

1: Chemical and nuclear reactions

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
1.1.5	Reaction rate—effect of catalysts and enzymes	hydrogen peroxide solution (H_2O_2) 20 volume (6%), manganese(IV) dioxide	small piece of fresh liver, small piece of apple or potato **Product** water (H_2O) **Product** oxygen (O_2) gas *Equipment:* 4 test tubes, test tube rack, wax taper, safety glasses	**Note**: 20 volume (6%) is a suitable concentration for hydrogen peroxide (H_2O_2). Beware of flames. Manganese dioxide is insoluble in water and cannot be washed down the drain.	**Refer to Risk Assessment:** **RA 1.1.5: Reaction rate—effect of catalysts and enzymes** Lab coat/safety glasses. Gloves. Wash hands after prac. Wipe benches. Tie back long hair.
1.2.1	Complete and incomplete combustion	natural gas, matches, kerosene, ethanol	candle *Equipment:* Pasteur pipette, kerosene with wick, lab coat, safety glasses, heatproof mat, watch-glass	Gas/matches/flame—heating: burning of flammable substances. Beware of flames and fire risk. Remove flammable items (including bottles of flammable liquids) from the vicinity. Ensure that there is good ventilation or use a fume cupboard. Burn risk—hot watch-glass: use tongs or allow cooling.	**Refer to Risk Assessment:** **RA: Heating** **RA 1.2.1: Complete and incomplete combustion** Lab coat/safety glasses. Good ventilation (or fume cupboard). Heatproof mat. Tongs. Tie back long hair. Wash hands. Wipe benches.

1: Chemical and nuclear reactions

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
1.2.2	Corrosion of iron	magnesium ribbon, natural gas, matches	5 iron nails (not galvanised), copper wire, salt solution (sodium chloride), distilled water *Equipment*: fine sandpaper or steel wool, 4 test tubes, test tube rack, Bunsen burner, bench mat, 250 mL beaker, peg or tongs, marking pen	Risks minimised by using short lengths of magnesium ribbon.	**Refer to Risk Assessment:** **RA 1.2.2 Corrosion of iron** Lab coat/safety glasses. Tie back long hair.
1.2.3	Observing iron hydroxides	1 M sodium hydroxide (NaOH) (4%)	0.1 M iron(II) chloride ($FeCl_2$) solution, 0.1 M iron(III) chloride ($FeCl_3$) solution **Product** iron(II) hydroxide (precipitate) **Product** iron(III) hydroxide (precipitate) *Equipment*: Test tube rack, 2 test tubes, Pasteur pipette	Dispense the solutions in dropping bottles. Iron(II) chloride ($FeCl_2$) solution should be prepared fresh.	**Refer to Risk Assessment:** **RA 1.2.3: Observing iron hydroxides** Lab coat/safety glasses. Gloves. Wash hands after prac. Wipe benches. Tie back long hair.

1: Chemical and nuclear reactions

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
1.2.4	Anodised aluminium	natural gas, matches, 2 M sulfuric acid	piece of aluminium, aluminium foil, detergent, fabric dye solution *<u>Equipment</u>:* safety glasses, two 250 mL beakers, tongs, tissues, 12 V power pack with wires and alligator clips, retort stand, bosshead and clamp, Bunsen burner or hot plate, tripod, gauze mat, bench mat	Check MSDS for hazard status of fabric dye solution. Gas/match/flame—heating: boiling water. Beware of flames/fire and hot items/burn risk. The foil over the beaker is part of the circuit; do not touch it when the power is on. It also minimises the risk of splatters. If acid comes into contact with other equipment, wipe up immediately, diluting with water if possible.	**Refer to Risk Assessment:** **RA: Heating** **RA 1.2.4: Anodised aluminium** Lab coat/safety glasses. Gloves. Heatproof mat. Tongs. Tie back long hair. Wash hands. Wipe benches.
1.3.1	Half-life is sweet	—	*<u>Equipment</u>:* Packet of M&Ms (or Skittles), a clean tray or sheet of A3 paper, a clean jar	**Suggestion**: Use 128 double-sided items, such as 5-cent coins, instead of sweets.	No safety equipment required.

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2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.1.1	Metallic crystals	—	0.1 M silver nitrate ($AgNO_3$) (1.7%), thick copper wire, 4% sodium thiosulfate (spill clean-up) **Product** silver (Ag) *Equipment*: 250 mL glass beaker, spatula, microscope slide, microscope, gloves, safety glasses, lab coat	Silver nitrate stains: spills can be decolourised with 4% sodium thiosulfate. Shattering of glassware. Suggestion: use 100 mL conical flask instead of a beaker.	**Refer to Risk Assessment: RA 2.1.1: Metallic crystals** Lab coat, safety glasses. Gloves. Wash hands. Wipe benches. Tie back long hair.
2.1.2	How much is it worth?	—	*Equipment*: $2, $1, 50c, 20c, 10c and 5c coins, the business section from a recent newspaper (not Monday), access to an electronic scale	No safety advice.	No safety equipment required.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.2.1	Chocolate chip mining	—	Chocolate chip cookies *Equipment*: access to electronic scales, access to a range of laboratory and non-laboratory equipment such as sieves, beakers, measuring cylinders etc.	The experiments designed by the students should be assessed by the teacher before carrying them out. Food items used in a laboratory must not be eaten. Discard cookie remains via the school waste system.	Lab coat.
2.2.2	Froth flotation	kerosene	sand, iron filings (1 part filings to 5 parts sand), detergent, water *Equipment*: large test tube, rubber stopper to fit test tube, spatula	To minimise the risk of students inhaling fumes/vapours, carry out this experiment in a fume cupboard. Sand and iron filings—contact with eyes poses a mechanical irritant risk.	**Refer to Risk Assessment:** **RA 2.2.2: Froth flotation** Lab coat/safety glasses. Gloves. Fume cupboard or good ventilation. Tie back long hair. Wash hands. Wipe benches.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.2.3	Extracting copper by electrolysis	natural gas, matches, 1 M sulfuric acid, black copper oxide	**Product** acidic copper(II) sulfate ($CuSO_4.5H_2O$) (weak solution) **Product** copper deposits (Cu) solid *Equipment*: spatula, 50 mL beaker, glass stirring rod, Bunsen burner, tripod, gauze mat, heatproof mat, 12 V power pack, globe, electrodes, connecting leads (a conductivity kit is ideal), filter paper or paper towel	Gas/match/flame—heating: warming liquids. Beware of flames/fire and hot items/burn risk. Use heatproof gloves/tongs to handle hot items and place them on a heatproof surface to cool.	**Refer to Risk Assessment:** **RA: Heating** **RA 2.2.3: Extracting copper by electrolysis** Lab coat/safety glasses. Gloves. Heatproof mat. Heatproof gloves/tongs. Tie back long hair. Wash hands. Wipe benches.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.2.4	Extracting copper by roasting	natural gas, matches, black copper oxide	charcoal **Product** copper (Cu) **Product** carbon dioxide (CO_2) gas *Equipment*: crucible with cover, ring stand, clay triangle, Bunsen burner, spatula, filter paper, watch-glass, balance, tongs	Gas/match/flame—heating crucible. Beware of flames/fire and hot items/burn risk. Instruct students to handle the hot crucible with tongs.	**Refer to Risk Assessment:** **RA: Heating** **RA 2.2.4: Extracting copper by roasting** Lab coat/safety glasses. Gloves. Heatproof mat. Heatproof gloves/tongs. Tie back long hair. Wash hands. Wipe benches.
2.3.1	Identifying plastics	matches, nail polish remover, methylated spirits, turpentine	dilute hydrochloric acid (suggested concentration 1 M), detergent *Equipment*: labelled pieces of polythene (each about 2 × 1 cm), polystyrene, PVC, Perspex, nylon, 'mystery' plastics, dissection board or bench mat, scissors, 250 mL beaker, tongs, access to meths burner set up in fume hood	The burning of plastic produces toxic fumes. Carry out this experiment in a fume cupboard and avoid inhalation at all times. Gas/match/flame—heating: burning plastic. Beware of flames, hot plastic and fire risk.	**Refer to Risk Assessment:** **RA: Heating** **RA 2.3.1: Identifying plastics** Lab coat/safety glasses. Fume cupboard. Bench mat. Tongs. Tie back long hair. Wash hands. Wipe benches.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.3.2	Making casein plastic	natural gas, matches Borax (for the extension)	full-cream milk, vinegar, water **Product** casein *Equipment*: Bunsen burner, bench mat, tripod, gauze mat, 100 mL measuring cylinder, two 250 mL beakers, thermometer, glass stirring rod, elastic band, coarse cloth for straining, paper towel or filter paper, assorted moulds (i.e. bottle caps, moulded chocolate trays), fine sandpaper, tongs	Gas/match/flame—heating: warming milk. Beware of flames/fire and hot items/burn risk. Use spirit thermometers rather than mercury thermometers.	**Refer to Risk Assessment:** **RA: Heating** **RA2.3.2: Making casein plastic** Lab coat/safety glasses. Bench mat. Tongs. Tie back long hair. Wash hands. Wipe benches.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.4.1	Making nylon: teacher demonstration	1,6-diaminohexane, anhydrous sodium carbonate, sebacoyl chloride or adipoyl chloride, cyclohexane Product hydrogen chloride gas > 5%	**Product** nylon *Equipment*: two 250 mL beakers, tweezers, glass stirring rod	This demonstration must be done in a fume cupboard. To eliminate the presence of the concentrated chemicals in the class environment, use freshly prepared solutions made in the preparatory area. Nylon samples can be rinsed in methylated spirits and dried in a fume cupboard. Have some prepared samples that can be passed around to students.	**Refer to Risk Assessment:** **RA 2.4.1:** Making nylon. Lab coat/safety glasses. Gloves. Fume cupboard. Tie back long hair. Wash hands. Wipe benches.
2.4.2	Identifying fibres	natural gas, matches	*Equipment*: labelled samples of fabric (wool, cotton, linen, rayon, nylon, polyester), microscope, microscope slide and coverslip, pins or tweezers, metal tongs, bench mat	Burning fabrics may produce dangerous fumes. Use a fume cupboard or ensure the area is well ventilated. Avoid inhalation of any fumes or smoke. Beware of flames/fire and melted plastic/hot cinders, burn risk. **Hint**: Extinguish samples by plunging them into a beaker of water.	**Refer to Risk Assessment:** **RA:** Heating Lab coat/safety glasses. Bench mat. Tongs. Fume cupboard (optional). Beaker of water. Tie back long hair.
2.4.3	Investigating fibres	—	Student design.	The experiments designed by the students should be assessed by the teacher before carrying them out.	Lab coat/safety glasses. Wash hands. Wipe benches.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
Science Focus	Making molecules	—	*Equipment*: molecular model-building kit (alternatively, use plasticine of different colours)	No safety advice.	No safety equipment required.
2.5.1	Make soap	natural gas, matches, 6 M sodium hydroxide, kerosene	saturated solution of sodium chloride, olive oil or coconut oil *Equipment*: 3 test tubes, rubber stopper, 400 mL beaker, 100 mL beaker, 250 mL beaker, hot plate (preferably) or a Bunsen burner, bench mat, tripod, gauze mat, filter paper or paper towel	The soap contains corrosive sodium hydroxide. Do not touch or use the soap produced. Gas/match/flame—heating: liquids (including corrosive sodium hydroxide solution). Beware of flames/fire and hot items/burn risk. Use tongs to handle hot items and place them on a heatproof surface to cool. **Hint**: To minimise the risk of students inhaling fumes/vapours, provide one bottle of kerosene in the fume cupboard for students to take turns using it.	**Refer to Risk Assessment:** **RA:** Heating **RA 2.5.1:** Make soap Lab coat/safety glasses. Fume cupboard. Gloves. Heatproof gloves. Heatproof mat. Tongs. Tie back long hair. Wash hands. Wipe benches.

2: Materials

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
2.5.2	How hard is it?	—	dilute magnesium sulfate solution, calcium hydrogen carbonate solution, suspension of calcium carbonate in water, small chips of bath soap, shampoo, detergent, distilled water, *Equipment*: 5 test tubes, test tube rack, rubber stoppers to fit test tubes	Suggested concentration for dilute magnesium sulfate is 0.1 M.	Lab coat/safety glasses. Wash hands. Wipe benches.
2.5.3	Powder and liquid laundry detergents		Student design.	The experiments designed by the students should be assessed by the teacher before carrying them out.	Lab coat/safety glasses. Wash hands. Wipe benches.

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3: Genetics

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
3.1.1	Observing mitosis	—	*Equipment:* microscope, prepared microscope slide showing onion root tips	Instruct students on the use and care of microscopes. Warn students that incorrect focusing techniques may result in broken cover slips and slides. Handle broken slides carefully and avoid sharp areas. Discard them into a glass or sharps bin.	Wash hands. Wipe benches. Tie back long hair.
3.1.2	Modelling meiosis	—	*Equipment:* 3 pieces (1 short, 1 medium and 1 long) of pipe cleaner, rolls of plasticine or jelly snakes of one colour, 3 more pieces (1 short, 1 medium and 1 long) of another colour to represent another chromosome, large sheet of paper for sketching cells	If the plasticine is too hard, place on paper towel and microwave for very brief time (too long and it melts).	Wash hands. Wipe benches. Tie back long hair.

3: Genetics

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
3.1.3	Modelling inheritance	—	*Equipment*: 60 counters or beads or buttons or jelly beans (thirty each of two different colours), two paper bags for each group	Food should not be eaten in a laboratory. If the jelly beans are to be eaten later, the handling and eating of the jelly beans should be under controlled hygienic conditions. Instruct students to wash hands before touching jelly beans and ensure that the jelly beans do not come into contact with potentially contaminated surfaces.	Wash hands. Wipe benches. Tie back long hair.
3.2.1	Dominant or recessive?	—	*Equipment*: 25 people to survey	Students may unwittingly discover evidence of their parentage which may be a surprise in some circumstances.	No safety equipment required.
3.2.2	Continuous variation	—	*Equipment*: tape measure or metre rulers	No safety notes required.	No safety equipment required.
3.2.3	Vegetable babies	—	*Equipment*: potato, onion, sultanas, fresh peas, slices of carrot and parsnip, long and short sticks of celery, toothpicks	The juice of onions may cause skin and eye irritation in some people. Instruct students to take care when handling sharp objects and to cut away from themselves.	Wash hands. Wipe benches. Tie back long hair.

3: Genetics

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
3.3.1	Modelling DNA	—	Student design.	Experiments designed by the students should be assessed by the teacher before carrying them out.	Wash hands. Wipe benches. Tie back long hair.
3.3.2	Extracting DNA	ice-cold 95% ethanol 	meat tenderiser, wheatgerm, dishwashing detergent *Equipment:* 250 mL beaker, 15 mL test tube, test tube rack, measuring cylinders (10 mL and 100 mL), thermometer, stirring rod, water bath, compound microscope	Use spirit thermometers rather than mercury thermometers. Do not use flammable liquids (ethanol) near ignition sources.	**Refer to Risk Assessment:** **RA 3.3.2: Extracting DNA** Lab coat/safety glasses. Gloves. Tie back long hair. Wash hands. Wipe benches.

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4: Health and disease

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
4.1.1	Orange juice and vitamin C	—	starch suspension, iodine solution, vitamin C solution (dissolve vitamin C tablet or powder in 50 mL of water), three different brands of orange juice, sodium thiosulfate 4% *<u>Equipment</u>:* 4 test tubes, test tube rack, 200 mL beaker, stirring rod, dropper, lab coat, safety glasses, gloves	Iodine solution stains; iodine spills can be decolourised with 4% sodium thiosulfate. Gloves can be provided. Waste can be flushed to the sewer with plenty of water. Small quantities of unreacted iodine should be decolourised prior to disposal via the sewer.	**Refer to Risk Assessment: RA: 4.1.1 Orange juice and vitamin C** Lab coat, gloves, safety glasses. Tie back long hair. Wash hands. Wipe benches.
4.3.1	Making yoghurt	—	new UHT Milk, natural yoghurt with live bacteria *<u>Equipment</u>:* 250 mL beaker, spoon, cling wrap, incubator, lab coat	Food items prepared in the laboratory must not be eaten.	Lab coat. Wash hands. Wipe benches. Tie back long hair.

4: Health and disease

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
4.3.2	Micro-organisms around you	natural gas, matches	*Equipment*: 5 Petri dishes containing nutrient agar (agar plates), wire loops, heatproof mat, Bunsen burner, masking tape, safety glasses, lab coat, gloves	Gas/match/flame—Beware of flames/fire and hot items/burn risk. Incubation of microbes presents a potential pathogen risk. **Agar plates should NOT be inoculated with human samples or from areas such as bathrooms, or soil**. Agar plates can be purchased or prepared on site. Inoculated agar plates should be taped shut. **Lids must not be removed from agar plates** or opened after this time. Incubate at no higher than 35°C. Technical notes: Bacteria appear in ~1–2 days, fungi ~3–4 days. Discarded agar plates should be sterilised prior to disposal. Sterilised plates can be discarded via normal school waste. Technicians should be familiar with good hygiene and standard sterile techniques when working with microbes.	**Refer to Risk Assessment: RA: Heating** Lab coat. Disinfect hands. Disinfect benches. Safety glasses, gloves. Tie back long hair.
4.4.1	Modelling the transmission of disease	phenolphthalein indicator	sodium hydroxide 0.1 M, hydrochloric acid 0.1 M *Equipment*: one test tube per person, one eye-dropper (Pasteur pipette) per person	Phenolphthalein indicator is highly flammable.	**Refer to Risk Assessment: RA 4.4.1: Modelling the transmission of disease** Lab coat/safety glasses. Gloves. Wash hands. Tie back long hair.

4: Health and disease

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
4.4.2	Effectiveness of antiseptics	Check antiseptic MSDS	4 different antiseptics (such as tea-tree oil, eucalyptus oil, commercial antiseptics) *Equipment*: 5 Petri dishes containing nutrient agar, cotton buds, masking tape, safety glasses, gloves	Incubation of microbes presents a potential pathogen risk. Agar plates can be purchased or prepared on site. Inoculated agar plates should be taped shut. **Lids must not be removed from agar plates** or opened after this time. Incubate at no higher than 35°C. Technical notes: Bacteria appear in ~1–2 days, fungi ~3–4 days. Discarded agar plates should be sterilised prior to disposal. Sterilised plates can be discarded via normal school waste. Technicians should be familiar with good hygiene and standard sterile techniques when working with microbes. Check MSDS for hazard status of antiseptics used.	**Refer to Instructions:** **Agar preparation and waste decontamination** Lab coat/safety glasses. Gloves or disinfect hands. Tie back long hair.

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5: Evolution

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
5.2.1	Natural selection	—	*Equipment:* 100 green toothpicks (to represent green worms), 100 reddish-brown toothpicks (to represent brown worms), a grassy area and a brown earth area	Adhere to school safety procedures for students operating within the school grounds. Hint: Colour toothpicks using food colouring.	Wash hands. Wipe benches. Tie back long hair.
5.3.1	Studying fossils	—	*Equipment:* access to a fossils kit	Some details may be difficult to see with the naked eye. A hand lens or stereo microscope may assist in viewing the fossils.	Wash hands. Wipe benches. Tie back long hair.
5.3.2	Constructing fossils	—	0.5% bleach solution (sodium hypochlorite), detergent *Equipment:* chicken or rabbit carcass, cooking implements (e.g. saucepan, hotplate), bench mat, 250 mL beaker, plaster, mud or clay	Beware of hot objects. Instruct students to cut away from themselves and to keep fingers out of cutting path. Cuts, sores or broken skin should be covered. Gloves may be worn. Instruct students to wash any animal blood/tissue off skin immediately using antibacterial hand wash.	**Refer to Risk Assessments:** **RA: Heating** **RA: 5.3.2 Constructing fossils** Lab coat/safety glasses. Gloves. Wash hands. Wipe benches.

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5: Evolution

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6: Motion

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
6.1.1	They've got the runs!	—	*Equipment*: stopwatches (one per person if possible), chalk or other markers, access to a tape measure	Running on a grassed area will minimise the risk of injury.	No safety equipment required.
6.1.2	Ticker-timer experiment	—	*Equipment*: AC ticker-timer, carbon paper circles, tape, power pack, scissors, ruler, graph paper, paper glue	Instruct students on the safe use of power supplies. Do not allow electrical equipment to come into contact with liquid.	Wash hands. Wipe benches. Tie back long hair.
6.1.3	Measuring speed (DYO)	—	*Equipment*: simple equipment such as tape measures and stopwatches or use datalogging equipment with appropriate sensors (light gates, ultrasonic sensors, microphones)	Experiments designed by students should be assessed by the teacher before carrying them out.	Wash hands. Wipe benches. Tie back long hair.
6.1.4	Chain reaction	—	*Equipment*: stopwatch, piece of paper, pen	Ensure that the area is clear of tables and chairs and any other potential trip hazards.	No safety equipment required.
6.1.5	Driving reaction times	—	*Equipment*: 30 cm ruler, table, chair, step stool, access to a calculator and the Internet	Ensure that the chair and table are stable. A student should hold the chair in place. Provide a secure step stool and assistance to students for climbing onto the table.	No safety equipment required.

6: Motion

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
6.2.1	Braking distances	—	*Equipment*: access to a calculator	No safety notes required.	No safety equipment required.
6.2.2	Acceleration and datalogging (DYO)	—	*Equipment*: datalogging equipment and sensors such as light gates and ultrasonic sensors	Experiments designed by students should be assessed by the teacher before carrying them out.	No safety equipment required.
6.2.3	Construct an accelerometer	—	water *Equipment*: glass jar with lid, sticky tape, cotton thread, paper clip	Ensure that the bench is clear of objects.	No safety equipment required.
6.3.1	Crash test dummies	—	plasticine or play dough, talcum powder *Equipment*: dynamics trolley, ramp, ruler, chalk, solid barrier such as a brick or wall, sticky tape	If the plasticine is too hard, place on paper towel and microwave for a very brief time (too long and it melts).	Wash hands. Wipe benches. Tie back long hair.
6.3.2	Inertial eggs	—	*Equipment*: 1 hard-boiled unpeeled egg, 1 fresh raw egg, smooth desk, pen or pencil	Ensure floors do not become a slip hazard due to broken eggs. Provide equipment to immediately clean up or isolate areas where there is broken egg.	Wash hands. Wipe benches. Tie back long hair.

6: Motion

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
6.3.3	The yolk's on you! (DYO)	—	one egg per student or light bulb for vegans *Equipment*: per student: one piece of cardboard of roughly A3 dimensions, sufficient string, sticky tape, staples, glue or other fixing to hold it together	Ensure floors do not become a slip hazard due to broken eggs. Provide equipment to immediately clean up or isolate areas where there is broken egg.	Wash hands. Wipe benches. Tie back long hair.
6.4.1	*F* = *ma*	—	*Equipment*: dynamics trolley, 50 g masses, pulley and clamp, block and clamp, string or fishing line, ruler, access to electronic balance or beam balance, a way of measuring acceleration (a ticker-timer with tape and carbon paper circles *or* stopwatch *or* appropriate light gates and datalogging equipment to measure acceleration)	Falling weights may cause physical injury. Monitor your set-up carefully.	Wash hands. Wipe benches. Tie back long hair.

6: Motion

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
6.5.1	Water rockets	—	*Equipment:* 1.25 L plastic soft drink bottle, champagne cork (other corks or rubber stoppers may do, but the fit must be tight), sandpaper, petroleum jelly, safety glasses, access to bike pump or electric pump, access to power drill with fine drill bit, access to hacksaw, retort stand, clamp and ring	Minimise the risks associated with the use of power tools and prepare the stopper assembly for the students. (Reuse each year.) For greater control, consider performing this task in teams or as a demonstration. Launches *must* be performed outside. Monitor the surrounding area and check that there is no risk of injury to people or other items prior to *each* launch. Instruct students on the safe use of a hacksaw.	Safety glasses.
6.5.2	A two-stage rocket	—	*Equipment:* plastic cup, scissors, 2 balloons (1 long, 1 round), tape	Launches should be performed outside. Monitor the proposed flight path and check that there is no risk of injury to people or other items prior to *each* launch.	Safety glasses.
6.6.1	Finding *g* using a ticker-timer	—	*Equipment:* AC ticker-timer and about 2 m tape, G-clamp, 50 g mass, sticky tape, ruler, access to a calculator	Falling weights may cause physical injury. Monitor your set-up carefully.	No safety equipment required.

6: Motion

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Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
6.6.2	Measuring height with a stopwatch!	—	*Equipment:* any small mass that won't break, stopwatch, metre ruler or tape measure, string with mass attached	Falling masses may cause physical injury. Monitor the proposed path of your mass and check that there is no risk of injury to people or other items prior to *each* launch.	No safety equipment required.
6.7.1	Extension of an elastic band	—	*Equipment:* three similar elastic bands, retort stand, bossheads and clamps, 50 g masses, ruler	Falling weights may cause physical injury. Monitor your set-up carefully.	Safety glasses.
6.7.2	Efficiency of a roller coaster	—	*Equipment:* material to make a track (clear plastic tubing is ideal), ball bearing or marble, retort stands, bossheads and clamps, metre ruler, access to electronic scales	Beware of projectile objects. Wear safety glasses.	Safety glasses.
6.7.3	Ball bounce (DYO)	—	*Equipment:* a variety of balls (tennis, sqush, superball, basketball), metre ruler	Beware of possible eye injury. Do not stand over the ball while bouncing it.	Safety glasses.

*** = No Safety Notes required**

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6: Motion

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7: Electricity, electromagnetism and communications technology

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
7.1.1	Simple series and parallel circuits	—	*Equipment*: three globes, connecting wires, switch, power pack	Power supplies should be checked for damaged leads and malfunction prior to use. Instruct students on the safe use of power supplies. Construct the circuits with the power off. Do not touch the circuits while the power is on.	Tie back long hair.
7.1.2	Measuring voltage and current in circuits	—	*Equipment*: three globes, connecting wires, switch, power pack, ammeter, voltmeter	Power supplies should be checked for damaged leads and malfunction prior to use. Instruct students on the safe use of power supplies. Construct the circuits with the power off. Do not touch the circuits while the power is on. Teacher should check before starting the activity.	Tie back long hair.
7.1.3	Ohm's law	—	*Equipment*: two resistors of known (but different) resistance value, connecting wires, switch, 12 volt power pack, ammeter, voltmeter	Power supplies should be checked for damaged leads and malfunction prior to use. Instruct students on the safe use of power supplies. Construct the circuits with the power off. Do not touch the circuits while the power is on. Teacher should check before starting the activity.	Tie back long hair.
7.2.1	Oersted's experiment and the electromagnet	—	*Equipment*: power supply, switch, insulated copper wire (1 m), tape, switch, small compass, cardboard tube, large iron nail	Check power supplies for damaged leads and malfunction prior to use. Instruct students on safe use of power supplies. Construct the circuits with the power off. Do not touch the circuits while the power is on.	Tie back long hair.

7: Electricity, electromagnetism and communications technology

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
7.2.2	Force on a wire	—	aluminum foil *Equipment*: small sheet of cardboard, scissors, sticky tape, retort stand, bosshead and clamps, wires with alligator clips, switch, power pack with circuit breaker/auto cutoff, horseshoe magnet	Instruct students on the safe use of power supplies. Construct the circuits with the power off. Do not touch the circuits while the power is on.	Tie back long hair.
7.2.3	A simple electric motor	—	1.5 metres of enamelled copper wire *Equipment*: 1.5 volt battery (‘D’ size), Blu-Tack, 2 rubber bands, 2 paperclips, small but strong disc magnet or a bar magnet, emery paper, pliers (optional)	Keep magnets away from any electronic devices such as laptop computers, digital balances and digital cameras.	Tie back long hair.
7.2.4	A simple generator	—	*Equipment*: solenoid, bar magnet, connecting wires, galvanometer or microammeter	Keep magnets away from any electronic devices such as laptop computers, digital balances and digital cameras.	Tie back long hair.

7: Electricity, electromagnetism and communications technology

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
7.3.1	Waves in a slinky	—	*Equipment:* a slinky, masking tape, stopwatch, floor or corridor space in which to generate waves between points 5–10 m apart	Minimise tangles: Instruct students on the care of slinkies.	Tie back long hair.
7.3.2	Other waves on the slinky	—	*Equipment:* a slinky, masking tape, stopwatch, floor or corridor space in which to generate waves between points 5–10 m apart	Minimise tangles: Instruct students on the care of slinkies.	Tie back long hair.
7.3.3	Polarised!	—	*Equipment:* two polarising filters, window or other light source	Do not use the Sun as a light source. Looking directly at the Sun may damage your eyes.	Tie back long hair.
7.4.1	Locating another mobile phone (DYO)	—	*Equipment:* mobile phone, land line phone, stopwatch	No safety notes required.	Tie back long hair.

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7: Electricity, electromagnetism and communications technology

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8: Global issues

The Safety Notes in *Science Focus 4* are designed to provide a quick reference guide for teachers to assess the requirements and Health and Safety considerations for each practical.

Prac	Name	HS/DG	Not HS	Other hazard/precautions/hints	Recommended safety requirements
8.2.1	The greenhouse effect	—	*Equipment*: small cardboard box (such as a shoe box), 2 thermometers or temperature probes and datalogging equipment, sheet of glass or polythene plastic, lamp	Use spirit thermometers rather than mercury thermometers. Instruct students to exercise caution when handling the lamp as it will become hot when left on for a period of time.	No safety equipment required.
8.2.2	Icebergs	—	*Equipment*: 4–6 ice cubes, cold water, large beaker, identical beaker containing frozen water as shown in Figure 8.2.15	Ensure that water and ice are contained and floors do not become a slip hazard.	Wash hands. Wipe benches. Tie back long hair.
8.4.1	Bioaccumulation	—	*Equipment*: 1 counter, marble, Lego block or some other object per student	Requirement: A defined and cleared area where students can run and not get hurt if they fall (e.g. on grass or carpet).	No safety equipment required.

*** = No Safety Notes required** **DG = Dangerous good**

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Technician's Checklist: Chemicals Used

(Hazardous classification according to ASCC (NOHSC); check information against your suppliers current MSDS) (d) = Teacher Demonstration

HS	Substances used	DG	Hazard category	MSDS issue	Req'd for Prac
Yes	Adipoyl chloride (can be used instead of sebacoyl chloride)	8	Corrosive		2.4.1
No	Agar, nutrient	None allocated	–		4.3.2
No	Aluminium/foil (Al)	None allocated	–		1.2.4, 7.2.2
Yes	Antiseptics (four different)	Need to check MSDS	–		4.4.1
No	Bleach solution (sodium hypochlorite) 5%	None allocated	–		5.3.2
No	Bleach solution (sodium hypochlorite) 0.5%	None allocated	–		5.3.2
Yes	Borax (sodium tetraborate) ($Na_2B_4O_7{\cdot}10H_2O$)	6.1	Toxic		2.3.2
No	calcium carbonate ($CaCO_3$) solid	None allocated	–		1.1.2, 1.1.4, 2.5.2
No	Calcium carbonate ($CaCO_3$) suspension	None allocated	–		2.5.2
No	Calcium hydrogen carbonate solution	None allocated	–		2.5.2
No	Charcoal powder (C) activated	None allocated	–		2.2.4
No	Coconut oil	None allocated	–		2.5.1
Yes	Copper(II) oxide (CuO) solid	None allocated	Harmful		2.2.3, 2.2.4
No	Copper wire (Cu)	None allocated	–		1.2.2, 2.1.1
Yes	Cyclohexane (C_6H_{12}) liquid	3	Highly flammable, harmful, dangerous for the environment		2.4.1

Technician's Checklist: Chemicals Used

(Hazardous classification according to ASCC (NOHSC); check information against your suppliers current MSDS) (d) = Teacher Demonstration

HS	Substances used	DG	Hazard category	MSDS issue	Req'd for Prac
No	Detergent	None allocated	–		1.2.4, 2.2.2, 2.3.1, 3.3.2, 5.3.2
Yes	1,6-diaminohexane ($C_6H_{16}N_2$) solid	8	Harmful		2.4.1
Yes	Ethanol (C_2H_5OH) or methylated spirits	3	Highly flammable		1.2.1, 4.4.1
Yes	Ethanol 95% (C_2H_5OH) ice-cold	3	Highly flammable		3.3.2
No	Fabric dye solution	None allocated			1.2.4
Yes	Hydrochloric acid (HCl) 32%–concentrated Conc>=25%: C; R34; R37 >=10%Conc<25%: Xi; R36/37/38	8	Corrosive		1.1.2, 1.1.3, 1.1.4, 2.3.1, 4.4.1
No	Hydrochloric acid (HCl) (7%) 2.0 M	None allocated	–		1.1.4
No	Hydrochloric acid (HCl) (3.7%) 1.0 M	None allocated	–		1.1.3, 2.3.1
No	Hydrochloric acid (HCl) (1.9%) 0.5 M	None allocated	–		1.1.2
No	Hydrochloric acid (HCl) (0.37%) 0.1 M	None allocated	–		4.4.1
Yes	35% (120 volume) or 30% (100 volume) hydrogen peroxide (H_2O_2) liquid	5.1/8	Corrosive, oxidising		1.1.3, 1.1.5
No	Hydrogen peroxide (H_2O_2) 20 volume (6%)	None allocated	–		1.1.3, 1.1.5
Yes	Iodine (I_2) (iodine crystals)	None allocated	Harmful, dangerous for the environment		4.1.1
No	Iodine solution (I_2) (potassium iodide/iodine solution)	None allocated	–		4.1.1

Technician's Checklist: Chemicals Used

(Hazardous classification according to ASCC (NOHSC); check information against your suppliers current MSDS) (d) = Teacher Demonstration

HS	Substances used	DG	Hazard category	MSDS issue	Req'd for Prac
Yes	Iron(II) chloride tetrahydrate ($FeCl_2.4H_2O$) solid	8	Corrosive, harmful, irritant		1.2.3
No	Iron(II) chloride tetrahydrate, 0.1 M ($FeCl_2.4H_2O$) (2%)	None allocated	–		1.2.3
Yes	Iron(III) chloride hexahydrate ($FeCl_3.6H_2O$) solid	None allocated	Harmful, irritant		1.2.3
No	Iron(III) chloride hexahydrate 0.1 M ($FeCl_3.6H_2O$) (2.7%)	None allocated	–		1.2.3
No	Iron (Fe) filings	None allocated	–		2.2.2
No	Iron (Fe) nails	None allocated	–		1.2.2
Yes	Kerosene liquid	3	Flammable, harmful, dangerous for the environment		1.2.1, 2.2.2, 2.5.1
No	Laundry detergents, powder and liquid	None allocated	–		2.5.3
No	Magnesium strips/ribbon (Mg)	4.1	Highly flammable		1.1.1, 1.1.3, 1.2.2
No	Magnesium sulfate ($MgSO_4$) solid	None allocated	–		2.5.2
No	Magnesium sulfate ($MgSO_4$) 0.1 M	None allocated	–		2.5.2
Yes	Manganese dioxide (MnO_2) solid	None allocated	Harmful		1.1.3, 1.1.5
No	Marble chips – calcium carbonate ($CaCO_3$) large and small	None allocated	–		1.1.4

Technician's Checklist: Chemicals Used

(Hazardous classification according to ASCC (NOHSC); check information against your suppliers current MSDS) (d) = Teacher Demonstration

HS	Substances used	DG	Hazard category	MSDS issue	Req'd for Prac
No	Meat tenderiser	None allocated	–		3.3.2
Yes	Methylated spirits	3	Flammable		2.3.1
Yes	Mineral turpentine	3	Flammable, harmful, dangerous for the environment		2.3.1
No	Nail polish remover	3	Flammable		2.3.1
No	Nutrient agar	None allocated	–		4.3.2, 4.4.1
No	Olive oil	None allocated	–		2.5.1
No	Petroleum jelly	None allocated	–		6.5.1
No	Phenolphthalein ($C_{20}H_{14}O_4$) solid	None allocated	–		4.4.1
No	Phenolphthalein indicator (0.1% in ethanol)	3	Flammable		4.4.1
No	Plasticine or play dough	None allocated	–		6.3.1
No	Potassium iodide (KI) solid	None allocated	–		4.1.1
Yes	Sebacoyl chloride ($ClOC(CH_2)_8COCl$) liquid	8	Corrosive, harmful		2.4.1
Yes	Silver nitrate ($AgNO_3$) solid	5.1	Corrosive, dangerous to the environment		2.1.1
No	Silver nitrate ($AgNO_3$) 0.1 M (1.7%)	None allocated	–		2.1.1
No	Salt (sodium chloride)	None allocated	–		1.2.2, 2.5.1
No	Sodium chloride (NaCl) saturated solution	None allocated			2.5.1

Technician's Checklist: Chemicals Used

(Hazardous classification according to ASCC (NOHSC); check information against your suppliers current MSDS) (d) = Teacher Demonstration

HS	Substances used	DG	Hazard category	MSDS issue	Req'd for Prac
Yes	Sodium carbonate anhydrous (Na_2CO_3) solid	None allocated	Irritant		2.4.1
No	Sodium chloride (NaCl) solid (salt)	None allocated	–		1.2.2
Yes	Sodium hydroxide (NaOH) solid Conc>=5%: C; R35 >=2%Conc<5%: C; R34 >=0.5%Conc<2%: Xi; R36/38	8	Very corrosive		1.2.3, 2.5.1, 4.4.1
Yes	6 M sodium hydroxide (NaOH) (24%)	8	Very corrosive		2.5.1
Yes	Sodium hydroxide (NaOH) (4%) 1.0 M	8	Corrosive		1.2.3
No	Sodium hydroxide (NaOH) (0.4%) 0.1 M	None allocated	–		4.4.1
No	Sodium thiosulfate ($Na_2S_2O_3$)	None allocated	–		2.1.1, 4.1.1
No	Sodium thiosulfate ($Na_2S_2O_3$) 4%	None allocated	–		2.1.1, 4.1.1
No	Starch	None allocated	–		4.1.1
No	Starch suspension	None allocated	–		4.1.1
No	Steel wool	None allocated	–		1.2.2
Yes	Sulfuric acid (H_2SO_4) (98%) concentrated (Conc>=15%: C; R35 >=5%Conc<15%: Xi; R36/38)	8	Very corrosive		1.1.1, 1.2.4, 2.2.3
Yes	Sulfuric acid (H_2SO_4) 2.0 M (19.6%)	8	Very corrosive		1.2.4
Yes	Sulfuric acid (H_2SO_4) 1.0 M (9.8%)	8	Irritant		1.1.1, 2.2.3
No	Talcum powder	None allocated	–		6.3.1

Technician's Checklist: Chemicals Used

(Hazardous classification according to ASCC (NOHSC); check information against your suppliers current MSDS) (d) = Teacher Demonstration

HS	Substances used	DG	Hazard category	MSDS issue	Req'd for Prac
No	Vinegar	None allocated	–		2.3.2
No	Vitamin C tablets or powder	None allocated	–		4.1.1
No	Vitamin C solution	None allocated	–		4.1.1

Recipes

Chemical	Formula	Molecular weight	Method (review associated prac risk assessment, and safety precautions prior to preparing any solution)
Agar preparation			Refer to instructions: Agar preparation and waste decontamination.
Bleach solution (sodium hypochlorite) 0.5%			Measure 10 mL of household bleach 5% (White King), add distilled water and make up to 100 mL with distilled water.
Calcium carbonate ($CaCO_3$) suspension	$CaCO_3$	100.087	Add half a spatula of calcium carbonate to 100 ml of water and stir.
Calcium hydrogen carbonate solution	$CaHCO_3$		Prepare carbon dioxide by reacting marble chips with 2 M hydrochloric acid and pass into 100 ml of distilled water to make carbonated water. Add 0.1 g of calcium carbonate to carbonated water to make calcium hydrogen carbonate.
Ethanol or methylated spirits	C_2H_5OH	46.08	Supplied as 99–100% or 95%. Decant in a fume hood.

Recipes			
Chemical	**Formula**	**Molecular weight**	**Method (review associated prac risk assessment, and safety precautions prior to preparing any solution)**
Ethanol 95% (C_2H_5OH) Ice-cold	C_2H_5OH	46.08	Decant in a fume hood. May use commercially prepared 95% ethanol or prepare it using absolute alcohol 99–100%. Measure 95 mL of absolute alcohol and add 5 mL of distilled water to it. Leave the solution in freezer.
Hydrochloric acid (7%) 2.0 M	HCl	36.46	The concentrated acid is available in two concentrated solutions 32% and 36%. The 32% is less unpleasant to handle and is suitable for school purposes. Supplied as 32%. Prepare in a fume hood. Measure 195 mL of hydrochloric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water
Hydrochloric acid (HCl) (3.7%) 1.0 M	HCl	36.46	The concentrated acid is available in two concentrated solutions 32% and 36%. The 32% is less unpleasant to handle and is suitable for school purposes. Supplied as 32%. Prepare in a fume hood. Measure 97 mL of hydrochloric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water
Hydrochloric acid (HCl) (1.9%) 0.5 M	HCl	36.46	The concentrated acid is available in two concentrated solutions 32% and 36%. The 32% is less unpleasant to handle and is suitable for school purposes. Supplied as 32%. Prepare in a fume hood. Measure 48.5 mL of hydrochloric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water

Recipes

Chemical	Formula	Molecular weight	Method (review associated prac risk assessment, and safety precautions prior to preparing any solution)
Hydrochloric acid (0.37%) 0.1 M	HCl	36.46	The concentrated acid is available in two concentrated solutions 32% and 36%. The 32% is less unpleasant to handle and is suitable for school purposes. Supplied as 32%. Prepare in a fume hood. Measure 9.7 mL of hydrochloric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water
Hydrogen peroxide (H_2O_2) 20 volume (6%)	H_2O_2	34.01	Supplied as 100 volumes (30%) Measure 20 mL of (30%) hydrogen peroxide solution and add to 90–100 mL of distilled water.
Iodine solution (I_2) (potassium iodide/iodine solution	I_2		Dissolve 4.0 g of potassium iodide in 100 mL of distilled water. Add 2.0 g of iodine crystal and make up to 1 litre with distilled water. Allow to stand for 24 h so that iodine crystals will dissolve. Store in brown bottles.
Iron(II) chloride tetrahydrate, 0.1 M (2%)	$FeCl_2.4H_2O$	198.81	Dissolve 19.81 g of iron(II) chloride tetrahydrate in distilled water and make up to 1 litre with distilled water.
Iron(III) chloride hexahydrate 0.1 M (2.7%)	$FeCl_3.6H_2O$	270.30	Dissolve 27.30 g of iron(III) chloride hexahydrate in distilled water and make up to 1 litre with distilled water.
Magnesium sulfate 0.1 M	$MgSO_4.7H_2O$	246.48	Dissolve 24.65 g of Epsom salts in distilled water and make up to 1 litre with distilled water.
Phenolphthalein solution, 0.1% in ethanol	$C_{20}H_{14}O_4$	318.31	Dissolve 1 g of phenolphthalein in 600 cm^3 of ethanol and make up to 1 litre with distilled water.
Silver nitrate 0.1 M (1.7%)	$AgNO_3$	169.87	Dissolve 16.98 g of silver nitrate in distilled water and make up to 1 litre with distilled water.

Recipes

Chemical	Formula	Molecular weight	Method (review associated prac risk assessment, and safety precautions prior to preparing any solution)
Sodium chloride (NaCl), saturated	NaCl	58.44	Dissolve 370 g of sodium chloride in distilled water and make up to 1 litre with distilled water.
6 M sodium hydroxide (NaOH) (24%)	NaCl	40.00	Dissolve 240.00 g of sodium hydroxide in distilled water and make up to 1 litre with distilled water.
Sodium hydroxide 1.0 M (4%)	NaOH	40.00	Dissolve 40.00 g of sodium hydroxide in distilled water and make up to 1 litre with distilled water.
Sodium hydroxide 0.1 M (0.4%)	NaOH	40.00	Dissolve 4.00 g of sodium hydroxide in distilled water and make up to 1 litre with distilled water.
Sodium thiosulfate 4%	$Na_2S_2O_3$	248.17	Dissolve 4 g of sodium thiosulfate in distilled water and make up to 100 mL with distilled water.
Starch suspension			Dissolve 2g of starch in a small amount of cold water to make a paste, make up to 100 mL with boiling water.
Sulfuric acid (H_2SO_4) 2.0 M (19.6%)	H_2SO_4	98.08	Supplied as 18 M (98%). Prepare in a fume hood. Measure 108 mL of sulfuric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water.
Sulfuric acid (H_2SO_4) 1.0 M (9.8%)	H_2SO_4	98.08	Supplied as 18 M (98%). Prepare in a fume hood. Measure 54 mL of sulfuric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water.

Recipes

Chemical	Formula	Molecular weight	Method (review associated prac risk assessment, and safety precautions prior to preparing any solution)
Sulfuric acid 0.1 M (0.98%)	H_2SO_4	98.08	Supplied as 18 M (98%). Prepare in a fume hood. Measure 5 mL of sulfuric acid; add to two-thirds of distilled water and make up to 1 litre with distilled water.

Science Focus 4 Technician's checklist: Agar preparation and waste decontamination

What you need: Agar, distilled water, electronic balance, spatula, microwave, 500 mL Schott bottles, sterile disposable Petri dishes, Bunsen burner, heatproof mat, matches, 70% ethanol or other disinfectant, heatproof gloves or 'hot hands', autoclave or pressure cooker

What to do

1 Prepare agar:

- Weigh ~15 g nutrient agar into 500 mL Schott bottle (or the quantity recommended for your product).
- Nutrient agar contains beef extract 3 g, peptone 5 g, agar 15 g, and is an excellent agar for a range of bacteria and fungi.
- Add 500 mL of distilled water. (Do not add a stirrer bar, as this is to be microwaved.)
- Mix the contents well and cap the bottle *loosely*.
- Schott bottles are used as they are designed to withstand the temperature and pressures of sterilisation.
- Note: A standard agar plate contains ~20 mL of agar; 500 mL should give 20 to 25 agar plates.

2 Dissolve agar:

- Microwave the agar solution in the Schott bottle until it is completely dissolved.
- The cap *must* be loose to prevent pressure build up and explosion.
- Suggested times: ~4 minutes on high, then check, mix contents well. (Use heatproof gloves to handle the bottle. Beware of hot items and scald risk. Tighten the cap when mixing the bottle.)
- Loosen the cap and microwave an extra 2 minutes, repeating this procedure until the agar is completely dissolved.

3 Prepare the autoclave/pressure cooker:

- Check vents, seal rings and valves for damage.
- Add water according to the operating instructions.
- Ensure you are familiar with the operation of this equipment, as the use of heat and pressure provides an explosion risk.

4 Sterilisation conditions:

- Sterilisation occurs when items have reached and are maintained at 121°C for 15 minutes. An autoclave set for 121°C for 15 minutes will not usually have achieved conditions necessary for sterilisation. Extra time must be allowed. The time required will depend on the volumes and nature of the items to be sterilised. Fifteen minutes starting from the time a pressure cooker has begun to vent steam is a good guide.
- Agar and other microbial growth media deteriorate with extended exposure to sterilisation temperatures and pressures, so allow the minimum time necessary.
- During decontamination of waste, err on the side of safety and extend times to ensure sterilisation conditions are met.

5 Sterilise the agar:

- Place the Schott bottles, containing thoroughly mixed and dissolved agar, evenly within your sterilisation equipment. If the agar is not dissolved it tends to boil over during sterilisation and is prone to producing an inconsistent concentration of agar.
- (Use heatproof gloves to handle the bottle. Beware of hot items and scald risk. Tighten the cap when mixing the bottle contents.)
- *Ensure the caps are loose*.
- Operate your equipment so that the agar reaches and is maintained at 121°C for 15 minutes.
- Allow the equipment to cool and slowly equalise in pressure over 15 to 30 minutes. A rapid decrease in pressure causes the agar to boil over.
- When the equipment has equalised in pressure, tighten the caps using heatproof gloves to handle the bottles. Beware of hot items and scald risk.
- Allow bottles to cool slightly, then place in a water bath at 45–50°C. (A sink with a thermometer is fine, but keep an eye on the temperature—agar starts setting at ~40–45°C.)
- Ensure the water level of the water bath covers the level of the agar in the bottle so that areas of agar do not cool at a different rate and set.
- Alternatively, allow the bottles of agar to set. These can be stored at 4°C for six months. When agar plates are required, microwave the bottles of agar (with loose caps) until liquefied and dispense the agar according to the method below.

6 Prepare the dispensing area:

- Agar should be dispensed into sterile Petri dishes in a sterile area using sterile techniques.
- Disinfect the area with 70% ethanol or other disinfectant.
- Wear a clean lab coat and sterile gloves, or disinfect gloves with 70% ethanol.
- A Bunsen burner set to a blue flame provides a sterile zone around it. This is the area in which to pour the agar into the plates. (Beware of fire risk if you are using ethanol.)
- Remove the required number of sterile Petri dishes from the sleeves.
- Arrange the Petri dishes according to personal preference. Most people find small stacks of plates easy to work with (e.g. five stacks of five per 500 mL bottle).

7 Dispense the agar:

- Cool the agar to 45–50°C and mix thoroughly. Allow bubbles to rise before pouring it into the plates. (Pouring hot agar results in a lot of condensation on the lids of the Petri dishes and they will need to be dried prior to use.)
- Open the bottle of agar within the sterile zone of the Bunsen burner, flame the mouth of the bottle, open the Petri dish lid, pour ~20 mL of agar into the Petri dish and replace the lid. Working from the bottom to the top of a stack of Petri dishes is effective. Gently swirl each dish to distribute any bubbles to the sides.
- Place the stack to one side to set.
- Repeat the procedure until the bottle is empty.

8 Packaging and storage of agar plates:

- Allow the agar plates to completely set prior to moving.
- Plates can be replaced into their plastic sleeves, sealed and stored at 4°C for six months.
- Remember to record the date of the batch. Incubate a sample plate as a test for sterility and quality control.
- Store inverted (agar-side up) to minimise moisture on the agar.
- Remove excess moisture on *sterile* agar plates/lids prior to use. Invert plates and quickly flick the moisture away; alternatively, incubate them overnight.

9 Inoculation of plates and incubation of microbes:

- Incubate agar plates agar-side up (to minimise moisture on the agar).
- Incubation of microbes presents a potential pathogen risk.
- Agar plates should *not* be inoculated with human samples, or from areas such as the bathrooms or from soil.
- Inoculated agar plates should be taped shut and not be opened after this time.
- If sterile swabs are not available, use cotton buds dipped in freshly boiled and cooled water.
- Incubate at no higher than 35°C (to limit human pathogens).
- Treat all used Petri dishes as though they contain a pathogen.
- To assist in keeping class sets together and minimising odours, try placing plates in a sealed plastic container for incubation. Open in plastic containers in the fume hood prior to class to minimise odour.
- Ensure hands are washed after handling inoculated plates.

10 Microbe identification:

- Bacteria appear in ~1 to 2 days. Often smooth, shiny, discrete colonies appear. Creeping colonies are often *Pseudomonas*, which is a motile bacterium (a bacillus with a flagella). (*Pseudomonas* is often found in inoculations taken from moist environments.)
- Yeast colonies look similar to bacteria colonies.
- Fungi and moulds appear in ~3 to 4 days, as furry colonies, bluish/grey (often *Penicillium*) or black (often *Aspergillus)*.

11 Waste decontamination and disposal:

- Used agar plates should be sterilised by autoclaving or in a pressure cooker at 121–124°C for at least 20 minutes. Allow extra time for temperature and pressure build up.
- Contain the plates in an open autoclave or oven bag. Remember, agar will liquefy, making a huge mess if it is not in a bag.
- Ensure the bags are *open*. Sterilisation requires steam penetration and closed bags may mean adequate temperature/pressure is not achieved. Avoid creating situations where air pockets may limit steam penetration.
- Sterilised plates can be discarded via normal school waste. Do not use biohazard bags as this can create disposal issues if other staff are not aware that sterilisation has been performed.
- Once items have been successfully sterilised they are not a biohazard risk.
- An alternative method for sterilisation/decontamination is to use sodium hypochlorite 4% (household bleach) to sterilise small items, such as microscope slides or dissecting equipment. Ensure bleach solutions are made fresh and items are soaked for at least an hour.
- Sodium hypochlorite 4% (household bleach) is not classified as hazardous by NOHSC. However, note: **S23 –** Do not breathe fumes/vapour/spray; **S24/25 –** Avoid contact with skin and eyes; **S36/37/39 –** Wear protective clothing, gloves and eye/face protection.