

Prac exam 2

ATAR course examination, Semester 1, 2021

Question/Answer booklet

CHEMISTRY
ATAR Year 11 Unit 1

Student Name: _____

Teacher Name: _____

Time allowed for this paper

Reading time before commencing work: ten minutes

Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet

Multiple-choice answer sheet

Chemistry Data booklet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,
correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Multiple-choice	25	25	50	25	25
Section Two Short answer	9	9	60	70	35
Section Three Extended answer	5	5	70	80	40
Total					100

Instructions to candidates

1. The rules for the conduct of ATAR course examinations are detailed in the *Year 12 Information Handbook 2021*. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
3. Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer Booklet.

4. When calculating numerical answers, show your working or reasoning clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Express numerical answers to the appropriate number of significant figures and include appropriate units where applicable.
5. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.
7. The Chemistry Data booklet is not to be handed in with your Question/Answer booklet.

Section One: Multiple-choice

25% (25 Marks)

This section has **25** questions. Answer **all** questions on the separate Multiple-choice answer sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 50 minutes.

1. Which one of the following is the correct name for the compound with the formula $\text{Mg}(\text{HSO}_4)_2$?
 - (a) magnesium hydrogen sulfate
 - (b) magnesium dihydrogen sulfate
 - (c) manganese dihydrogen sulfite
 - (d) manganese hydrogen sulfate

2. Which one of the following formulas is written correctly?
 - (a) CaOH
 - (b) AlOH_3
 - (c) ZnCl_2
 - (d) NaO

3. Which one of the following is the correct name for the compound with the formula N_2O ?
 - (a) nitrogen oxide
 - (b) nitrogen monoxide
 - (c) nitrogen dioxide
 - (d) dinitrogen monoxide

4. Which one of the following is the correct valency of the ion formed by an element with an electron configuration of 2,8,2?
 - (a) +2
 - (b) -6
 - (c) -2
 - (d) +4

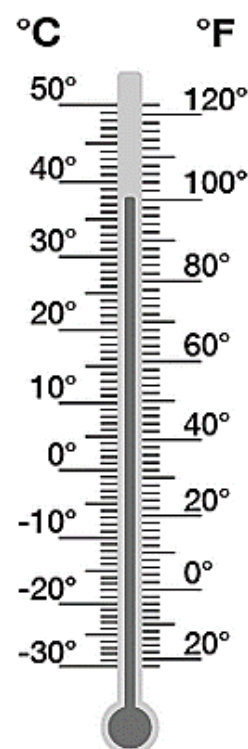
5. Which one of the following processes is endothermic?
- (a) burning magnesium metal
 - (b) water vapour condensing
 - (c) candle wax melting
 - (d) combustion of biodiesel
6. An element has an atomic number of 33. Which one of the following shows the element's correct location on the Periodic Table?
- (a) Group 5 Period 4
 - (b) Group 13 Period 3
 - (c) Group 15 Period 3
 - (d) Group 15 Period 4
7. Which one of the following is the formula of an alkane?
- (a) C_2H_2
 - (b) C_2H_4
 - (c) C_2H_6
 - (d) $\text{C}_2\text{H}_4\text{O}$
8. Which one of the following is the correct name for the compound shown?
- $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- (a) pentane
 - (b) methylbutane
 - (c) ethylpropane
 - (d) dimethylpropane
9. Which one of the following lists contains only pure substances?
- (a) iron, oxygen gas, water
 - (b) iron, copper chloride solution, water
 - (c) salt, oxygen gas, air
 - (d) salt, iron, sea water

10. When solutions of lead(II) nitrate and sodium iodide are mixed, an insoluble precipitate of lead(II) iodide is produced. By which one of the following methods can the solid product be separated?
- (a) evaporation
 - (b) filtration
 - (c) crystallisation
 - (d) distillation
11. An element has an atomic number of 47 and a mass number of 107. Which one of the following lists correctly describes the common ion of this element?

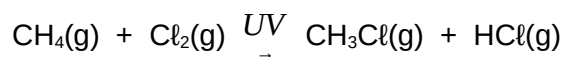
	Symbol	Number of neutrons	Number of electrons
(a)	Ag	47	47
(b)	Ag	60	47
(c)	Ag ⁺	47	46
(d)	Ag ⁺	60	46

12. Which of the following statements is/are correct regarding the two isotopes of helium, ³He and ⁴He?
- (i) They differ in mass.
 - (ii) They have a different number of protons.
 - (iii) ³He is more abundant in nature than ⁴He.
 - (iv) They have different chemical properties.

- (a) i only
 - (b) i and ii only
 - (c) i, ii and iii only
 - (d) ii and iv only
13. Which one of the following is the correct reading (in °C) on the thermometer shown here?
- (a) 33
 - (b) 37
 - (c) 38
 - (d) 100



14. Which one of the following is the electron configuration of P^{3-} ?
- (a) 2,8
 - (b) 2,8,3
 - (c) 2,8,5
 - (d) 2,8,8
15. Which one of the following best describes the number of valence electrons in an atom?
- (a) the total number of electrons in the atom
 - (b) the positive or negative charge on the ion of the atom
 - (c) the number of electrons needed to fill the outer electron shell
 - (d) the number of electrons in the outer shell
16. Which one of the following shows the products formed by the complete combustion of a hydrocarbon?
- (a) carbon and water
 - (b) carbon and hydrogen
 - (c) carbon dioxide and water
 - (d) carbon dioxide and hydrogen
17. Which one of the following terms best describes the reaction shown below?



- (a) addition
- (b) combustion
- (c) substitution
- (d) gaseous

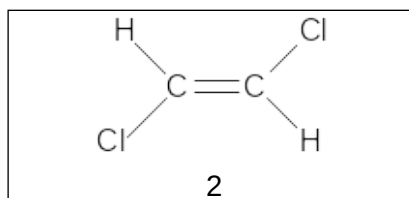
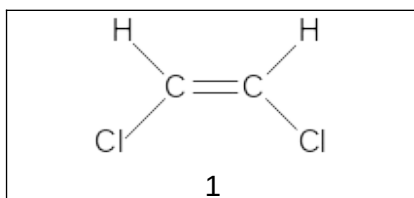
18. Bromine water is a solution of bromine in water. Hex-1-ene is a colourless liquid that is immiscible (insoluble) in water. Consider the statements below describing possible observations for a shaken mixture of the two.

- (i) the mixture separates into 2 layers
- (ii) the mixture remains as 1 layer
- (iii) the orange colour of the bromine fades quickly
- (iv) the orange colour of the bromine remains

Which **two** of these statements are correct?

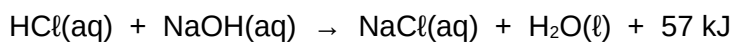
- (a) i and iv
- (b) i and iii
- (c) ii and iii
- (d) ii and iv

19. Consider the two structures shown below.



Which one of the following statements about these structures is correct?

- (a) They are the same compound.
 - (b) They are both hydrocarbons.
 - (c) They are *cis-trans* isomers of each other.
 - (d) The IUPAC name for both is 1,2-dichloroethane.
20. The molecular equation for the reaction of hydrochloric acid solution and sodium hydroxide solution is shown below.



Which one of the following best describes the change in temperature of the mixture?

The temperature of the mixture

- (a) increases because the reaction is exothermic.
- (b) decreases because the reaction is exothermic.
- (c) increases because the reaction is endothermic.
- (d) decreases because the reaction is endothermic.

21. Which one of the following statements about the combustion of fuels is correct?

The total enthalpy of the products will be

- (a) greater than the reactants as energy is given to the surroundings.
 - (b) less than the reactants as energy is given to the surroundings.
 - (c) greater than the reactants as energy is taken from the surroundings.
 - (d) less than the reactants as energy is taken from the surroundings.
22. Which one of the following is the best explanation as to why the elements carbon, silicon, tin and lead are found in the same Group of the Periodic Table?
- (a) They are all metals with increasing metallic properties down the Group.
 - (b) Their atoms all have the same number of valence electrons.
 - (c) They all conduct electricity in solid and molten states.
 - (d) They have the same physical and chemical properties.
23. Which one of the following pairs of elements would you expect to react together to form an ionic compound?
- (a) C and Cl
 - (b) Li and F
 - (c) S and N
 - (d) H and S
24. Which one of the following increases for each element down Group 1 of the Periodic Table?
- (a) 1st ionisation energy
 - (b) electronegativity
 - (c) valency
 - (d) atomic radius
25. Which one of the following statements about a property of benzene is correct?
- Benzene
- (a) has a flat hexagonal structure.
 - (b) is highly reactive to chlorine gas.
 - (c) does not undergo combustion.
 - (d) has the formula C₆H₁₂.

End of Section One

Section Two: Short Answer

35% (70 Marks)

This section has **9** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for the use of planning/continuing your answer to a question have been provided at the end of this Question/Answer booklet. If you use the space to continue an answer, indicate at the original answer where the answer is continued, i.e., give the page number.

Suggested working time: 60 minutes.

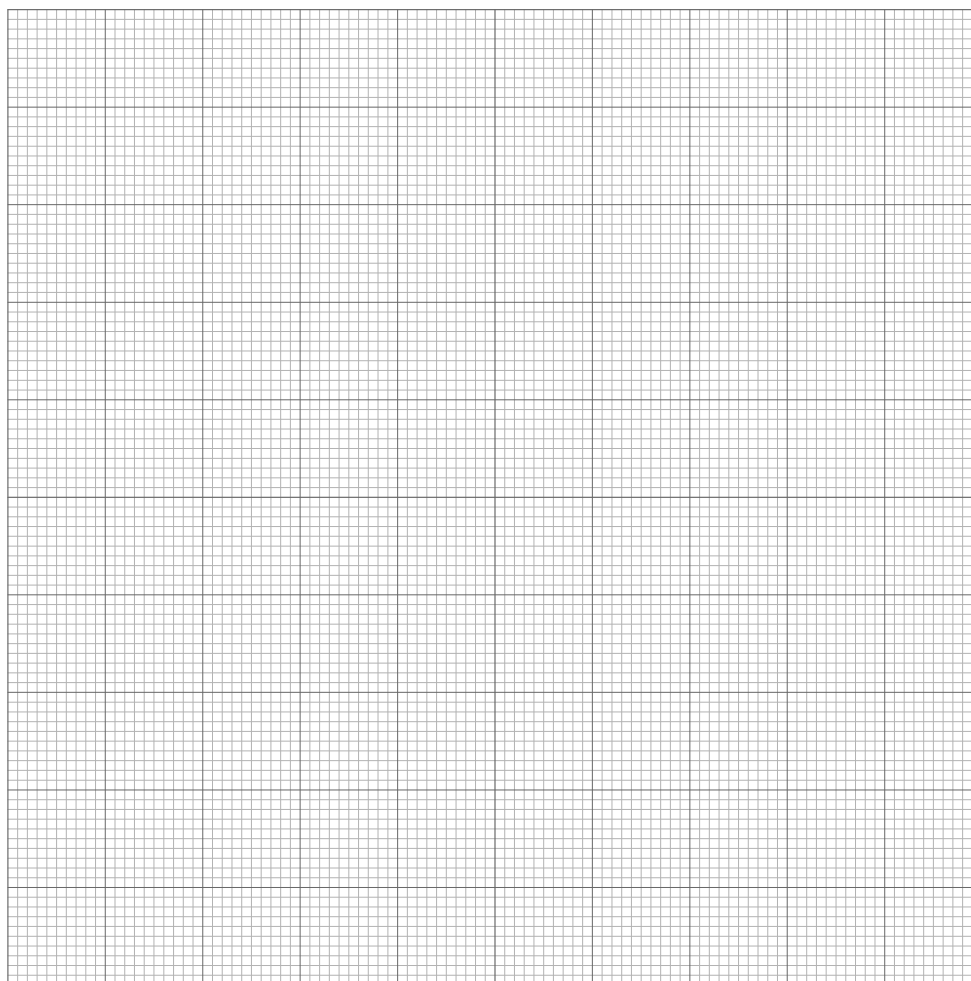
Question 26

(9 marks)

Some bore water was analysed by atomic absorption spectroscopy to determine its lead content. The safe levels for lead are less than 0.01 mg L^{-1} in drinking water and less than 0.1 mg L^{-1} in non-drinking uses. Five standard lead solutions of differing concentration were analysed by atomic absorption spectroscopy yielding the following data for the standard solutions and a sample of the bore water.

Lead concentration (mg L^{-1})	0.010	0.02 5	0.050	0.10	0.15	Bore water
Absorbance	0.16	0.41	0.87	1.8	2.5	1.5

- (a) Draw a suitable graph of the results on the grid below and, using the graph, explain that the bore water is safe to use for watering plants but not safe for drinking. (6 marks)



Spare grid at the end of the paper. If you use it cross out this attempt and indicate you have redrawn.

Atomic absorption spectroscopy uses the unique nature of an element's absorption spectrum to determine its concentration in a mixture.

- (b) Explain why each element has a unique absorption spectrum. (3 marks)

Question 27

(8 marks)

- (a) Using information from the data booklet, determine the approximate percentage abundance of the two main isotopes of boron ^{10}B and ^{11}B in a sample of boron. Show your working. (4 marks)

- (b) List 4 key steps in the mass spectrometry process to determine the abundance of these isotopes in a sample of boron. (4 marks)

(7 marks)

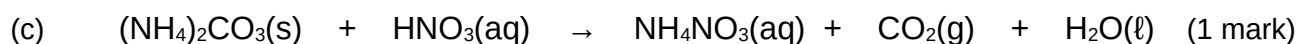
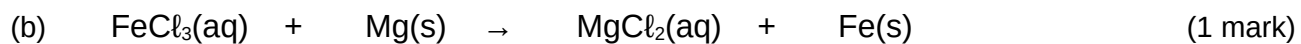
- | Full structural formula of main organic product | Name of main organic product |
|---|------------------------------|
| | |

- | Full structural formula of main organic product | Name of main organic product |
|---|------------------------------|
| | |

Question 29

(3 marks)

Balance the following equations. Each formula is correctly written.



Question 30

(9 marks)

Complete the table describing some properties of carbon graphite, carbon dioxide and silicon carbide (SiC) by circling the correct terms. (9 marks)

	Graphite	Carbon dioxide	Silicon carbide
Strength of the solid structure	high medium low	high medium low	high medium low
Melting point	high medium low	high medium low	high medium low
Electrical conductivity	high medium low	high medium low	high medium low

Question 31

(8 marks)

Draw full structural formulas for and name 4 possible isomers of C_4H_8 .

(8 marks)

Full structural formula	Name

Question 32**(7 marks)**

Gold is a highly efficient electrical conductor that can carry tiny currents making it very useful in electronic components.

- (a) Explain, with the aid of a labelled diagram, the structure of gold that allows it to conduct electricity. (3 marks)

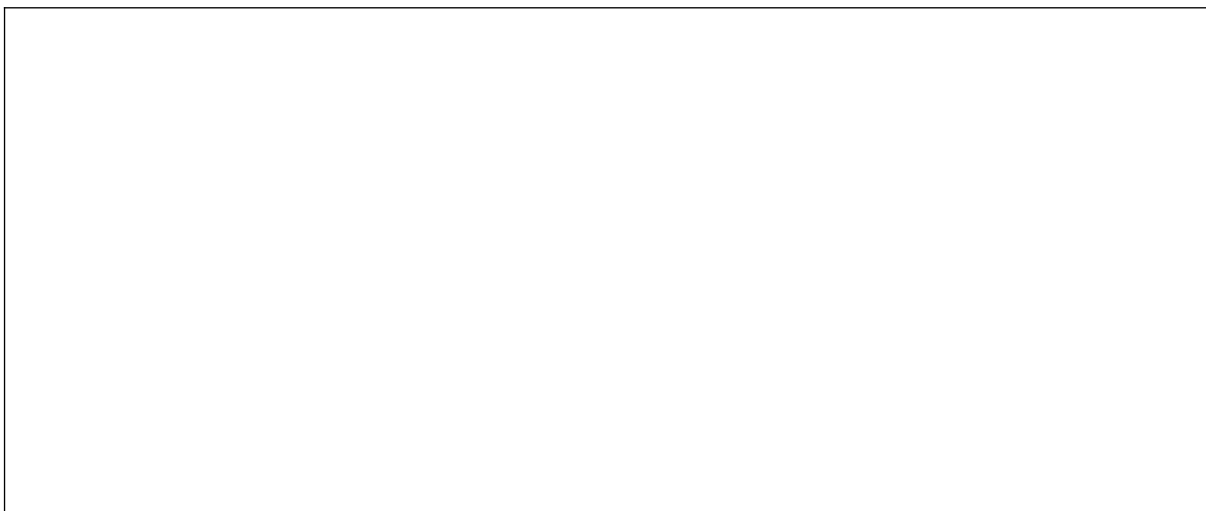
Gold nanoparticles can be used to treat cancerous tumours as they can absorb light, rapidly heat up, and kill tumour cells.

- (b) State the size range of nanoparticles. (1 mark)

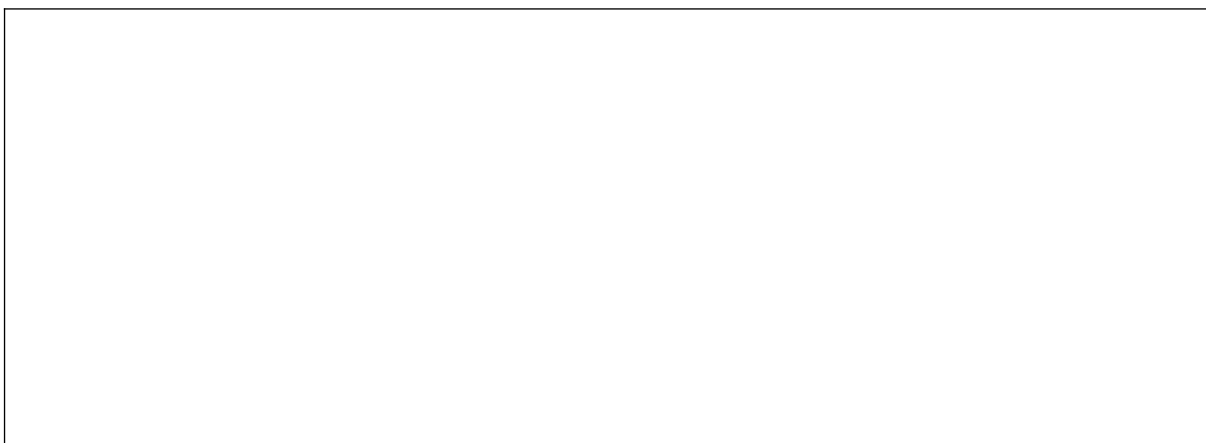
- (c) If gold is harmless to the body can it be assumed gold nanoparticles will also be harmless. Justify your answer. (3 marks)

Question 33**(7 marks)**

- (a) Draw and label a diagram of the structure of a nitrogen atom showing the particles in the nucleus and electron levels. (4 marks)



- (b) Briefly describe (or draw) how J.J. Thomson's model of this atom might look. (1 mark)



- (c) Which subatomic particle did Sir James Chadwick discover in 1932 and why was this particle the last to be discovered? (2 marks)

Question 34

(12 marks)

- (a) By referring to its bonding and structure explain why aluminium is a solid at room temperature. (3 marks)

- (b) By referring to its bonding and structure explain why chlorine is a gas at room temperature. (3 marks)

- (c) State the trend in electronegativity for Period 3 elements. (1 mark)

- (d) Refer to the electron configurations of the elements chlorine and aluminium to explain why aluminium chloride has the formula AlCl_3 . (5 marks)

End of Section Two

Section Three: Extended answer**40% (80 Marks)**

This section contains **5** questions. You must answer **all** questions. Write your answers in the spaces provided.

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and for coherence and clarity of expression. Lists or dot points are unlikely to gain full marks.

Final answers to calculations should be expressed to the appropriate number of significant figures.

Supplementary pages for the use of planning/continuing your answer to a question are provided at the end of this Question/Answer booklet. If you use the space to continue an answer, indicate in the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 70 minutes.

Question 35**(21 marks)**

Biofuels can be blended with fossil fuels for use in cars and trucks.

- (a) List the names of three biofuels and three fossil fuels.

(6 marks)

Biofuels	Fossil fuels

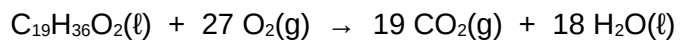
- (b) Compare the general differences between biofuels and fossil fuels by completing the table below (Circle correct choice)

(6 marks)

	Biofuel	Fossil fuel
Carbon emissions	low high	low high
Sulfur emissions	low high	low high
Sustainability	low high	low high

Question 35 continued

An equation for the complete combustion of a biodiesel is shown below.



Source: <http://biofuel.org.uk/how-do-biofuels-burn.html>

- (c) Calculate the number of moles of CO_2 emissions produced from 1.00 kg of biodiesel.
(4 marks)

- (d) Given that 1.00 kg of biodiesel has a volume of about 1.14 L; calculate the mass of oxygen gas required to completely burn 1.00 L of biofuel vapour.
(5 marks)

Question 36

(17 marks)

Students were asked to plan an experiment to determine the amount of energy that could be obtained from various liquid fuels by using a measured mass of each fuel to heat a measured volume of water.

They were asked to conduct a risk assessment and devise a safe method for this experiment.

- (a) State one safety issue that could arise and how the risk could be minimised. (2 marks)

Safety issue
Risk minimisation

- (b) Use the following information about some liquid fuels to write a hypothesis for the experiment. (3 marks)

Liquid fuel	Energy released (kJ g⁻¹)
Petrol	48
Diesel	45
Bioethanol	30
Biodiesel	42

- (c) Complete the table below describing this experiment (4 marks)

Two controlled variables	
One possible random error	
One possible systematic error	

Question 36 continued

- (d) Describe the effect random errors have on a set of results and state one way to reduce random errors. (3 marks)

- (e) Describe the effect systematic errors have on a set of results and state one way to reduce systematic errors. (3 marks)

- (f) After obtaining many results how would the students know the results were reliable? (1 mark)

- (g) How could the students improve the validity of their experiment? (1 mark)

Question 37

(15 marks)

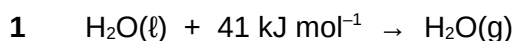
Underground salt lakes, situated inland from Perth, contain unusually high levels of potassium and sulfate ions in solution. This allows the production of SOP (sulfate of potash) fertiliser containing two essential plant elements, potassium and sulfur.

Evaporation and crystallisation are used to obtain solid potassium sulfate from the salt lakes.

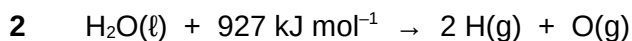
A group of students was given a 100 mL sample of the salt solution and asked to carry out experiments to obtain solid potassium sulfate.

- (a) Briefly describe how they could use evaporation and crystallisation to obtain a sample of solid potassium sulfate. (3 marks)

The evaporation of water can be represented by the equation shown below.



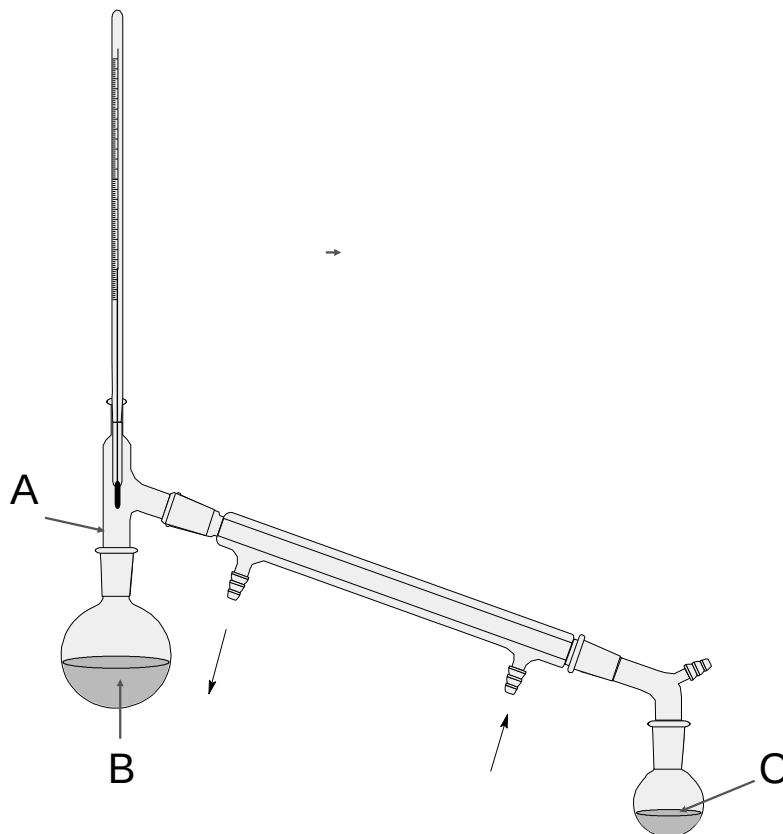
The decomposition of water can be represented by the equation shown below.



- (b) Explain why the energy required to decompose water is much greater than the energy required to evaporate water. (4 marks)

Question 37 continued

In the laboratory pure water can be obtained from salt-water using the equipment shown in the diagram below.



- (c) Complete the table describing the substances found at A, B and C. (6 marks)

Substance	Name of substance	Pure substance or mixture?
A		
B		
C		

Differences in the physical properties of substances in a mixture can be used to separate them.

- (d) Describe two differences in physical properties that allow separation of salt and water by distillation. (2 marks)

Question 38

(13 marks)

Pink Himalayan salt is often advertised as a healthier salt than table salt as it provides higher levels of some essential minerals as shown in the table below.

Nutrient concentration (mg kg^{-1})							
Product	Ca	Cu	Fe	Mg	K	P	Na
Table salt	393	0.1	0	84	152	0	427,636
Himalayan salt	1799	0.1	44	1345	2086	29	394,315

The recommended intake of salt per day for an adult is less than 6.00 g (1 teaspoon).

The recommended minimum daily intake of calcium for an adult is 1.00×10^3 g.

- (a) Calculate the percentage of this daily intake of calcium provided by 1 teaspoon of Himalayan salt? State your answer to 3 significant figures. (3 marks)

- (b) If 50.0 g of table salt is dissolved in water and made up to 500.0 mL, calculate the concentration of sodium in g L^{-1} and mol L^{-1} . (4 marks)

The main component in Himalayan salt is sodium chloride.

- (c) Under the following headings compare the bonding in sodium and sodium chloride. (6 marks)

	sodium	sodium chloride
Type of bonding	(1)	(1)
Main particles		

involved in bonding		
	(2)	(2)

Question 39**(14 marks)**

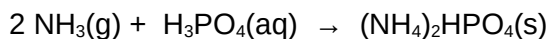
The commonly used fertiliser, diammonium hydrogen phosphate ($(\text{NH}_4)_2\text{HPO}_4$), supplies two essential elements to plants, nitrogen and phosphorus. It is produced by reacting ammonia gas and phosphoric acid.

In the ammonia molecule, the nitrogen and hydrogen atoms are held together by strong covalent bonds.

- (a) Name the elements in Period 2 of the Periodic Table which can exhibit covalent bonding. (2 marks)

- (b) Describe a covalent bond. (4 marks)

The overall equation for the production of diammonium hydrogen phosphate as shown below.



- (c) Calculate the number of atoms of hydrogen in 1 mole of diammonium hydrogen phosphate. (2 marks)

- (d) Use the equation above to calculate the minimum mass of phosphoric acid required to react with 10.5 g of ammonia. (6 marks)

End of questions

Question number_____

[illegible]

Question number_____

[illegible]

Question number_____

[illegible]

