



## Western Australian Certificate of Education Examination, 2014

### Question/Answer Booklet

# CHEMISTRY

## Stage 2

Please place your student identification label in this box

Student Number: In figures

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In words

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### Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: three hours

### Materials required/recommended for this paper

#### *To be provided by the supervisor*

This Question/Answer Booklet

Multiple-choice Answer Sheet

Chemistry Data Sheet

Number of additional  
answer booklets used  
(if applicable):

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#### *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 the WACE examinations

### 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 notes or other items of a non-personal nature in the examination room. 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 exam
Section One: Multiple-choice	25	25	45	25	25
Section Two: Short answer	12	12	70	101	40
Section Three: Extended answer	5	5	65	85	35
Total					100

## Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2014*. Sitting this examination implies that you agree to abide by these rules.

2. 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. 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.

3. When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to **three** significant figures and include appropriate units where applicable.
4. 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.
5. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
  - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
  - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.
6. The Chemistry Data Sheet is **not** to be handed in with your Question/Answer Booklet.

## Section One: Multiple-choice

25% (25 Marks)

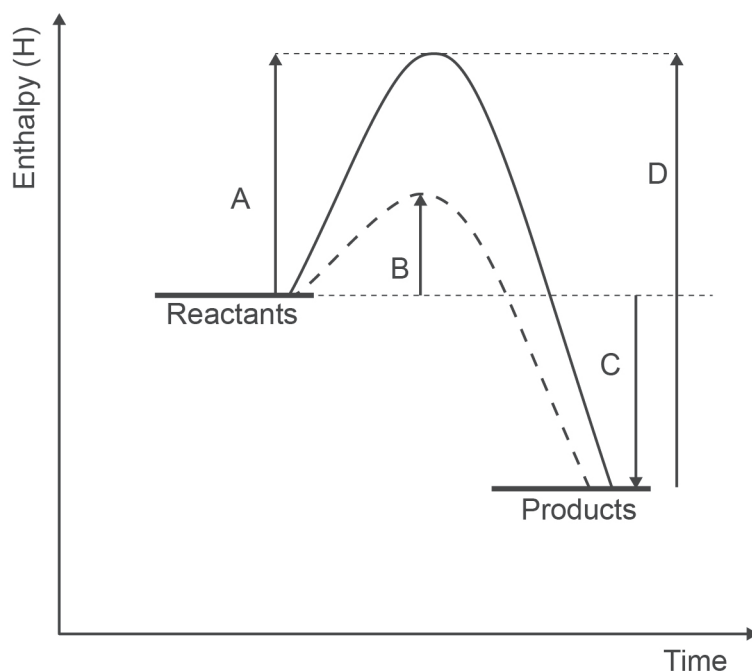
This section has **25** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, then shade your new answer. 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: 45 minutes.

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1. Homogeneous mixtures are sometimes referred to as solutions. Which one of the following statements about solutions is true?
  - (a) All solutions are made by dissolving a solid in a liquid.
  - (b) The properties of solutions remain constant throughout.
  - (c) Solutions are pure substances.
  - (d) Solutions become more homogeneous as they are heated.
  
2. If salt crystals dissolve when added to a salt solution, it can be concluded correctly that the original solution was
  - (a) unsaturated.
  - (b) saturated.
  - (c) supersaturated.
  - (d) either saturated or supersaturated.
  
3. Cycloalkenes undergo
  - (a) substitution reactions only.
  - (b) addition reactions only.
  - (c) combustion reactions only.
  - (d) addition and combustion reactions.
  
4. Which one of the following substances contains only covalent bonds?
  - (a)  $\text{Al}_2\text{O}_3$
  - (b)  $\text{NH}_4\text{NO}_3$
  - (c)  $\text{NaCl}$
  - (d)  $\text{SiO}_2$
  
5. Which of the following oxides is the **most** basic?
  - (a) potassium oxide
  - (b) silicon dioxide
  - (c) phosphorus pentoxide
  - (d) sulfur dioxide

6. A student was conducting an investigation to determine the rate of a chemical reaction. To obtain accurate results, the student should
- (a) use up all the chemicals provided, being careful not to spill any.
  - (b) repeat the investigation at least twice from the beginning.
  - (c) have a colleague check the method, equipment and the results.
  - (d) repeat the procedure until consistent measurements are produced.
7. Which one of the following features of a sugar solution will **not** be affected by increasing its concentration?
- (a) conductivity
  - (b) vapour pressure
  - (c) melting point
  - (d) boiling point
8. Look at the energy profile diagram below for a chemical reaction.



Which arrow represents the enthalpy change for the forward reaction?

- (a) A
- (b) B
- (c) C
- (d) D

9. Name the organic compound which produces 2,3-dichloropentane when it reacts with chlorine gas.

(a) *cis*-pent-2-ene  
(b) 1-chloropentane  
(c) pent-1-ene  
(d) 1,2-dichloropentane

10. Which one of the following equations is balanced?

(a)  $\text{C}_3\text{H}_8 + 7 \text{O}_2 \rightarrow 3 \text{CO} + 4 \text{H}_2\text{O}$   
(b)  $2 \text{C}_3\text{H}_8 + 7 \text{O}_2 \rightarrow 3 \text{CO}_2 + 8 \text{H}_2\text{O}$   
(c)  $\text{C}_3\text{H}_8 + 5 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$   
(d)  $\text{C}_3\text{H}_8 + 10 \text{O}_2 \rightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$

11. According to the following equation:



what is the greatest number of moles of potassium chloride (KCl) that could be produced when 5 mol of potassium sulfite ( $\text{K}_2\text{SO}_3$ ) are mixed with hydrochloric acid (HCl)?

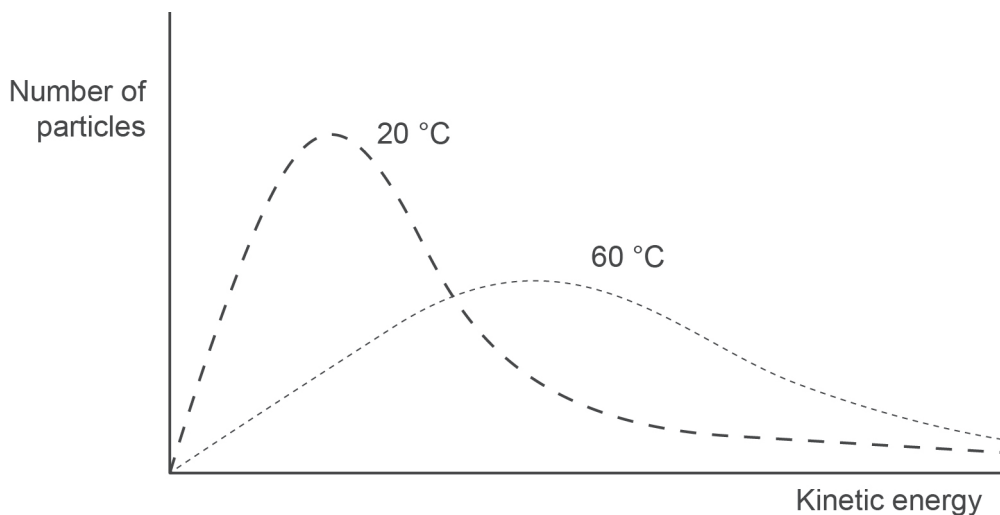
- (a) 2 mol  
(b) 2.5 mol  
(c) 5 mol  
(d) 10 mol
12. If molten sodium chloride (NaCl) is electrolysed using inert electrodes, which one of the following will occur?
- (a) Sodium ions will move toward the anode through the molten electrolyte.  
(b) Chloride ions will be oxidised at the anode to form chlorine gas.  
(c) Electrons will combine with chloride ions.  
(d) Electrons will travel through the electrolyte.
13. Methylated spirits ('metho') can be used as a fuel in camping stoves. The main component in 'metho' is ethanol and its combustion reaction is shown below.



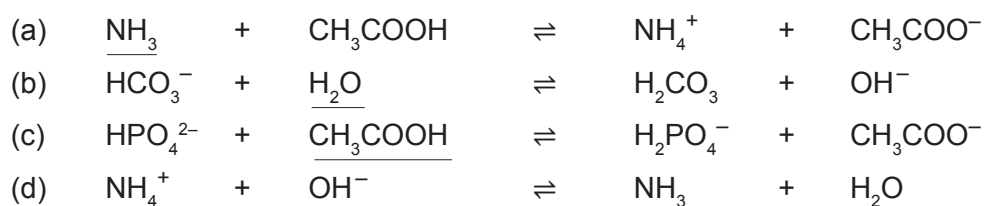
Which of the following **best** explains why a lighted match is required for the reaction to start?

(a) This is an exothermic reaction.  
(b) The lighted match provides oxygen for the reaction.  
(c) The lighted match provides the initial activation energy.  
(d) Heat from the match compensates for the loss of energy to the surroundings.

14. Which one of the following is the oxidation state of sulfur in  $\text{H}_2\text{SO}_4$ ?
- (a) - 4  
(b) - 2  
(c) + 1  
(d) + 6
15. The kinetic energy distributions of particles of a gas at  $20^\circ\text{C}$  and at  $60^\circ\text{C}$  is shown below.



- Which one of the statements relating to these distributions is correct?
- (a) At  $20^\circ\text{C}$  the average kinetic energy of the particles is higher than at  $60^\circ\text{C}$ .  
(b) At  $20^\circ\text{C}$  there are no particles with a high kinetic energy.  
(c) At  $60^\circ\text{C}$  there are no particles with a low kinetic energy.  
(d) At  $60^\circ\text{C}$  there are more particles with higher kinetic energy than at  $20^\circ\text{C}$ .
16. Which one of the following is **not** a use of vinegar?
- (a) flavouring foods  
(b) fuelling portable stoves  
(c) preserving foods  
(d) removing mineral deposits in kettles
17. In which one of the following equations is the underlined species acting as a Brønsted-Lowry base?



18. Silicon dioxide does not conduct electricity. Which of the following **best** explains this observation?
- (a) It has delocalised valence electrons.
  - (b) It consists only of non-metal atoms.
  - (c) All of the valence electrons are involved in covalent bonds.
  - (d) It is a covalent network substance.
19. Which one of the following is **not** true for the pure substance silver chloride ( $\text{AgCl}$ )?
- (a) it is brittle
  - (b) it conducts electricity when molten
  - (c) it is a non-electrolyte
  - (d) it is insoluble in water
20. A few drops of water are added to one litre of pure nitric acid. Which one of the following **best** describes the resulting solution?
- (a) a concentrated solution of a strong acid
  - (b) an acidic solution with a pH greater than 7
  - (c) a dilute solution of a weak acid
  - (d) a concentrated solution of a weak acid
21. The chemical properties of an element are influenced mainly by the number of
- (a) protons in the nucleus of its atoms.
  - (b) valence electrons of its atoms.
  - (c) occupied electron shells of its atoms.
  - (d) protons and neutrons in the nucleus of its atoms.
22. An ion of Y has a charge of +1 and an ion of Z has a charge of -2. Which of the following is the **most** likely formula of the compound formed between Y and Z?
- (a) YZ
  - (b)  $\text{Y}_2\text{Z}$
  - (c)  $\text{YZ}_2$
  - (d)  $\text{YZ}_6$
23. Which of the following solids has the highest electrical conductivity?
- (a) graphite
  - (b) sulfur
  - (c) sodium chloride
  - (d) diamond

24. Which one of the following ions does **not** have the same electron configuration as an inert gas?

- (a)  $\text{Li}^+$
- (b)  $\text{N}^{3-}$
- (c)  $\text{O}^{2-}$
- (d)  $\text{F}^+$

25. Which of the following are isotopes of each other?

$^{12}\text{C}$	$^{12}\text{N}$	$^{13}\text{C}$	$^{14}\text{C}$	$^{12}\text{O}$	$^{14}\text{F}$
I	II	III	IV	V	VI

- (a) I and III only
- (b) I, II and V only
- (c) I, III and IV only
- (d) IV, V and VI only

**End of Section One**



## Section Two: Short answer

40% (101 Marks)

This section has **12** questions. Answer **all** questions. Write your answers in the space provided.

When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to **three** significant figures and include appropriate units where applicable.

Do not use abbreviations, such as 'nr' for 'no reaction', without first defining them.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

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- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

Suggested working time: 70 minutes.

## Question 26

(5 marks)

Complete the table below.

Element	Atomic N <sup>o</sup>	Mass N <sup>o</sup>	Number of electrons	Symbol
Sulfur		32		$^{32}_{16}\text{S}^{2-}$
Chlorine	17		18	$^{35}_{17}\text{Cl}^{-}$
Sodium	11	23	10	
Phosphorus	15	31	18	

## Question 27

(5 marks)

- (a) Complete the table below by writing the names of the ionic compounds. (3 marks)

Formula	Name
$\text{CaSO}_4$	
$\text{Fe}_2\text{O}_3$	
$\text{K}_3\text{PO}_4$	

- (b) Complete the table below by writing the formulae of the ionic compounds. (2 marks)

Name	Formula
chromium(III) chloride	
calcium hydrogencarbonate	

See next page

## Question 28

(6 marks)

For the species listed in the table below, draw Lewis structure (electron dot) diagrams.

All valence shell electron pairs should be represented either as  $\cdot$  or as  $—$

(for example, water  $\text{H}:\ddot{\text{O}}:\text{H}$  or  $\text{H}-\ddot{\text{O}}-\text{H}$  or  $\text{H}-\ddot{\text{O}}^--\text{H}$ )

Species	Lewis structure (electron dot) diagram
CaO	
$\text{Cl}_2\text{O}$	

## Question 29

(3 marks)

Calculate the percentage by mass of oxygen in slaked lime,  $\text{Ca}(\text{OH})_2$ .

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## Question 30

(8 marks)

- (a) Classify the following pure substances into their bonding class by placing each symbol or formula into the appropriate box in the table below. (6 marks)

Fe    Si     $\text{NH}_4\text{Cl}$      $\text{HCl}$      $\text{H}_2\text{O}$      $\text{CaCl}_2$

Metallic	Ionic	Covalent network	Covalent molecular

- (b) What is it about the bonding of solid metals that explains why they are good conductors of electricity? (2 marks)

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## Question 31

(12 marks)

Sodium carbonate solid is added to excess nitric acid solution.

- (a) Write an ionic equation for the reaction. (3 marks)

- (b) Describe the predicted observations for this reaction. (2 marks)

- (c) When concentrated nitric acid is added to copper metal, a brown gas, NO<sub>2</sub>, is produced. The equation is shown below.



0.444 g of Cu reacts with excess 6.00 mol L<sup>-1</sup> nitric acid.

- (i) Calculate the number of moles of Cu consumed. (2 marks)

- (ii) Calculate the number of moles of NO<sub>2</sub> produced. (2 marks)

- (iii) What volume of  $\text{NO}_2$  was produced at STP?  
(Give your answer to **three** significant figures and with the correct units.) (3 marks)

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**Question 32****(8 marks)**

- (a) Classify the following  $1.00 \text{ mol L}^{-1}$  solutions as acidic, basic or neutral. (5 marks)

Solution	Acidic, basic or neutral
$\text{CH}_3\text{COOH}$	
$\text{NH}_3$	
$\text{CaCl}_2$	
$\text{HNO}_3$	
$\text{Ba(OH)}_2$	

- (b) (i) Which solution will have the highest pH? (1 mark)

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- (ii) Explain your choice. (2 marks)

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## Question 33

(12 marks)

- (a) State **two** features about the bonding of carbon that account for the great diversity of carbon-based compounds. (2 marks)

One: \_\_\_\_\_

Two: \_\_\_\_\_

- (b) Draw the structural formula of but-1-ene ( $C_4H_8$ ) and one of its isomers (show **all** H atoms). (4 marks)


- (c) State the IUPAC name for each of the following organic compounds.

- (i)  $CH_3 - CHBr - CH_2 - CH_2 - CHBr - CH_2 - CH_3$  (1 mark)

\_\_\_\_\_

- (ii)  $CH_2 = CH - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$  (1 mark)

\_\_\_\_\_

- (iii) 
$$\begin{array}{cc} H_2C & - & CH_2 \\ | & & | \\ H_2C & - & CH_2 \end{array}$$
 (1 mark)

\_\_\_\_\_

- (iv) 
$$\begin{array}{c} H_3C \\ \diagdown \\ H & & C = C & \diagup \\ & & & H \\ & & & | \\ & & & CH_2 - CH_2 - CH_3 \end{array}$$
 (1 mark)

\_\_\_\_\_

- (d) Draw the structural formula for any product(s) formed when pent-1-ene ( $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ ) is mixed with hydrogen gas ( $\text{H}_2$ ) in the presence of a catalyst (show **all** H atoms). (2 marks)

**This space has been left blank intentionally**

## Question 34

(8 marks)

- (a) The labels have fallen off two bottles containing colourless liquids. One label reads 'octane' and the other label reads 'oct-2-ene'. Describe a chemical test and expected observations that could be used to identify each liquid. (3 marks)

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- (b) (i) Another bottle contains a colourless liquid. Its label reads 'benzene'. Draw a structural formula for benzene, showing **all** of its bonds. (2 marks)

Structural formula

- (ii) Describe how benzene's reactivity is different from carbon compounds containing double bonds. (3 marks)

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## Question 35

(14 marks)

- (a) A range of chemicals are used in the home every day. Some homes use gas to cook food. The gas most commonly used is methane ( $\text{CH}_4$ ). The burning of methane gas with oxygen in the air is called combustion.

The equation for this reaction is:  $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$

Describe this reaction by using the appropriate words from this list. These words may be used more than once. Write either the word or corresponding capital letter in the spaces provided below the text. (10 marks)

- |                  |              |             |
|------------------|--------------|-------------|
| A. exothermic    | H. forming   | O. bonds    |
| B. endothermic   | I. greater   | P. nucleus  |
| C. released to   | J. lesser    | Q. more     |
| D. absorbed from | K. reactants | R. less     |
| E. raising       | L. products  | S. stronger |
| F. lowering      | M. releases  | T. weaker   |
| G. breaking      | N. absorbs   |             |

As the methane gas molecules and oxygen gas molecules react, they produce an (i) reaction, which results in heat energy being (ii) the surroundings. As the surroundings include the cooking vessel, this results in a (iii) of the temperature of the food.

A chemical reaction involves the (iv) of the reactants' bonds and the (v) of bonds to make new substances called the (vi). Energy is stored in a substances' (vii). Breaking bonds (viii) energy while forming bonds (ix) energy. The more bonds and the stronger the bonds, the (x) energy is required to break them or is released when they are formed.

(i) _____	(vi) _____
(ii) _____	(vii) _____
(iii) _____	(viii) _____
(iv) _____	(ix) _____
(v) _____	(x) _____

- (b) Match each common chemical listed below to its household use. Each chemical may only be used once. (4 marks)

sodium chloride      sodium hypochlorite (bleach)      ammonia solution      caustic soda

Household use	Household chemical
Glass cleaner	
Food additive	
Drain cleaner	
Washing clothes	

See next page

## Question 36

(13 marks)

A 375 mL can of ginger beer contained 41.0 g of sugar. Assume all the sugar in ginger beer is a sugar called sucrose ( $C_{12}H_{22}O_{11}$ ).

(a) Calculate the concentration of sugar in:

(i) grams per litre ( $g\ L^{-1}$ ). (2 marks)

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Answer: \_\_\_\_\_

(ii) moles per litre ( $mol\ L^{-1}$ ). (3 marks)

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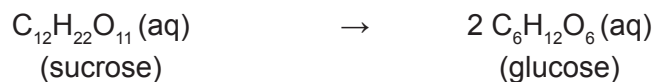
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Answer: \_\_\_\_\_

(b) The first stage of the digestion of sucrose in the human body is the breakdown of the sucrose into glucose as shown in the **incomplete** equation below.



(i) By adding a water molecule, re-write a balanced chemical equation for this process. (1 mark)

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(ii) Use the idea of conservation of mass in a chemical reaction to explain why a water molecule is required for this equation. (2 marks)

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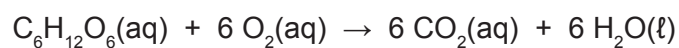
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(iii) What information does the state symbol (aq) provide about the reaction? (1 mark)

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- (c) Within living cells, glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) provides the human body with energy by undergoing the reaction represented in the following equation.



The normal human body temperature is 37 °C.

- (i) Predict what will happen to the rate of this reaction if the human body temperature drops below 37 °C. (1 mark)

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- (ii) Use the collision theory to explain your answer to part (c)(i). (3 marks)

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## Question 37

(7 marks)

A student placed an iron (Fe) nail into an aqueous solution of copper(II) sulfate ( $\text{CuSO}_4$ ) in a beaker. Her observations are recorded below.

	Original appearance	Appearance after 1 minute	Appearance after 10 minutes
Iron nail	shiny grey solid metal	the part of the nail in the solution turns a darker colour	the part of the nail in the solution has a salmon pink coloured coating
Copper(II) sulfate solution	bright blue solution	no change	there are some salmon pink to brown coloured solid lumps at the bottom of the beaker. The blue colour of the solution has faded slightly

- (a) Name the substance that forms on the surface of the iron nail. (1 mark)

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- (b) Write a half-equation showing the reaction of  $\text{Cu}^{2+}$  ions that occurs at the surface of the nail. Include state symbols. (2 marks)

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- (c) Use this half-equation to explain why the blue colour of the solution fades. (2 marks)

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- (d) The student conducting the investigation had a second beaker of copper(II) sulfate that she used as a control so she did not add a nail to this beaker. Explain why a control was used. (2 marks)

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End of Section Two

See next page

## Section Three: Extended answer

35% (85 Marks)

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

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Suggested working time: 65 minutes.

## Question 38

(23 marks)

A student was provided with four colourless liquids labelled 'A', 'B', 'C' and 'D'. The liquids were

- phosphoric acid solution
- phenolphthalein
- water
- barium hydroxide solution.

Note: Phenolphthalein is an indicator that is pink in basic solutions.

The student then conducted a series of tests to determine the identity of the liquids by combining them and obtained the following results.

Liquids mixed	Observation
A + B	white precipitate formed
A + C	no visible change
B + C	solution turns pink
C + D	no visible change

- (a) From these observations, identify each of the liquids. (4 marks)

Liquid	Identity
A	
B	
C	
D	

**Question 38** (continued)

- (b) Write an ionic equation for the reaction between phosphoric acid solution and barium hydroxide solution. Include the state symbols. (3 marks)

- (c) Phosphoric acid is a polyprotic acid. With the aid of equations, use phosphoric acid as an example to explain the term 'polyprotic'. (4 marks)

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- (d) Phosphoric acid is a weak acid and a weak electrolyte. Barium hydroxide is a strong base and a strong electrolyte. Using equations containing phosphoric acid and barium hydroxide, explain the difference between the terms 'strong' and 'weak' when referring to electrolytes. (4 marks)

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- (e) A student reacts 125 mL of 0.250 mol L<sup>-1</sup> nitric acid with 50.0 mL of 1.13 mol L<sup>-1</sup> potassium hydroxide solution.

- (i) How many moles of hydrogen ions are available for reaction? (2 marks)

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- (ii) How many moles of hydroxide ions are available for reaction? (2 marks)

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- (f) Identify the limiting reagent when the two solutions from part (e) are mixed together. Show your reasoning. (3 marks)

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- (g) Circle whether the resulting solution has a pH above, below or equal to 7 at 25 °C. (1 mark)

Below 7

Above 7

Equal to 7

## Question 39

(21 marks)

An organic compound was found to contain carbon, hydrogen and chlorine. When a 2.62 g sample of the compound was combusted, it produced 3.69 g of carbon dioxide and 1.13 g of water.

- (a) Determine the number of moles and the mass of carbon in the sample. (4 marks)

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- (b) Determine the number of moles and mass of hydrogen in the sample. (4 marks)

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- (c) Determine the mass and number of moles of chlorine in the sample. (3 marks)

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- (d) Determine the simplest mole ratio of carbon, hydrogen and chlorine in the compound. (2 marks)

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See next page



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## Question 40

(11 marks)

Copper is a widely used metal which can be refined by electrolysis.

- (a) State **one** use of copper in the home. (1 mark)

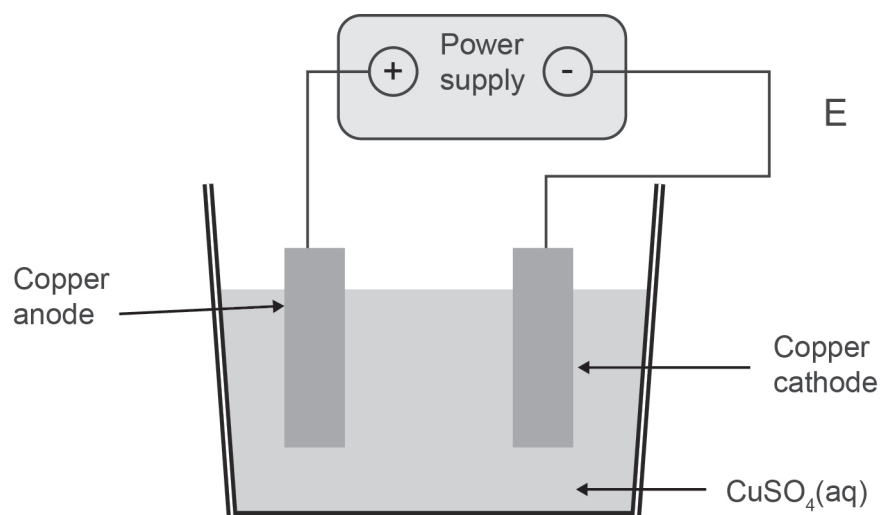
\_\_\_\_\_

- (b) State **two** properties of copper that make it suitable for the use stated in part (a). (2 marks)

One: \_\_\_\_\_

Two: \_\_\_\_\_

Look at the diagram below, which represents an electrolytic cell that can be used to produce pure copper from a solution of copper(II) sulfate ( $\text{CuSO}_4$ ).



- (c) (i) Draw an arrow on the diagram to show the direction of the movement of electrons in the external circuit at Point E. (1 mark)
- (ii) Draw an arrow on the diagram to show the direction of the movement of copper ions ( $\text{Cu}^{2+}$ ) in the solution. (1 mark)

- (d) Why must the power supply be direct current (DC) and not alternating current (AC)?  
(3 marks)

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- (e) Explain why the copper(II) sulfate needs to be dissolved in water for the electrolysis process to work.  
(3 marks)

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## Question 41

(15 marks)

Indigestion is caused by the build-up of excess acid (mainly hydrochloric acid – HCl) in the stomach. Indigestion tablets work by neutralising this excess acid. A common brand contains 680 mg of calcium carbonate per tablet.

The reaction that occurs as the acid is neutralised is shown below.



Two students each developed a hypothesis relating to the action of indigestion tablets.

Hypothesis 1: Crushing the tablet will make the carbonate in the tablet less concentrated. This will reduce the rate of the reaction with the hydrochloric acid and the indigestion will take longer to be treated.

Hypothesis 2: Crushing the tablet will spread the chemical out and then it is free to react with more of the acid, which will cure the indigestion better.

The students carried out an experiment in two parts to test their hypotheses. They decided to measure the rate of the reaction by timing how quickly carbon dioxide was produced.

The procedure used was as follows.

**Part A: Whole tablet**

1. Add 25.0 mL of 1.00 mol L<sup>-1</sup> hydrochloric acid to a small flask connected to a gas syringe.
2. Add one whole tablet to the flask. Quickly replace the stopper and start a stopwatch.
3. Stop the watch when 20.0 mL of gas has been collected in the gas syringe and record the time taken.
4. Repeat Steps 1–3 of the procedure two more times.

**Part B: Crushed tablet**

5. Repeat part A, Steps 1–3, but this time crush the tablet before adding it to the acid in the flask.
6. Repeat Step 5 two more times.

The results obtained are shown below.

Tablet state	Trial	Time taken to produce 20.0 mL of gas (s)
Whole	1	15.4
	2	16.2
	3	15.8
Crushed	1	4.5
	2	8.1
	3	6.3

- (a) Calculate the average time taken for the whole tablets to release 20.0 mL of gas. (2 marks)

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- (b) Calculate the average time taken for the crushed tablets to release 20.0 mL of gas. (2 marks)

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- (c) What conclusion can be drawn by comparing the answers for part (a) and part (b)? (1 mark)

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- (d) Suggest why the three results for the crushed tablet show greater variation than those for the whole tablet. (1 mark)

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- (e) Which hypothesis (1 or 2) is **best** supported by the results of the experiment? (1 mark)

Hypothesis \_\_\_\_\_

- (f) Rewrite the hypothesis chosen in part (e), using scientific language that demonstrates your understanding of rates of reaction. (3 marks)

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**Question 41** (continued)

- (g) In this experiment the rate of the reaction was monitored by measuring the time taken to produce a certain volume of gas. Outline **one** other way in which the rate of this reaction could be monitored. Explain your answer with reference to the equation for the reaction. (3 marks)

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- (h) Suggest a source of error in this experiment and what could be done to minimise the error. (2 marks)

Source of error: \_\_\_\_\_

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How to minimise the error: \_\_\_\_\_

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## Question 42

(15 marks)

The formation of acid in the environment can have a significant impact on the environment. Examples of such acid formation include:

- acid rain
- soil acidification in agriculture
- acidification of ground water.

- (a) Choose **one** of the above examples and explain what the term means. (2 marks)

Chosen example: \_\_\_\_\_

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- (b) Name **two** chemicals that contribute to the formation of the acid described in part (a). For each chemical, name **one** source. (4 marks)

Name of chemical	Source of chemical

- (c) Outline **two** negative impacts that such acid formation has on the environment. (4 marks)

One: \_\_\_\_\_

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**Question 42(c) (continued)**

Two: \_\_\_\_\_

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\_\_\_\_\_

- (d) Using **one** of the chemicals and its source listed in part (b), explain how the acid in the environment is formed. Include relevant equations. (5 marks)

[illegible]

**End of questions**



### Additional working space

[illegible]

### Additional working space

[illegible]

### Additional working space

[illegible]

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