



Established in 1879

Raffles Girls' School

(SECONDARY)

Name: _____

Class: 4 / _____

Register No: _____

CHEMISTRY

RAFFLES PROGRAMME/RAFFLES ACADEMY (STANDARD)

YEAR FOUR

End-of-Year Assessment

Monday

1 October 2018

2 hours

INSTRUCTIONS TO CANDIDATES

This question paper contains two sections.

Section A – Answer **ALL** questions and record your answers as instructed on the OMR answer sheet.

Section B – Answer **ALL** questions and write your answers in the spaces provided.

Use only a black or dark blue pen, except for diagrams.

Do not use correction tape or fluid.

Omission of essential working or units, or expressing answers with an incorrect number of significant figures will result in a loss of marks.

School approved calculators are allowed.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is **80**.

For examiners' use

Question	Marks Obtained
Section A (20 marks)	
1-20	
Section B (60 marks)	
B1	/4
B2	/3
B3	/6
B4	/4
B5	/7
B6	/7
B7	/4
B8	/7
B9	/7
B10	/11
Units	
Statements	
Significant Figures	
Total	80

Parents's / Guardian's Name: _____

Signature: _____ Date: _____

Section A – Multiple Choice Questions [20 marks]

Four possible answers (A, B, C, and D) are given for each question. Choose the most appropriate answer and record your answer in the OMR form provided.

- 1 Which statement best describes both hydrochloric acid and ethanoic acid of the same concentration?
- A Both have a pH of 4.
B Both are strong electrolytes.
C Both turn moist red litmus paper blue.
D Both react with metal carbonates to liberate a gas.
- 2 Which of the following oxides is most suitable to reduce the alkalinity of soil?
- A sulfur dioxide
B calcium oxide
C carbon monoxide
D magnesium oxide
- 3 Which salt could **not** be prepared by reacting a metal with a dilute acid?
- A zinc nitrate
B iron(II) chloride
C copper(II) chloride
D magnesium sulfate
- 4 Which method could be used to prepare a pure sample of barium sulfate from dilute sulfuric acid?
- A add aqueous barium nitrate, filter, crystallise the filtrate
B add aqueous barium chloride, filter, wash and dry the residue
C add an excess of barium hydroxide, filter, crystallise the filtrate
D add an excess of barium carbonate, filter, wash and dry the residue
- 5 Solid **R** is gradually added to aqueous solution **S**. The changes in pH are shown on the graph. Which statement can be deduced from the graph?



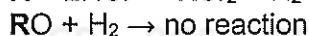
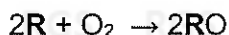
- A Solid **R** is insoluble in water.
B Solid **R** is a non-metal oxide.
C The identity of **S** is sulfuric acid.
D The salt formed is an insoluble salt.

- 6 Which reagent could be used to distinguish between dilute nitric acid and dilute hydrochloric acid?
- A aqueous lead(II) nitrate
 - B aqueous ammonia
 - C aqueous lithium carbonate
 - D iron(II) carbonate
- 7 X, Y and Z are three elements with consecutive atomic numbers. Y is a noble gas. When X and Z react to form a compound, which of the following statements is correct?
- A Atom of X transfers one electron to an atom of Z.
 - B Atom of Z loses one electron and atom of X accepts one electron.
 - C Atom of X shares two electrons to form a single covalent bond with Z.
 - D Atoms of X and Z share an electron each to form a single covalent bond.
- 8 The element francium, Fr, is in the same group as Na in the Periodic Table. Which of the following is likely to be a property of Fr?
- A It is too hard to be cut by a knife.
 - B It has poor electrical conductivity in solid state.
 - C It reacts explosively with water to release hydrogen gas.
 - D It forms a covalent compound with chlorine of the formula FrCl_7 .
- 9 Two different hydrocarbons each contain the same percentage by mass of hydrogen. Which property will be the same for both hydrocarbons?
- A empirical formula
 - B structural formula
 - C relative molecular mass
 - D number of atoms in a molecule
- 10 12.0 g of anhydrous magnesium sulfate combines with 12.6 g of water to form hydrated magnesium sulfate. What is the formula of the hydrated magnesium sulfate? [M_r of $\text{MgSO}_4 = 120$]
- A $\text{MgSO}_4 \cdot 3\text{H}_2\text{O}$
 - B $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$
 - C $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
 - D $\text{MgSO}_4 \cdot 9\text{H}_2\text{O}$
- 11 Which of the following represents 1 mole of a substance?
- A number of atoms in 1 g of helium
 - B number of molecules in 35.5 g of chlorine gas
 - C number of ions in 29.25 g/dm^3 of sodium chloride solution
 - D number of chloride ions in 95 g of magnesium chloride

12 In which oxide does **X** have the same oxidation state as the chloride **XC_l₃**?

- A **X₃O**
- B **X₂O**
- C **XO₂**
- D **X₂O₃**

13 An element **R** reacts in the following ways:



What is the identity of **R**?

- A iron
- B copper
- C calcium
- D aluminium

14 In an electrolysis experiment, the same quantity of electricity deposited 32 g of copper and 12 g of titanium. What is the charge on the titanium ion?

- A 1+
- B 2+
- C 3+
- D 4+

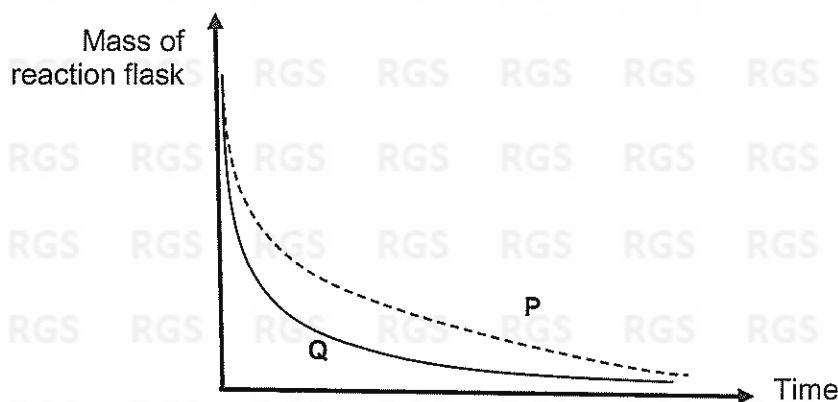
15 Which of the following statements is true about an endothermic process?

- A Light energy is required to break the bonds in the reactants.
- B Activation energy is smaller than the enthalpy change of the reaction.
- C The total energy content of the products is more than that of the reactants.
- D The total energy change in bond formation is more than that in bond breaking.

16 Which of the following statements is false about combustion of fuels?

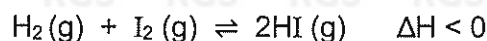
- A The products formed are very stable.
- B The process involves both bond breaking and bond formation.
- C The products formed have a lower energy content than the reactants.
- D The complete combustion of hydrogen fuel produces carbon dioxide and water.

- 17 The mass of the reaction flask containing marble chips and dilute hydrochloric acid was measured. The graph shows the results of two experiments, **P** and **Q**.



Which of the following explains the difference in results between **P** and **Q**?

- A A catalyst is added in **Q**.
 - B A higher temperature is used in **P**.
 - C Larger marble chips are used in **Q**.
 - D A higher concentration of hydrochloric acid is used in **P**.
- 18 Which of the following will increase the yield of hydrogen iodide, HI ?



- A removal of hydrogen gas
 - B increasing the temperature
 - C decreasing the temperature
 - D decreasing the volume of the reaction vessel
- 19 What property would show that a compound **must** be an alkene?

- A It reacts with bromine.
- B It can undergo combustion in air.
- C It is a hydrocarbon with a C=C bond.
- D It only contains carbon and hydrogen.

- 20 Which of the following can distinguish between ethane and ethanol?

- A litmus paper
- B chlorine gas in the dark
- C aqueous barium chloride
- D acidified potassium dichromate(VI)

End of Section A

Section B (60 Marks)

Answer **ALL** questions and write your answers in the spaces provided.

B1 Molybdenum is a transition element used to make hardened steel. Molybdenum can be produced by heating molybdenum(VI) oxide, MoO_3 , and aluminium.

(a) Construct the equation for this reaction.

..... [1]

(b) Using your answer in (a), explain if molybdenum or aluminium is considered the more reactive metal.

..... [1]

(c) Molybdenum has a melting point of 2623°C . Describe its bonding and structure.

..... [2]

B2 Potassium sulfide can be produced by heating potassium sulfate with carbon as shown in the equation below.



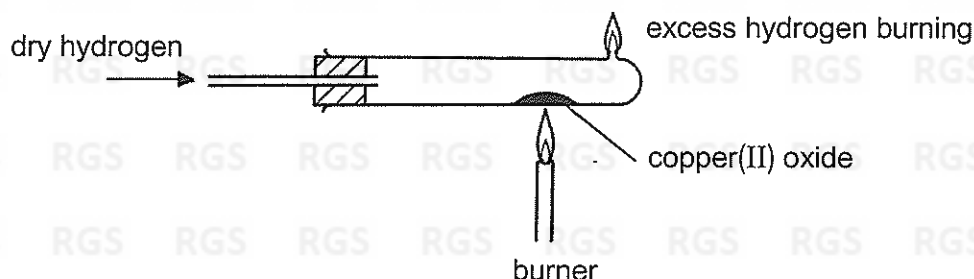
(a) Draw the dot and cross diagram to show the bonding in potassium sulfide.

..... [2]

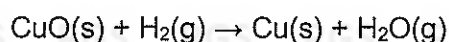
(b) State a physical property of carbon monoxide.

..... [1]

- B3** Copper can be obtained by heating copper(II) oxide in a stream of hydrogen gas as shown in the diagram below. The burner is turned off when the reaction is completed but the hydrogen is kept flowing until the tube is cold.



The reaction is represented by the following equation.



- (a) Suggest why hydrogen is kept flowing until the tube is cold after the reaction is completed.

[1]

- (b) Explain, in terms of oxidation state, whether copper(II) oxide has been oxidised or reduced.

[2]

- (c) 9.00 g copper was formed when 11.5 g of copper(II) oxide was reacted with hydrogen. Calculate the percentage yield of copper.

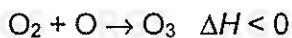
[2]

- (d) The Statue of Liberty in New York is made from iron frame covered with copper plates. In 2004, work had to be carried out to stop the iron frame from rusting away. The iron frame rusted more quickly when it was in contact with copper.

Explain why copper in contact with iron causes the iron to rust faster.

[1]

B4 Ozone molecules are formed from oxygen gas in the presence of UV light. It is a strong oxidizing agent and is used in many industrial applications such as in the preparation of pharmaceuticals and synthetic lubricants. The equation below shows how ozone can be formed in the atmosphere.



- (a) Explain, in terms of bond breaking and bond forming, why this reaction is exothermic.

.....
.....

[1]

- (b) When 100 g of oxygen molecules react, 1225 kJ of energy is released. Calculate the enthalpy change of this reaction.

.....
.....

[2]

- (c) State a pollutant that depletes ozone in the atmosphere.

.....

[1]

- B5** The graph below shows the volume of carbon dioxide produced over time in the reaction between dilute hydrochloric acid and aqueous sodium carbonate.

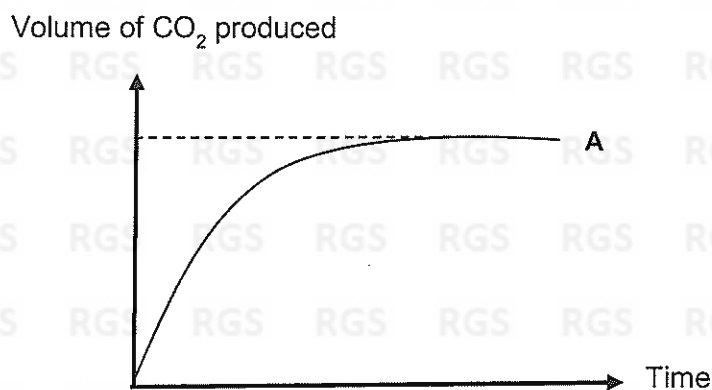


Figure 1

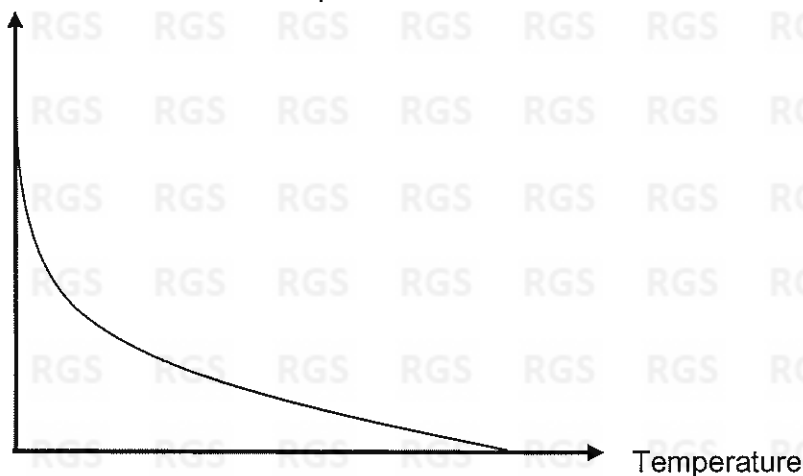
- (a) In experiment **A**, 15.0 cm³ of 1.00 mol/dm³ of aqueous sodium carbonate reacted with 40.0 cm³ of 1.00 mol/dm³ of dilute hydrochloric acid. Calculate the volume of carbon dioxide produced at room temperature and pressure.



- (b) The experiment is repeated using cooled dilute hydrochloric acid. Sketch the graph on Figure 1 and label it **X**.

- (c) The graph below shows how the time taken for a reaction to reach completion changes with temperature.

Time taken for reaction to reach completion



- (i) With reference to the graph above, state the relationship between rate of reaction and temperature.

.....
.....

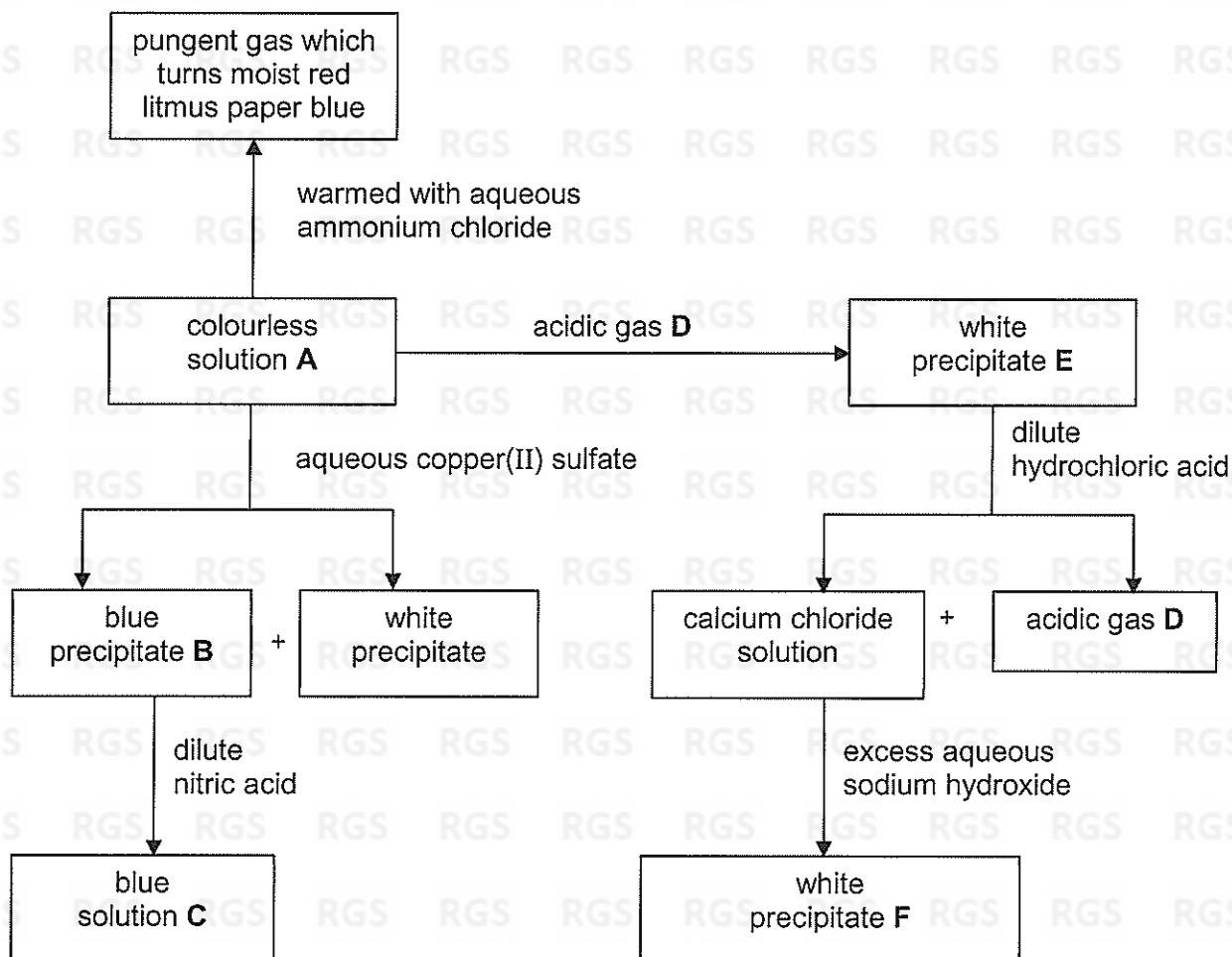
[1]

- (ii) Explain your answer to c(i) using the collision theory.

.....
.....
.....
.....
.....
.....
.....

[3]

B6 Study the reaction scheme below and answer the questions that follow.



(a) Identify the following substances.

A:

B:

C:

D:

E:

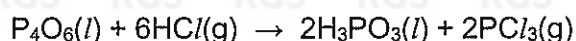
[5]

(b) Write an ionic equation for the formation of F.

.....

[2]

- B7** Phosphoric acid can be formed when phosphorus(III) oxide, P_4O_6 , reacts with hydrogen chloride at $100\text{ }^{\circ}\text{C}$.



- (a) Predict the effect on the concentration of phosphoric acid when some phosphorus trichloride is removed. Explain why.

.....

.....

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.....

.....

[2]

- (b) Predict the effect on the concentration of phosphoric acid when the pressure of the system was decreased. Explain why.

.....

.....

.....

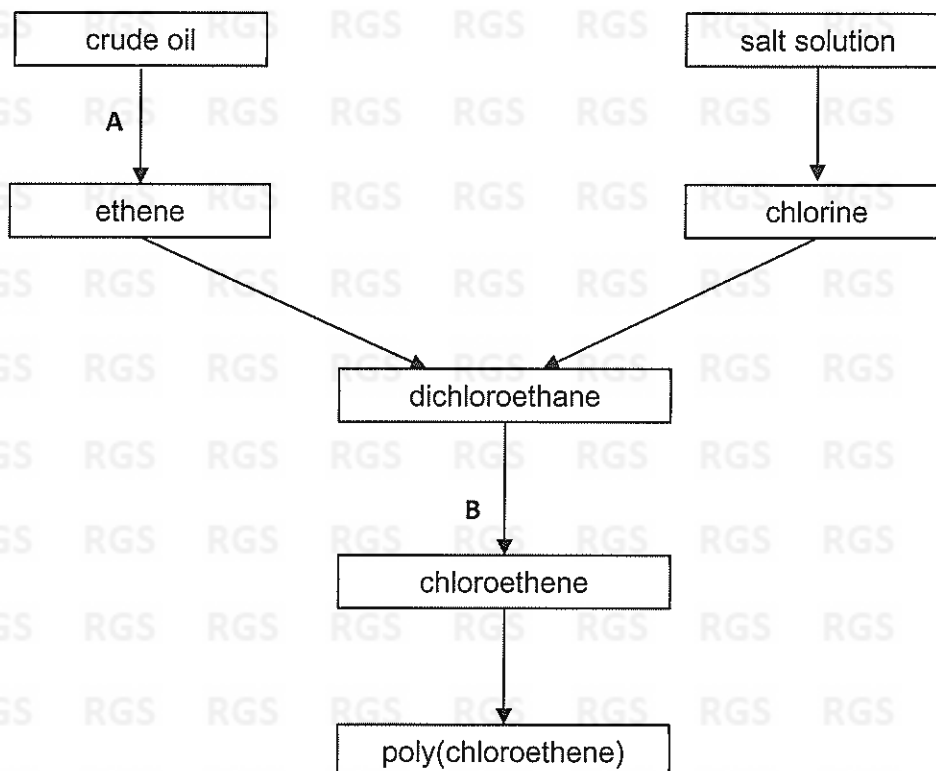
.....

.....

[2]

- B8** Plastic litter is one of the biggest problems facing the world's seas with the amount of plastic in the ocean tripling by the year 2025. One of the most common plastic disposed is poly(chloroethene). Large quantities of poly(chloroethene) are manufactured annually and used in the production of a variety of products, including children's toys.

The flow chart shows the steps involved in the manufacture of poly(chloroethene).



- (a) Name the **two** processes involved in **A**.

[2]

- (b) State the type of reaction in **B**.

[1]

- (c) Draw the full structural formula for dichloroethane.

[1]

- (d) Ethene can also be used to manufacture ethanol. State the reagent and conditions for this reaction.

Reagent:

Conditions:

[2]

- (e) Draw **three** repeating units of poly(chloroethene).

[1]

- B9** Carboxylic acids are a homologous series of organic compounds. The table below shows some physical properties of carboxylic acids.

Carboxylic acid	Condensed Structural Formula	Melting point / °C	Boiling point / °C
Methanoic acid	HCO ₂ H	8	100
Ethanoic acid	CH ₃ CO ₂ H	17	118
Propanoic acid	CH ₃ CH ₂ CO ₂ H	-21	141
Butanoic acid	CH ₃ (CH ₂) ₂ CO ₂ H	-8	164
Hexadecanoic acid	?	63	269

- (a) Predict the condensed structural formula for hexadecanoic acid that contains 16 carbon atoms.

..... [1]

- (b) With reference to carboxylic acids, explain the term *homologous* series.

.....
..... [2]

- (c) Propanoic acid reacts with ethanol to produce an ester.

- (i) State the reagent for this reaction.

..... [1]

- (ii) Name and draw the full structural formula of this ester.

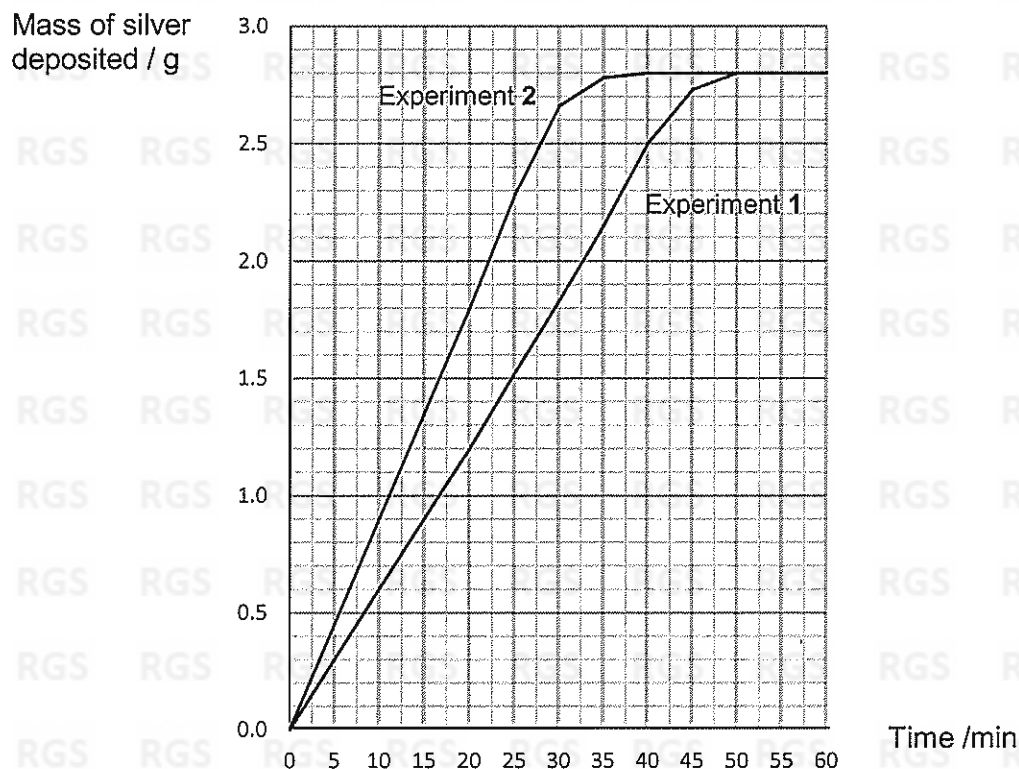
Name: [2]

- (d) State the formula of the salt formed when butanoic acid reacts with magnesium hydroxide.

..... [1]

B10 A student carried out two experiments to compare the mass of silver deposited on the electrode over 60 minutes. For both experiments, she used 250 cm^3 of aqueous silver nitrate of the same concentration with platinum electrodes.

In Experiment 1, a current of 1.0 ampere was used and the mass of one electrode was weighed every 5 minutes. In Experiment 2, the procedure was repeated with a current of 2.0 ampere instead. The results were plotted and shown below.



- (a) (i) Which electrode was weighed in the experiment?

..... [1]

- (ii) Write the half-equation for the reaction which took place at this electrode in a(i).

..... [1]

- (b) With reference to the graph above, state **two** trends observed from the graph above.

.....
.....
..... [2]

- (c) Determine the mass of the silver deposited after 15 minutes for Experiment 2.
..... [1]
- (d) With reference to the above experiments, suggest the modifications made to the electrodes in the industrial purification of impure silver.
Anode:
Cathode: [1]
- (e) At the end of both experiments, the student added dilute hydrochloric acid into the beaker. There was no precipitate formed. Calculate the molar concentration of the aqueous silver nitrate at the start of the experiment.
..... [1]
- (f) The student repeated the experiment with 125 cm³ of the same concentration of aqueous silver nitrate and applied a current of 4.0 ampere for 60 minutes. Sketch the expected results on the same graph above and label it as X. [2]
- (g) Explain why silver metal conducts electricity and explain how this differs from the conduction of electricity by aqueous silver nitrate.
.....
.....
..... [2]

End of Section B

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The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
Key proton (atomic) number atomic symbol name relative atomic mass																	
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40										
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	89 – 103 actinoids		104 Rf Rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -						

lanthanoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).