



Established in 1879

Raffles Girls' School

(SECONDARY)

Name: _____

Class: _____

Register No: _____

RAFFLES PROGRAMME CHEMISTRY YEAR FOUR

Pen-and-Paper Assessment

Tuesday

31 March 2020

1 hour

INSTRUCTIONS TO CANDIDATES

This question paper contains two sections.

Section A – 10 marks

Answer **ALL** the questions and shade your answers on the OMR answer sheet provided.

Section B – 30 marks

Answer **ALL** the questions and write your answers in the spaces provided. Use a black or blue pen to write your answers, except for diagrams. Do not use correction tape or fluid.

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

INFORMATION FOR CANDIDATES

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

A copy of the Periodic Table is provided on the last page of the Question Paper.

The weighting for the paper is **20%**.

For examiners' use

Question / Section	Marks Obtained
A	10
B1	7
B2	7
B3	5
B4	5
B5	6
statement	
units	
s.f.	
Total marks	40

Parent's / Guardian's Name: _____

Signature: _____ Date: _____

Section A – Multiple Choice Questions [10 marks]

Answer all questions. For each question, there are four possible answers (**A**, **B**, **C**, and **D**). Choose the most appropriate answer and record your choice in the separate Answer Sheet provided.

- 1 Flowers of *Hydrangea* are pink when grown in alkaline soil and blue when grown in acidic soil.

Which solution can be added to the soil of a *Hydrangea* with pink flowers so that the flowers can remain pink?

- A citric acid
- B sodium chloride
- C potassium sulfate
- D calcium hydroxide

- 2 The oxide of element **V** was added separately to aqueous nitric acid and aqueous potassium hydroxide as shown below.

oxide of **V** + aqueous nitric acid → no reaction

oxide of **V** + aqueous potassium hydroxide → no reaction

Which row describes the nature of element **V** and its oxide?

	V	oxide of V
A	metallic	neutral
B	metallic	amphoteric
C	non-metallic	acidic
D	non-metallic	neutral

- 3 Which of the following salts **cannot** be prepared by the reaction between a dilute acid and an insoluble base or carbonate?

- A zinc sulfate
- B copper(II) chloride
- C ammonium sulfate
- D magnesium nitrate

- 4 In an experiment, 10.0 cm³ of 1.00 mol/dm³ aqueous copper(II) sulfate was mixed with 7.0 cm³ of 1.00 mol/dm³ aqueous sodium carbonate.

Which of the following best describes the observations seen?

- A a white precipitate and a blue solution
- B a blue precipitate and a colourless solution
- C a green precipitate and a colourless solution
- D a greenish-blue precipitate and a blue solution

- 5 An oxide of titanium contains 60 % by mass of titanium.

What is the empirical formula for this oxide?

- A TiO
 B TiO_2
 C Ti_2O
 D Ti_2O_3

- 6 The table below shows the observations from tests conducted on solution **W**.

	Test	Observations
1	To 1 cm ³ of solution W , add aqueous sodium hydroxide dropwise until aqueous sodium hydroxide is in excess. Warm gently.	No visible change. Moist red litmus paper remains red.
2	To 1 cm ³ of solution W , add 2 cm ³ of aqueous sodium hydroxide followed by Devarda's alloy. Warm gently.	Colourless, pungent gas evolved. Gas turned moist red litmus paper blue.

Which conclusion must be correct?

- A **W** contains nitrite ions only.
 B **W** contains nitrate ions only.
 C **W** contains ammonium ions only.
 D **W** contains ammonium and nitrate ions.

- 7 An acid, **X**, was added to a solution of metal nitrate, **Y**. A white precipitate was formed.

Which of the following are possible identities of **X** and **Y**?

	X	Y
A	HCl	$\text{Ca}(\text{NO}_3)_2$
B	HNO_3	$\text{Zn}(\text{NO}_3)_2$
C	H_2SO_4	$\text{Al}_2(\text{SO}_4)_3$
D	H_2SO_4	$\text{Ba}(\text{NO}_3)_2$

- 8 Hydrogen peroxide reacts with acidified potassium iodide to form iodine as one of the products. Hydrogen peroxide can turn acidified potassium dichromate(VI) from orange to green.

Which statement is true?

- A Hydrogen peroxide can act as a reducing agent only.
- B Hydrogen peroxide can act as an oxidising agent only.
- C Hydrogen peroxide is neither an oxidising agent nor a reducing agent.
- D Hydrogen peroxide can act as both an oxidising agent and a reducing agent.

- 9 Zinc metal is placed in an aqueous solution containing a mixture of magnesium nitrate and copper(II) sulfate.

Which element would be displaced?

- A sulfur
- B copper
- C nitrogen
- D magnesium

- 10 Which of the following is the reducing agent used in the blast furnace for extraction of iron from its ore?

- A silica
- B carbon dioxide
- C carbon monoxide
- D calcium carbonate

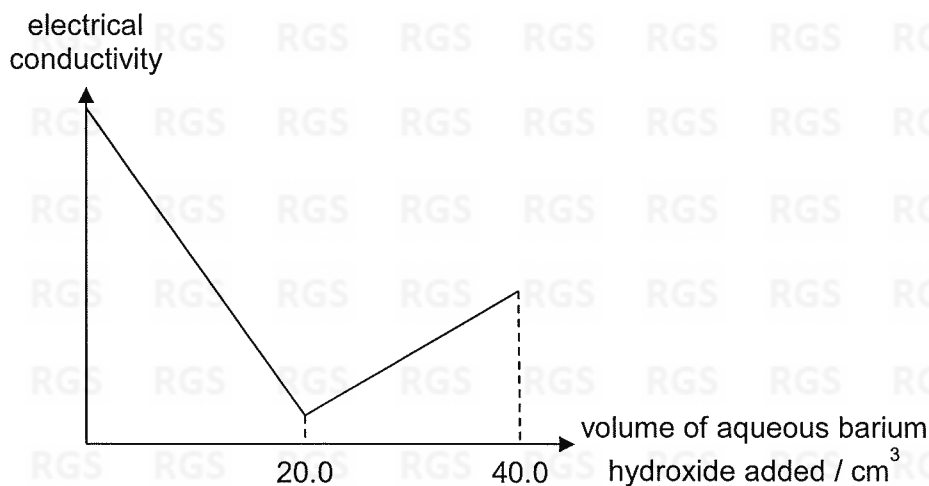
----- End of Section A -----

Section B – Structured Questions [30 Marks]

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

- B1** In an experiment, 0.100 mol/dm^3 aqueous barium hydroxide was added dropwise to 20.0 cm^3 of 0.100 mol/dm^3 aqueous sulfuric acid.

The graph below shows the electrical conductivity of the mixture.



- (a) State the type of reaction for the above experiment.

[1]

- (b) Write the chemical equation, with state symbols, for this reaction.

[2]

- (c) A change in the electrical conductivity of the mixture can be observed.

State one other observation for this reaction.

[1]

- (d) Explain the shape of the graph.

[2]

- (e) The experiment was repeated using 0.100 mol/dm^3 aqueous barium hydroxide and 20.0 cm^3 of 0.100 mol/dm^3 aqueous nitric acid.

State the volume of aqueous barium hydroxide needed for electrical conductivity to reach a minimum value.

[1]

B2 Calcium sulfate can be prepared by the following procedure:

- (i) adding excess calcium oxide to dilute nitric acid,
- (ii) adding excess dilute sulfuric acid,
- (iii) filtering the mixture, and
- (iv) washing the residue formed with distilled water.

(a) Explain why it is not advisable to prepare calcium sulfate by adding calcium oxide to dilute sulfuric acid directly.

[2]

(b) Name one possible impurity that might be removed when the residue is washed.

[1]

(c) Write the ionic equation, with state symbols, for the reaction between calcium oxide and dilute nitric acid.

[2]

(d) A student wishes to prepare 10.0 g of calcium sulfate using the above-mentioned method.

Calculate the minimum mass of calcium oxide he would need to use. (Assuming 100 % yield.)

[2]

B3 In a chemical reaction, 12.0 g of anhydrous magnesium sulfate reacted with 12.6 g of water to form hydrated magnesium sulfate with the formula of $\text{MgSO}_4 \cdot n\text{H}_2\text{O}$ (n is a whole number).

- (a) Determine the value of n and write the chemical formula of the hydrated magnesium sulfate salt. [3]

- (b) 16.5 g of anhydrous magnesium sulfate was dissolved in water and recrystallised to obtain hydrated magnesium sulfate crystals.

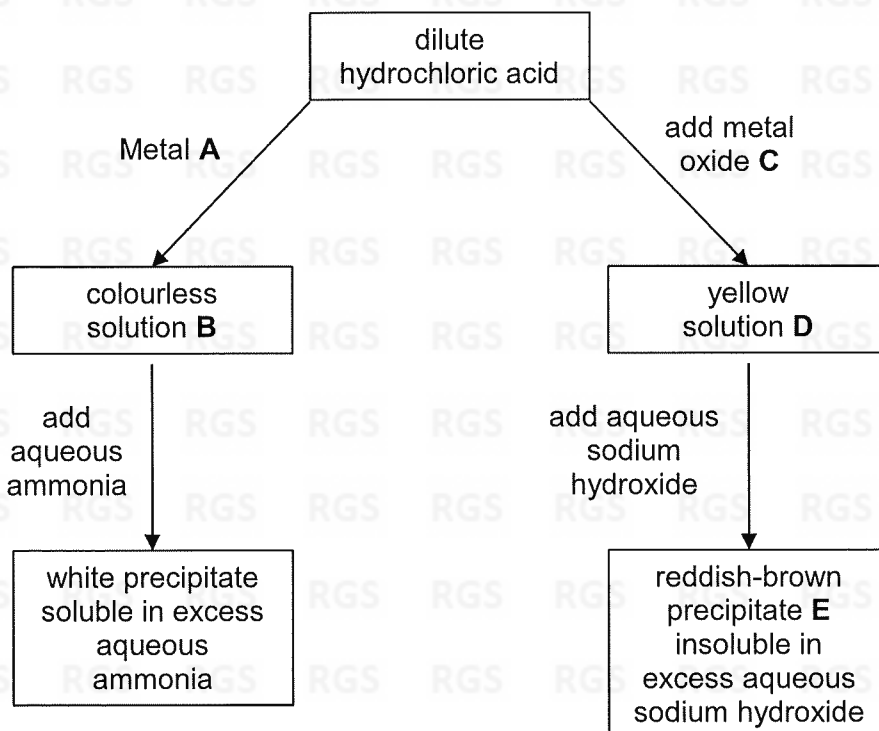
Calculate the expected mass of hydrated magnesium sulfate that can be formed. [1]

- (c) The percentage yield of hydrated magnesium sulfate obtained from crystallisation is 84.6 %.

Calculate the actual mass of hydrated magnesium sulfate crystals obtained.

[1]

- B4** The diagram below describes some of the properties and reactions of several substances.



- (a) Based on the information given above, identify the following substances.

A : _____

B : _____

C : _____

D : _____

E : _____

[5]

B5 Copper(I) oxide is a reddish-brown solid. It is commonly used as a pigment in household paints. Copper(I) oxide can react with excess dilute sulfuric acid to form copper(II) sulfate, copper metal and one other product.

(a) Write the chemical equation, with state symbols, for this reaction.

[2]

(b) State two observations for this reaction.

[2]

(c) State and explain which substance has been **both** oxidised and reduced in this reaction.

[2]

----- End of Section B -----

The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	0	
		proton (atomic) number atomic symbol name relative atomic mass																
		1 H hydrogen 1																
3 Li lithium 7	4 Be beryllium 9	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	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	2 He helium 4		
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	75 Re rhenium 186	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 -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganeson -	119 Uue unbinilium -	120 Uuh ununilium -	