

Raffles Girls' School

(SECONDARY)

Name:

Class:

Register No:

CHEMISTRY YEAR FOUR

Questions marked with an asterisk * are not tested in CBA 1. Please skip these questions when doing your revision.

For examiners' use

Pen-and-Paper Assessment

Friday

06 May 2022

INSTRUCTIONS TO CANDIDATES

Write your name and register number in the spaces provided. Write in dark blue or black ink.

For **Section A**, indicate your answers on the separate Answer Sheet provided.

Answer all other questions in the space provided.

All quantitative answers should include appropriate units and significant figures.

Omission of statements and working may result in loss of marks.

INFORMATION FOR CANDIDATES

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

The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table is on page 12.

The total number of marks for this paper is **40** and the weighting is **20%**.

Parent's / Guardian's Name: ______ Signature: ______ Date: _____

This Question Paper consists of **12** printed pages, including the cover page.

1 hour

Question / Section	Marks Obtained									
Section	A / 10									
1-10										
Section	В/30									
11	/4									
12	/6									
13	/11									
14	/9									
statement/ units/ sig. fig.										
Total	40									

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** The diagram shows the reactions of solution E.



What are the ions present in solution E?

- **A** zinc ions and nitrate ions
- **B** lead(II) ions and chloride ions
- **C** aluminium ions and nitrate ions
- **D** ammonium ions and chloride ions
- *2 The following observations are recorded after tests are carried out on a green solid.
 - Test 1: Upon strong heating, green solid turns black.
 - Test 2: Effervescence is observed when dilute nitric acid is added to the green solid. Upon adding aqueous barium nitrate to the resultant mixture, no visible reaction is seen.

What is the identity of the green solid?

- A iron(III) sulfate
- **B** iron(III) carbonate
- **C** copper(II) sulfate
- D copper(II) carbonate

***3** In an experiment, 4.0 cm³ of 1.0 mol/dm³ iron(III) sulfate solution is mixed with 4.0 cm³ of 1.0 mol/dm³ sodium hydroxide solution.

What is observed at the end of the reaction?

- **A** green precipitate in yellow solution
- **B** green precipitate in colourless solution
- **C** reddish brown precipitate in yellow solution
- **D** reddish brown precipitate in colourless solution
- 4 In which reaction does the underlined reactant undergo oxidation?
 - $\textbf{A} \quad \underline{PbO}(s) \ + \ CO(g) \rightarrow Pb(s) \ + \ CO_2(g)$
 - $\textbf{B} \quad 2H_2S(g) \ + \ \underline{SO_2}(g) \ \rightarrow \ 3S(g) \ + \ 2H_2O(l)$
 - $\textbf{C} \quad \underline{Ca(OH)_2}(aq) \ + \ CO_2(g) \ \rightarrow \ CaCO_3(s) \ + \ H_2O(l)$
 - $\label{eq:constraint} \textbf{D} \quad \text{KClO}(aq) \ + \ \underline{\text{SO}_2}(g) \ + \ \text{H}_2\text{O}(l) \rightarrow \ \text{KCl}(aq) \ + \ \text{H}_2\text{SO}_4(aq)$
- ***5** Four experiments are carried out to investigate the factors that affect the rusting of iron.



Which row shows a decreasing rate of rusting for the four experiments?

- **A** 1, 2, 3, 4 **B** 1, 3, 2, 4
- **C** 3, 4, 1, 2
- **D** 3, 1, 4, 2

6 Which substance will decolourise aqueous bromine?

- A chlorine gas
- **B** aqueous iron(II) sulfate
- C aqueous iron(III) nitrate
- **D** aqueous sodium chloride

7 Two elements J and M form ionic compounds, JBr₂ and M₂O₃. The molten compounds are electrolysed using inert electrodes in separate experiments.

What are the products formed at the anodes?

- A J and M
- **B** bromine and oxygen
- **C** hydrogen and oxygen
- **D** hydrogen and bromine
- 8 Which row shows the products formed during electrolysis?

	electrolyte	prod	lucts
Α	dilute magnesium nitrate	magnesium	oxygen
В	concentrated magnesium nitrate	magnesium	oxygen
С	dilute hydrochloric acid	hydrogen	chlorine
D	concentrated hydrochloric acid	hydrogen	chlorine

9 The diagram shows three simple cells.



Which row represents cell 3?

	positive electrode	negative electrode	Voltage /V
Α	R	Q	+0.8
В	R	Q	+1.4
С	Q	R	-0.8
D	Q	R	-1.4

***10** A series of experiments is conducted to determine that the reactivity of three metals in descending order is Z, X and Y.

Which experiment is unnecessary?

- $\textbf{A} \quad X(s) + H_2O(l) \rightarrow \text{no reaction}$
- $\textbf{B} \quad X(s) + YO(s) \rightarrow XO(s) + Y(s)$
- $\textbf{C} \quad Z(s) + YSO_4(aq) \rightarrow ZSO_4(aq) + Y(s)$
- $\textbf{D} \quad Z(s) + 2H_2O(l) \rightarrow Z(OH)_2(aq) + H_2(g)$

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

Section B – Structured Questions [30 marks]

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

11 Pieces of tin are added to 250 cm³ of 2.0 mol/dm³ aqueous copper(II) sulfate. The blue solution is observed to turn completely colourless after a while. The equation for the reaction is shown.

 $Sn(s) + CuSO_4(aq) \rightarrow SnSO_4(aq) + Cu(s)$

.....

- *(a) State one other observation.
 - (b) Calculate the mass of tin used in this reaction.

[1]

[1]

(c) The resultant reaction mixture is filtered. The filtrate is heated until saturation and then cooled. 111.6 g of hydrated tin(II) sulfate, SnSO₄.H₂O, is obtained.

Calculate the percentage yield of hydrated tin(II) sulfate.

[Total: 4]

*12 The diagram shows the reaction scheme of two elements, a grey metal **P** and a black solid **Q**.



- **13** Electrolysis of dilute zinc sulfate solution using graphite electrodes is conducted using the set up shown.
 - (a) Label the anode and cathode, and indicate the direction of electron flow.



(e) A student predicts that the products obtained will be the same if dilute zinc sulfate solution is replaced with dilute copper(II) nitrate solution.

State and explain if you agree with this prediction.

[3]

[Total: 11]

14 The table shows the reactions between four metals and excess dilute hydrochloric acid at room temperature and pressure. The metals have equal number of moles.

experiment	metal added	total volume of hydrogen gas evolved / cm³	observations
1	aluminium	144	very slow reaction at first,
			after 1 minute.
2	iron	96	slow reaction
3	X	144	moderately rapid reaction
4	zinc	96	rapid reaction

*(a) Arrange the four metals in order of decreasing reactivity.

.....[1]

*(b) Explain the observations in experiment 1.

*(c) Using the information from the table above, predict and explain the charge of the metal **X** ion formed in experiment 3.

(d) (i) Write the chemical equation for the reaction in experiment 4.

.....[1]

(ii) Explain, in terms of oxidation states, why the reaction in experiment 4 is a redox reaction.

.....[2]

(iii) Calculate the mass of zinc used in experiment 4.

[1]

[Total: 9]

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

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The volume of one mole of any gas is 24 \mbox{dm}^3 at room temperature and pressure (r.t.p.).