

ST. PAUL'S COLLEGE
F.4 Mid-year Examination Sample Paper
CHEMISTRY

Name _____

Form 4 _____ Class No. _____

X1 / X2 / X3

Time allowed : **1 1/2 hours**

Instructions

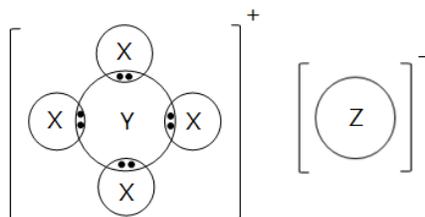
1. Answer **ALL** questions.
2. There are **TWO** sections in this paper, Section A and Section B.
3. Section A consists of 25 multiple-choice questions.
4. Section B consists of 4 conventional questions.

Section	Question No.	Marks
A	–	
B	1	
	2	
	3	
	4	
	Total	

Section A

1. Answer all questions by filling in the multiple-choice answer sheet.
2. Mark your answers in pencil.

1. X, Y and Z are three different elements. The electron diagram (showing electrons in the outermost shells only) of the compound formed by X, Y and Z is shown below:



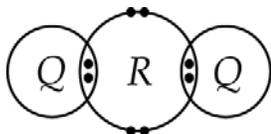
Which of the following statements are CORRECT?

- (1) There is one electron in the outermost shell of an atom of X.
 - (2) There are five electrons in the outermost shell of an atom of Y.
 - (3) There are eight electrons in the outermost shell of an atom of Z.
- A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)
2. Which of the following ions has the same number of protons as the hydroxide ion, OH⁻?
A. O²⁻
B. F⁻
C. Na⁺
D. Mg²⁺
 3. The atomic number of element X is 16. Which of the following statements concerning X are CORRECT?
(1) X can react with calcium to form an ionic compound.
(2) The oxide of X dissolves in water to form an acidic solution.
(3) X can conduct electricity in its molten state.
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)
 4. Which of the following is correctly matched?

<u>Formula</u>	<u>Name</u>
A. AgI ₂	Silver iodide
B. BaSO ₄	Barium sulphate
C. LiCO ₃	Lithium carbonate
D. ZnHSO ₃	Zinc hydrogensulphite

5. Which of the following compounds, when dissolved in water, gives a green solution?
- magnesium sulphate
 - cobalt(II) chloride
 - nickel(II) sulphate
 - iron(III) sulphate

6. The electron diagram of a molecule RQ_2 is shown below:



To which group of the Periodic Table does R belong?

- Group II
 - Group V
 - Group VI
 - Group VII
7. The atomic numbers of two elements A and B are 13 and 8 respectively. The compound formed between A and B
- is soluble in tetrachloromethane.
 - is a liquid at room temperature.
 - has a formula A_3B_2 .
 - conducts electricity in its molten state.
8. Which of the following is correctly matched?
- | <u>Ore</u> | <u>Compound</u> |
|------------------|----------------------|
| A. Galena | Lead(II) oxide |
| B. Bauxite | Iron(III) oxide |
| C. Haematite | Aluminium oxide |
| D. Copper pyrite | Copper iron sulphide |
9. Recycling of metals is important because
- (1) waste disposal problems can be solved.
 - (2) this raises the public awareness of conservation.
 - (3) metals are renewable.
- (1) and (2) only
 - (1) and (3) only
 - (2) and (3) only
 - (1), (2) and (3)

10. What are the values of **w**, **x**, **y** and **z** in the following equation?



- | | <u>w</u> | <u>x</u> | <u>y</u> | <u>z</u> |
|----|-----------------|-----------------|-----------------|-----------------|
| A. | 1 | 1 | 2 | 2 |
| B. | 2 | 2 | 2 | 1 |
| C. | 2 | 2 | 4 | 1 |
| D. | 2 | 4 | 4 | 1 |

11. Which of the following would be observed when calcium is burnt in air?

- A. A brick-red flame is seen and a white powder is left.
- B. A brick-red flame is seen and a yellow powder is left.
- C. A bluish green flame is seen and a white powder is left.
- D. A bluish green flame is seen and a yellow powder is left.

12. Which of the following equations represents a possible reaction?

- A. $4\text{Ag(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{Ag}_2\text{O(s)}$
- B. $\text{Mg(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Mg(OH)}_2(\text{s}) + \text{H}_2(\text{g})$
- C. $\text{Pb(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Pb(OH)}_2(\text{s}) + \text{H}_2(\text{g})$
- D. $\text{Cu(s)} + 2\text{HCl(aq)} \rightarrow \text{CuCl}_2(\text{aq}) + \text{H}_2(\text{g})$

13. A scientist extracted a sample of 'oxygen' from air by removing the nitrogen and carbon dioxide in the sample. The scientist then compared the mass of a known volume of the 'oxygen' sample (m_1) with that of the same volume of pure oxygen (m_2) under the same condition. It was found that m_1 was greater than m_2 .

Which of the following gases is likely to be present in the 'oxygen' obtained to account for the result that m_1 is greater than m_2 ?

(Relative atomic masses: H = 1.0, C = 12.0, O = 16.0, Ne = 20.2, Ar = 40.0)

- A. Methane
- B. Water vapour
- C. Neon
- D. Argon

14. Which of the following statements is/are INCORRECT?

- (1) If a sample turns dry cobalt(II) chloride paper pink, the sample is pure water.
- (2) If a sample contains chloride ions, white precipitate is formed when excess dilute nitric acid and aqueous silver nitrate is added to the sample.
- (3) If a flame test is performed, dilute hydrochloric acid is used to moisten the platinum wire.

- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

15. Which of the following statements correctly explain(s) the chemical weathering of calcite?
- (1) Calcite reacts with oxygen in air.
 - (2) Carbon dioxide in air dissolves in rainwater to form an acid which can dissolve calcite.
 - (3) Calcite reacts with a large amount of water to form soluble calcium hydroxide solution.
- A. (1) only
 B. (2) only
 C. (1) and (3) only
 D. (2) and (3) only

16. Calcium carbonate can be produced from quicklime through two processes as shown below.



Which of the following combinations is correct?

- | <u>Process 1</u> | <u>Process 2</u> |
|------------------------------|---------------------------|
| A. Adding water | Heating |
| B. Adding carbon dioxide gas | Adding water |
| C. Adding water | Adding carbon dioxide gas |
| D. Heating | Adding water |
17. In which of the following processes would carbon dioxide gas be produced?
- (1) Respiration
 - (2) Heating slaked lime strongly
 - (3) Adding dilute hydrochloric acid to quicklime
- A. (1) only
 B. (2) only
 C. (1) and (3) only
 D. (2) and (3) only
18. How many atoms are there in 3.40 g of ammonia gas?
 (Relative atomic masses: H = 1.0, N = 14.0)
- A. 0.20
 B. 0.80
 C. $0.20 \times 6.02 \times 10^{23}$
 D. $0.80 \times 6.02 \times 10^{23}$

19. Compound A has the following composition:

Percentage by mass of magnesium	21.9%
Percentage by mass of phosphorus	27.8%
Percentage by mass of oxygen	50.3%

Which of the following is the empirical formula of A?

(Relative atomic masses: O = 16.0, Mg = 24.3, P = 31.0)

- A. MgPO_2
- B. MgPO_3
- C. $\text{Mg}_2\text{P}_2\text{O}_7$
- D. $\text{Mg}_3\text{P}_2\text{O}_8$

20. 1.26 g of a hydrated salt ($X \cdot n\text{H}_2\text{O}$) gives 0.90 g of anhydrous salt (X) on heating. Given that the relative molecular mass of X is 90.0, what is the value of n ?

(Relative atomic masses: H = 1.0, O = 16.0)

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

21. Equal masses of aluminium, magnesium, zinc and iron are added to excess dilute hydrochloric acid. Which of the above metals will give the greatest mass of hydrogen gas?

(Relative atomic masses: H = 1.0, Mg = 24.3, Al = 27.0, Fe = 55.8, Zn = 65.4)

- A. Aluminium
- B. Magnesium
- C. Zinc
- D. Iron

22. Car exhaust pipes usually corrode at a higher rate because

- (1) the exhaust gases are acidic.
- (2) there is more oxygen in the exhaust gases.
- (3) the temperature of the car exhaust pipes is high.

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

23. Which of the following are the advantages of anodization of aluminium?

- (1) It enables the surface of aluminium to adsorb dyes.
- (2) It enhances the corrosion resistance of aluminium.
- (3) It increases the electrical conductivity of aluminium.

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

Directions: Each question below (Question Nos. 24 to 25) consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table:

- A. Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
- B. Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
- C. The 1st statement is false but the 2nd statement is true.
- D. Both statements are false.

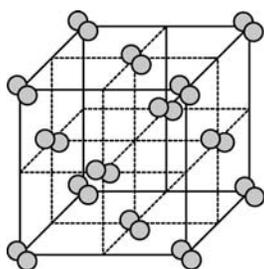
	1st statement	2nd statement
24.	Titanium is used to make water pipes.	Titanium is very corrosion resistant.
25.	Freshly cut surface of sodium is shiny. However, on further standing in air, the surface becomes dull.	Sodium reacts with oxygen in air to form sodium oxide.

– END OF SECTION A –

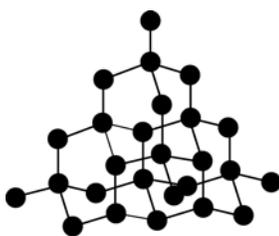
Section B

Answer **ALL** questions in this section. Write your answers in the spaces provided.

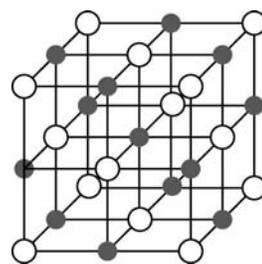
1. (a) The following diagrams show the structures of three solids at room conditions:



Solid A



Solid B



Solid C

- (i) Suggest three substances that have the same structures as A, B and C respectively. (3 marks)

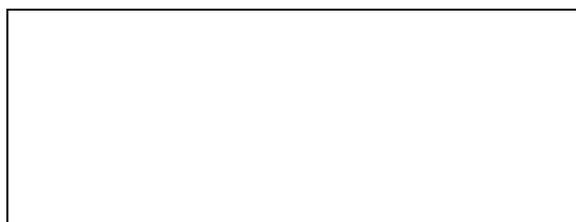
- (ii) Compare the melting points of solids A and B. Explain your answer briefly. (5 marks)

- (iii) State and explain which of the above substances can conduct electricity in molten state. (2 marks)

(b) Strontium (Sr) is an alkaline earth metal.

- (i) Strontium reacts with chlorine to form compound X. Draw the electron diagram of X, showing electrons in the outermost shells only. (1 mark)

- (ii) Explain why strontium is ductile. Illustrate your answer with a suitable labelled diagram showing the structure of metals. (5 marks)

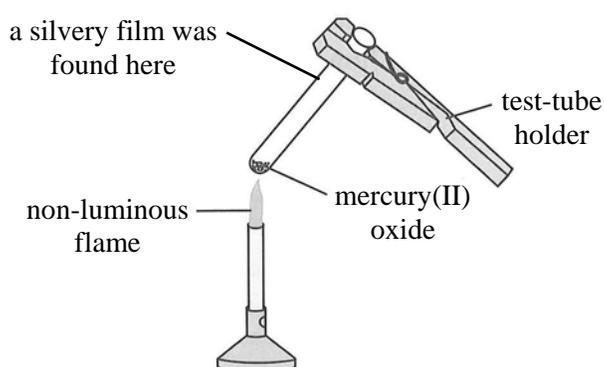


(iii) Explain why compound X is not ductile. (1 mark)

(iv) The electrical conductivity of strontium decreases when temperature increases. Suggest a reason for this. (2 marks)

(v) Chlorine reacts with hydrogen to give compound Y. Draw the electron diagram of Y, showing electrons in the outermost shells only. (1 mark)

2. (a) (i) A student heated a sample of mercury(II) oxide in a test tube as shown below. After some time, a silvery liquid was formed and a silvery film also appeared on the upper part of the test tube.



(1) Describe the appearance of mercury(II) oxide. (1 mark)

- (2) What is the silvery film? Why did it appear on the upper part of the test tube? (2 marks)

- (3) Write a chemical equation, with state symbols, for any reaction involved. (2 marks)

- (4) What safety precaution should be taken when doing this experiment? Explain your answer. (2 marks)

- (ii) The student claimed that a colourless gas should also be given out during the heating.

- (1) What is the gas? (1 mark)

- (2) What should the student do to test for the gas? (1 mark)

- (b) Two experiments were performed for metals X and Y, and the results are given in the table below:

	Experiment	Metal X	Metal Y
I	Adding the metal to dilute hydrochloric acid	No observable change	Small colourless gas bubbles were evolved
II	Adding zinc to the metal nitrate solution	A reddish brown solid was formed	A grey solid was formed

(Given: X and Y are metals that form ions of 2+ charges, and their sulphates are both soluble in water.)

- (i) Arrange metals X, Y and zinc in descending order of reactivity. Explain your answer. (3 marks)

(ii) Suggest what metal X and metal Y might be. (1 mark)

(iii) Draw a labelled diagram for an appropriate set-up to collect the gas evolved in Experiment I over water in a test tube scale. (2 marks)

(iv) Give ONE more observable change when zinc is added to the metal nitrate solution of metal X in Experiment II. (1 mark)

(v) Dilute sulphuric acid is now used in place of dilute hydrochloric acid in Experiment I. Describe the observations and write ionic equation(s) for any reactions involved. (4 marks)

Metal X: _____

Metal Y: _____

3. (a) A student performed an experiment to extract common salt from sea water. He followed the following procedures:

- (1)
- (2) The sea water was heated gently until a saturated solution was formed.
- (3) The hot saturated solution was cooled down quickly.
- (4) Some small and irregular-shaped crystals were formed.
- (5) The crystals were separated from the solution by filtration.
- (6) A small amount of cold distilled water was used to wash the crystals.
- (7)

(i) Explain what is a “saturated solution”. (2 marks)

(ii) What is the name of procedure (4)? (1 mark)

(iii) (1) Suggest what changes the student can make to the above procedures to obtain some larger and regular-shaped crystals. (1 mark)

(2) Explain why larger and regular-shaped crystals can be obtained in your modified procedures. (1 mark)

(iv) (1) What is the purpose of carrying out procedure (6)? (1 mark)

(2) Why should only a small amount of cold distilled water be used to wash the crystals? (2 marks)

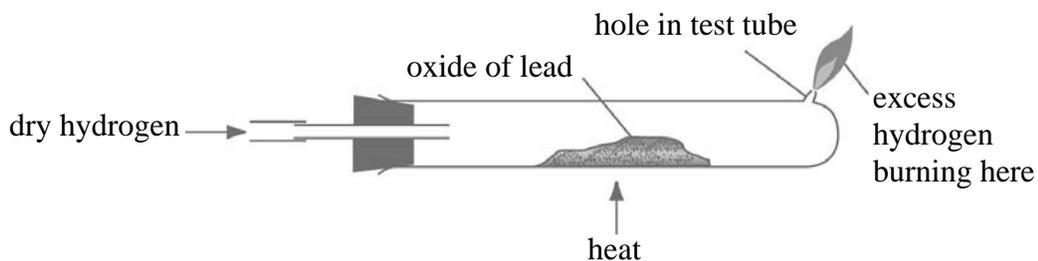
- (3) How can the student remove water from the crystals after procedure (6)?
(1 mark)

- (b) For each of the following pairs of substances, suggest a test to distinguish one substance from the other and state the expected observations.

- (i) Potassium chloride and sodium chloride (3 marks)

- (ii) Calcium nitrate and calcium carbonate (3 marks)

- (c) The following experimental set-up was used to reduce an oxide of lead to lead. 68.5 g of the oxide gave 62.1 g of lead.



- (i) Determine the empirical formula of the oxide.
(Relative atomic masses: O = 16.0, Pb = 207.2) (3 marks)

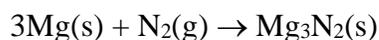
- (ii) Explain why the excess hydrogen was burnt out. (1 mark)

- (iii) After the reaction, the hydrogen was kept flowing until the tube was cooled. Explain why this precaution is necessary. (1 mark)

- (iv) Write a chemical equation for the reaction involved in this experiment. (1 mark)

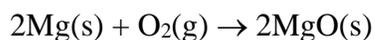
4. (a) When magnesium burns in air, a mixture of magnesium oxide and magnesium nitride forms. In an experiment, 19.44 g of magnesium ribbon burnt in air to give 31.17 g of solid residue.

- (i) Magnesium reacts with nitrogen according to the following chemical equation:



If the mass of magnesium reacted with nitrogen is y g, calculate the mass of magnesium nitride formed (express your answer in terms of y). (2 marks)
(Relative atomic masses: N = 14.0, Mg = 24.3)

- (ii) Magnesium reacts with oxygen according to the following chemical equation:



Calculate the mass of magnesium oxide formed (express your answer in terms of y). (2 marks)

(Relative atomic masses: O = 16.0, Mg = 24.3)

- (iii) Use your answers to (i) and (ii); and the other information from the question to determine the percentage by mass of magnesium that has reacted with nitrogen. (2 marks)

- (b) The atmosphere on Mars consists of 96.0% of carbon dioxide, 1.9% of nitrogen and 1.9% of argon. Unlike Earth, there are only trace amounts of oxygen and water in the atmosphere of Mars.

- (i) Suggest a method to separate the components of gases in a sample of gas collected from Mars. (1 mark)

- (ii) Suggest ONE reason why it is NOT suitable for humans to emigrate to Mars. (1 mark)

- (iii) Compare the rate of rusting of iron on Earth and that on Mars. Explain your answer. (2 marks)

(iv) Iron is commonly used in construction and making containers. The following photos show some of the examples.



Photo 1: Cross-river bridge



Photo 2: Garbage bin

(1) Suggest a method to prevent the cross-river bridge in Photo 1 from rusting. Explain the underlying principle of the suggested method. (2 marks)

(2) Suggest a material that can replace iron to make the garbage bin in Photo 2. State an advantage of using the suggested material over iron. (2 marks)

– END OF SECTION B –

– END OF PAPER –