06-07 Formulae, Equations and the Mole

Set A Foundations

Name	Time 50 minutes	Total 27 marks	Score ____ / 27

Use a copy of the Periodic Table where you need one. One mole of any gas occupies 24 dm^3 at room temperature and pressure.

A Multiple choice

9 MARKS

1 Dimethylglyoxime has the chemical formula $(CH_3CNOH)_2$. How many atoms does one molecule of dimethylglyoxime contain?

A 5 **B** 8 **C** 10 **D** 16

/1 Answer ☐ [1]

Source: 2023 GESS Sec 3 End-of-Year P1 Q19

2 The formula of iridium sulfate is $Ir_2(SO_4)_3$ and that of zinc hypochlorite is $Zn(ClO)_2$. What is the formula of iridium hypochlorite?

A $Ir_2(ClO)_2$ **B** $Ir_2(ClO)_3$ **C** IrClO **D** $Ir(ClO)_3$

/1 Answer ☐ [1]

Source: 2023 GESS Sec 3 End-of-Year P1 Q20

3 A piece of zinc strip is burnt in oxygen to form zinc oxide. Which of the following chemical equations is correct?

A $2Zn + O_2 \rightarrow 2ZnO$
B $2Zn + O \rightarrow Zn_2O$
C $Zn + O_2 \rightarrow ZnO_2$
D $Zn + O \rightarrow ZnO$

/1 Answer ☐ [1]

Source: 2023 XMS Sec 3 WA2 Q3

4 Which chemical equation is not balanced?

A $C_6H_{12}O_6 + 3O_2 \rightarrow 6CO_2 + 6H_2O$
B $2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$
C $2KClO_3 \rightarrow 2KCl + 3O_2$
D $4P + 5O_2 \rightarrow 2P_2O_5$

/1 Answer ☐ [1]

Source: 2023 XMS Sec 3 WA2 Q5

5 Mercury hydroxide reacts with phosphoric acid in the reaction below. $w\ Hg(OH)_2 + x\ H_3PO_4 \rightarrow y\ Hg_3(PO_4)_2 + z\ H_2O$. Which values of w, x, y and z correctly balance the equation?

	w	*x*	*y*	*z*
A	2	3	1	4
B	3	3	2	7
C	3	2	1	6
D	6	4	2	11

/1

Answer [1]

Source: 2023 GESS Sec 3 End-of-Year P1 Q23

6 Which compound contains the highest percentage of nitrogen by mass?

A $Al(NO_3)_3$ **B** Mg_3N_2 **C** NO **D** NO_2

/1

Answer [1]

Source: 2023 GESS Sec 3 End-of-Year P1 Q24

7 A new element was discovered. The relative abundance of its isotopes is shown below. What is its relative atomic mass?

nucleon number of isotope	63	65	67
relative abundance / %	68.54	29.51	1.95

A 33.33 **B** 63.67 **C** 63.71 **D** 65.00

/1

Answer [1]

Source: 2023 GESS Sec 3 End-of-Year P1 Q26

8 What is the empirical formula of a compound consisting of 4.8 g of carbon and 0.8 g of hydrogen?

A CH **B** CH_2 **C** C_2H_3 **D** C_4H_8

/1

Answer [1]

Source: 2023 GESS Sec 3 End-of-Year P1 Q27

9 A sample of nitrogen of mass 5.00 g is completely converted into an oxide of nitrogen. The mass of the oxide formed is 19.30 g. What is the empirical formula of the oxide?

A NO **B** NO_2 **C** N_2O_3 **D** N_2O_5

/1

Answer [1]

Source: SJI 2020 Year 3 End-of-Year P1 Q15

B Structured questions

18 MARKS

10 Balance the following chemical equations.

(a) ..... S_8 + ... O_2 → ..... SO_3 [1]

(b) ..... C_3H_8 + ... O_2 → ..... CO_2 + ... H_2O [1]

(c) ..... $AlBr_3$ + ... K_2SO_4 → ..... KBr + ... $Al_2(SO_4)_3$ [1]

/3

Source: 2023 XMS Sec 3 WA2 Q6

11 Write the chemical equations for the following reactions.

(a) Sodium metal reacts with water to form hydrogen gas and sodium hydroxide.

.....

[1]

(b) Nitric acid reacts with calcium oxide to form calcium nitrate and water.

.....

[1]

(c) Propene (C_3H_6) burns in oxygen to form carbon dioxide and water.

.....

[1]

/3

Source: 2022 XMS Sec 3 WA2 B3(a)

12 A student prepares barium sulfate by mixing two solutions, barium nitrate and potassium sulfate. Barium sulfate is collected as the residue.

(a) Write a balanced chemical equation for the reaction between barium nitrate and potassium sulfate.

.....

[1]

(b) Hence, construct the ionic equation for the reaction.

.....

[1]

/2

Source: SJI 2020 Year 3 End-of-Year P2 A5(a)

13 Carbon can be reacted with boron to form compound R. A sample of R was found to contain 78.6% boron by mass.

Deduce the empirical formula of R. Show your working.

[3]

/3

Source: 2024 CHS Sec 3 End-of-Year Section B Q3(b)

14 25.0 cm^3 of 0.40 mol/dm^3 sulfuric acid was reacted with exactly 35 cm^3 of sodium hydroxide. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

(a) Calculate the concentration of sodium hydroxide used.

[2]

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

.....

[1]

/3

Source: 2023 GESS Sec 3 End-of-Year P2 B11(a) and (b)

15 Wollastonite, $CaSiO_3$, can be produced from the reaction between calcium phosphate and silicon dioxide. $2Ca_3(PO_4)_2 + 6SiO_2 \rightarrow P_4O_{10} + 6CaSiO_3$. 100 g of calcium phosphate, $Ca_3(PO_4)_2$, was used in this reaction. The actual mass of wollastonite produced was 87 g.

Calculate the percentage yield of wollastonite.

[4]

/4

Source: 2023 GESS Sec 3 End-of-Year P2 A9