06-07 Formulae, Equations and the Mole

Set B Exam practice

Name	Time 55 minutes	Total 29 marks	Score ____ / 29

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.

Marks by notes section For the marker: total each row. A score below the target means that section of the notes needs revising.

Notes section	Questions	Marks	Target	Score
07 · 2 The Mole	3, 7	2	2	
07 · 3 Empirical and Molecular Formulae	2	1	1	
07 · 4 Stoichiometry	1, 4, 5, 6, 10, 11, 12, 13	24	15	
07 · 5 Percentage Yield and Purity	8, 9	2	2	

A Multiple choice

9 MARKS

1 Sodium hydrogencarbonate decomposes on heating. $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$. In an experiment, 5.0 mol of sodium hydrogencarbonate was heated. What is the volume of carbon dioxide evolved, at room temperature and pressure?

A 24 dm^3 **B** 36 dm^3 **C** 48 dm^3 **D** 60 dm^3

/1

Answer ☐ [1]

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

2 The atomic number of ruthenium is 44. One of the oxides of ruthenium is a black solid, X. 5.79 g of X contains 1.39 g of oxygen. What is the empirical formula of X?

A Ru_2O_3 **B** RuO **C** RuO_2 **D** Ru_2O

/1

Answer ☐ [1]

Source: 2023 PLMGS Sec 3 End-of-Year P1 Q25

3 Which contains the greatest mass of solute?

A 100 cm^3 of 1.00 mol/dm^3 sodium hydroxide, NaOH

B 500 cm^3 of 0.05 mol/dm^3 sulfuric acid, H_2SO_4

C 1.00 dm^3 of 0.10 mol/dm^3 potassium hydroxide, KOH

D 2.00 dm^3 of 0.01 mol/dm^3 hydrochloric acid, HCl

/1

Answer ☐ [1]

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

4 The forward reaction for the Haber process is $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$. 15 cm^3 of nitrogen was added to 60 cm^3 of hydrogen in a container. What is the total volume of gas remaining in the container after the reaction is complete?

A 30 cm^3 **B** 40 cm^3 **C** 45 cm^3 **D** 105 cm^3

Answer [1]

/1

Source: 2023 GESS Sec 3 End-of-Year P1 Q25

5 Carbon monoxide reacts with oxygen to form carbon dioxide: $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$. In this reaction, 3 moles of carbon monoxide and 2 moles of oxygen are mixed. When the reaction is complete, there will be

A 0.5 mole of oxygen unreacted.
B 1 mole of carbon monoxide unreacted.
C 2 moles of carbon dioxide produced.
D 4 moles of carbon dioxide produced.

Answer [1]

/1

Source: SJI 2020 Year 3 End-of-Year P1 Q17

6 In a titration, 26.4 cm^3 of 0.2 mol/dm^3 aqueous calcium hydroxide was required to completely neutralise 19.0 cm^3 of dilute hydrochloric acid. What is the concentration of the acid used?

A 0.28 mol/dm^3 **B** 0.36 mol/dm^3 **C** 0.56 mol/dm^3 **D** 0.84 mol/dm^3

Answer [1]

/1

Source: 2023 HYSS Sec 3 End-of-Year P1 Q18

7 20.0 cm^3 of 0.100 mol/dm^3 potassium hydroxide is completely reacted with 20.0 cm^3 of sulfuric acid solution. What is the concentration of potassium ions in the resultant solution?

A 0.050 mol/dm^3 **B** 0.100 mol/dm^3 **C** 0.250 mol/dm^3 **D** 0.300 mol/dm^3

Answer [1]

/1

Source: SJI 2020 Year 3 End-of-Year P1 Q16

8 On adding 53 g of impure sodium carbonate, Na_2CO_3 (M_r = 106), to excess hydrochloric acid, 3.0 dm^3 of CO_2 was evolved at room temperature and pressure. What is the percentage purity of the sodium carbonate?

A 25% **B** 50% **C** 75% **D** 100%

Answer [1]

/1

Source: 2023 GESS Sec 3 End-of-Year P1 Q28

9 Zinc blende is mainly zinc sulfide, ZnS. When it is burnt in air: $2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$. 194 g of an impure zinc blende sample is burnt in excess oxygen to produce 43.2 dm^3 of sulfur dioxide. What is the percentage purity of zinc sulfide in the sample?

A 80.0% **B** 85.0% **C** 90.0% **D** 95.0%

Answer [1]

/1

Source: SJI 2020 Year 3 End-of-Year P1 Q18

B Structured questions

20 MARKS

10 Methane, CH_4, is a commonly used gas for household cooking. 20 cm^3 of methane and 60 cm^3 of oxygen are reacted to form carbon dioxide and water as the only products.

(a) Write a balanced chemical equation with state symbols for the reaction of methane and oxygen.

.....

[2]

(b) Determine which is the limiting reagent for the reaction in (a).

[3]

(c) Calculate the total volume of gas remaining at the end of the reaction at room temperature and pressure.

[2]

(d) In reality, the percentage yield of carbon dioxide produced is only 70%. Calculate the volume of CO_2 produced.

[1]

/8

Source: SJI 2020 Year 3 End-of-Year P2 A4

11 30.0 cm^3 of 0.80 mol/dm^3 nitric acid was reacted with 10 g of magnesium.

Calculate the mass of magnesium nitrate produced.

/3

[3]

Source: 2023 GESS Sec 3 End-of-Year P2 B12(a)

12 Sodium hydride, NaH, is an ionic compound. In a reaction, 0.24 g of sodium hydride was reacted with 1.8 cm^3 of water to form sodium hydroxide solution and hydrogen gas at r.t.p.

(a) Write a balanced chemical equation for the above reaction.

.....

[1]

(b) Given that the density of water is 1 g/cm^3, determine the limiting reactant of this reaction and hence calculate the number of moles of sodium hydroxide formed.

/4

[3]

Source: 2024 SMSS Sec 3 End-of-Year P2 Q5(b)

13 A common antacid is magnesium hydroxide, $Mg(OH)_2$, a base that is slightly soluble in water. 25.0 cm^3 of a saturated solution of magnesium hydroxide required 27.60 cm^3 of 0.220 mol/dm^3 dilute hydrochloric acid for complete neutralisation.

(a)

(i) Write a balanced chemical equation for the reaction between magnesium hydroxide and dilute hydrochloric acid.

.....

[1]

(ii) Using your equation in (a)(i), calculate the concentration, in mol/dm^3, of the saturated magnesium hydroxide solution.

[2]

(b) Calculate the mass of magnesium hydroxide dissolved in 1.00 dm^3 of the saturated magnesium hydroxide solution.

[1]

(c) Given that a 10.0 g tablet of antacid contains 100% magnesium hydroxide by mass, calculate the minimum volume of water needed to fully dissolve the tablet.

[1]

/5

Source: 2024 CHS Sec 3 End-of-Year Section B Q7