

## Multiple Choice Questions

# The Mole & the Avogadro Constant

The Mole / Linking Moles, Mass & Mr / Reacting Masses / Calculating Concentration / Titration Calculations / Empirical & Molecular Formula / Percentage Yield & Purity

Easy (5 questions)	/5
Medium (6 questions)	/6
Hard (5 questions)	/5
<b>Total Marks</b>	<b>/16</b>

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# Easy Questions

## 1 Extended Only

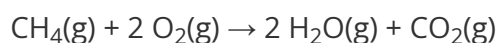
Which row correctly describes the mole and the value of Avogadro's constant?

	one mole of a substance is equal to	one mole of a substance contains
<b>A</b>	the substances relative atomic or molecular mass in grams	$6.02 \times 10^{23}$ atoms, molecules or formula units
<b>B</b>	the substances atomic number in grams	$6.02 \times 10^{23}$ atoms, molecules or formula units
<b>C</b>	the substances relative atomic or molecular mass in grams	$12.04 \times 10^{23}$ atoms, molecules or formula units
<b>D</b>	the substances atomic number in grams	$12.04 \times 10^{23}$ atoms, molecules or formula units

(1 mark)

## 2 Extended Only

The complete combustion of methane produces carbon dioxide and steam.



Which statements are about the reaction correct?

1	The empirical formula of methane is CH <sub>4</sub>
2	The number of atoms in 1 mole of methane is 4 x Avogadro's constant
3	1 mole of methane produces 72 dm <sup>3</sup> of gaseous products at r.t.p
4	1 mole of methane occupies a volume of 12 dm <sup>3</sup> at r.t.p

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

(1 mark)

### 3 Extended Only

Magnesium carbonate and hydrochloric acid react to produce salt, water and carbon dioxide.



What is the volume of CO<sub>2</sub> produced when 21 g of magnesium carbonate ( $M_r = 84$ ) reacts completely with excess hydrochloric acid?

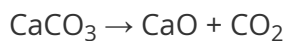
One mole of gas occupies 24.0 dm<sup>3</sup> at room temperature and pressure.

- A. 4 dm<sup>3</sup>
- B. 8 dm<sup>3</sup>
- C. 6 dm<sup>3</sup>
- D. 2 dm<sup>3</sup>

(1 mark)

## 4 Extended Only

Calcium carbonate undergoes thermal decomposition at high temperatures to form calcium oxide and carbon dioxide.



What mass of calcium oxide ( $M_r = 56$ ) is formed when 60 g of calcium carbonate ( $M_r = 100$ ) is completely decomposed?

- A. 28 g
- B. 18.5 g
- C. 60 g
- D. 33.6 g

(1 mark)

## 5 Separate: Chemistry and Extended Only

Substance **X** was analysed and found to contain 40.00% carbon, 6.67% hydrogen and 53.33% oxygen by mass.

What is the empirical formula of **X**?

- A.  $\text{C}_4\text{H}_8\text{O}_4$
- B.  $\text{C}_6\text{H}_{12}\text{O}_8$
- C.  $\text{C}_2\text{H}_4\text{O}_2$
- D.  $\text{CH}_2\text{O}$

(1 mark)

# Medium Questions

## 1 Separate: Chemistry and Extended Only

What is the concentration in  $\text{mol dm}^{-3}$  of a solution of sodium hydroxide that contains 16 g of NaOH in  $200 \text{ cm}^3$  of distilled water?

- A.  $2 \text{ mol dm}^{-3}$
- B.  $2.5 \text{ mol cm}^{-3}$
- C.  $0.2 \text{ mol dm}^{-3}$
- D.  $1 \text{ mol cm}^{-3}$

(1 mark)

## 2 Separate: Chemistry and Extended Only

A student was given a sample of hydrochloric acid and asked to find its concentration in  $\text{mol / dm}^3$ . She titrated  $25 \text{ cm}^3$  of the acid against a standard solution of sodium hydroxide of  $0.1 \text{ mol dm}^{-3}$ . The average titre of sodium hydroxide was  $30 \text{ cm}^3$ .

What is the concentration of the acid?

- A.  $0.50 \text{ mol dm}^{-3}$
- B.  $0.12 \text{ mol dm}^{-3}$
- C.  $1.25 \text{ mol dm}^{-3}$
- D.  $1.0 \text{ mol dm}^{-3}$

(1 mark)

### 3 Separate: Chemistry and Extended Only

A substance was analysed and found to contain 26.57 % potassium, 35.36 % chromium, and 38.07 % oxygen by mass.

What is the empirical formula of the substance?

- A.  $\text{KCr}_2\text{O}_7$
- B.  $\text{K}_2\text{CrO}_7$
- C.  $\text{K}_2\text{Cr}_2\text{O}_5$
- D.  $\text{K}_2\text{Cr}_2\text{O}_7$

(1 mark)

### 4 Separate: Chemistry and Extended Only

Substance X was analysed and found to contain 40.00 % carbon, 6.67 % hydrogen and 53.33 % oxygen by mass. The compound has a relative molecular mass of  $60.0 \text{ g mol}^{-1}$ .

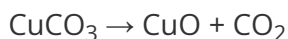
What is the molecular formula of X?

- A.  $\text{C}_4\text{H}_8\text{O}_4$
- B.  $\text{C}_6\text{H}_{12}\text{O}_8$
- C.  $\text{C}_2\text{H}_4\text{O}_2$
- D.  $\text{CH}_2\text{O}$

(1 mark)

## 5 Separate: Chemistry and Extended Only

A student thermally decomposes 24.8 g of copper carbonate and obtains 11.2 g of copper(II) oxide and carbon dioxide gas which is released.



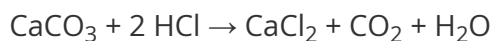
What is the percentage yield of CuO?

- A. 55 %
- B. 70 %
- C. 82 %
- D. 90 %

(1 mark)

## 6 Separate: Chemistry and Extended Only

A sample of chalk (limestone) with a mass of 1.70 g was reacted with excess HCl and the amount of carbon dioxide given off was measured using a gas syringe. 0.36 dm<sup>3</sup> of CO<sub>2</sub> gas was collected at r.t.p.



What is the percentage purity of the chalk?

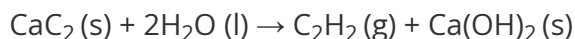
- A. 75 %
- B. 88 %
- C. 90 %
- D. 98 %

(1 mark)

# Hard Questions

## 1 Extended Only

Calcium carbide and water react to produce ethyne and calcium hydroxide.



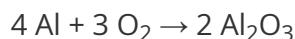
What is the volume of  $\text{C}_2\text{H}_2$  produced, at standard temperature and pressure, when 45 g of water reacts completely with calcium carbide?

- A. 72 dm<sup>3</sup>
- B. 30 dm<sup>3</sup>
- C. 24 dm<sup>3</sup>
- D. 6 dm<sup>3</sup>

(1 mark)

## 2 Extended Only

Aluminium and oxygen react to produce aluminium oxide.



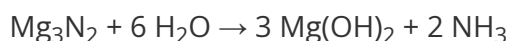
How many kilograms of aluminium oxide are formed when 5.4 kg of aluminium react with excess oxygen?

- A. 5.4 kg
- B. 88 kg
- C. 10.2 kg
- D. 33.6 kg

(1 mark)

### 3 Extended Only

Magnesium nitride and water react to produce a precipitate of magnesium hydroxide and ammonia gas.



How much magnesium nitride is needed to produce 87 g of the precipitate in excess water?

- A. 24 g
- B. 50 g
- C. 30 g
- D. 12 g

(1 mark)

### 4 Separate: Chemistry and Extended Only

A student was asked to find the concentration in  $\text{g / dm}^3$  of a solution of sulfuric acid. She transferred  $25 \text{ cm}^3$  of the acid to a  $250 \text{ cm}^3$  volumetric flask and made it up to the mark. She titrated  $25 \text{ cm}^3$  of the diluted acid against a standard solution of sodium hydroxide of  $0.1 \text{ mol dm}^{-3}$ . The average titre of sodium hydroxide was  $18 \text{ cm}^3$ .

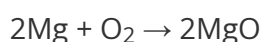
What is the concentration of the original acid in grams per decimetre?

- A.  $9.85 \text{ g dm}^{-3}$
- B.  $12.25 \text{ g dm}^{-3}$
- C.  $98 \text{ g dm}^{-3}$
- D.  $35.28 \text{ g dm}^{-3}$

(1 mark)

### 5 Extended Only

A chemist reacted 0.6 g of magnesium with  $0.6 \text{ dm}^3$  of oxygen in a sealed container to produce magnesium oxide.



Which row correctly describes the limiting reactant?

	limiting reactant	reason
<b>A</b>	Mg	in excess
<b>B</b>	Mg	is used up first
<b>C</b>	O <sub>2</sub>	is used up first
<b>D</b>	O <sub>2</sub>	in excess

**(1 mark)**