

APOLLO

# Counting particles by mass: The mole

## HL

Chemistry

First assessment 2025

11 questions | questions

5. What is the empirical formula of a compound with the following composition by mass?

C = 37.5%      H = 12.5%      O = 50.0%

- A.  $\text{C}_4\text{H}_{12}\text{O}_5$
- B.  $\text{C}_3\text{H}_{12}\text{O}_3$
- C.  $\text{C}_3\text{HO}_4$
- D.  $\text{CH}_4\text{O}$

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4445-0213

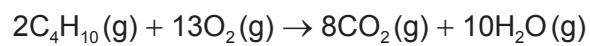
1. How many oxygen atoms are present in 0.0200 mol  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ?
- A.  $1.20 \times 10^{22}$
  - B.  $1.08 \times 10^{22}$
  - C.  $6.02 \times 10^{23}$
  - D.  $1.08 \times 10^{23}$

2. What is a possible empirical formula for a substance with  $M_r = 58$ ?

- I.  $\text{C}_2\text{H}_5$
- II.  $\text{C}_4\text{H}_{10}$
- III.  $\text{C}_3\text{H}_6\text{O}$

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

3. Which volume of butane gas, in  $\text{cm}^3$ , will produce  $40 \text{ cm}^3$  of carbon dioxide gas when it is completely combusted in oxygen?



- A. 5
- B. 10
- C. 20
- D. 40

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2225-0219

7. An unknown organic compound contains only carbon, hydrogen and oxygen.

- (a) 4.32 g of the compound was combusted completely in oxygen and produced 9.49 g of  $\text{CO}_2$  and 5.18 g of  $\text{H}_2\text{O}$ .  
Determine the empirical formula of the compound, using sections 1 and 7 of the data booklet.

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- (b) The same organic compound was vaporized completely at a controlled temperature and pressure.

- (i) 0.108 g of the vaporized compound was found to have a volume of  $55.7 \text{ cm}^3$  at  $100^\circ\text{C}$  and a pressure of  $1.00 \times 10^5 \text{ Pa}$ .  
Calculate the amount, in moles, of the compound. Use sections 1, 2 and 4 of the data booklet.

[2]

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- (ii) Determine the molar mass of the organic compound, using section 1 of the data booklet.  
If you did not get an answer to (i), use  $n = 0.00220 \text{ mol}$ , although this is not the correct answer.

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4420-0209

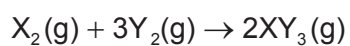
4. 5.72 g of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  ( $M_r = 286 \text{ g mol}^{-1}$ ) is dissolved in water to prepare  $0.4 \text{ dm}^3$  of aqueous solution.

What is the concentration of sodium ions, in  $\text{mol dm}^{-3}$ , in the resulting solution?

- A. 0.02
- B. 0.04
- C. 0.05
- D. 0.10

- 25.** Equal volumes of  $X_2$  and  $Y_2$  gases are allowed to react in a sealed container to form  $XY_3$  gas. After completion of the reaction, the volume of  $XY_3$  is measured to be  $40\text{ cm}^3$ .

What was the volume, in  $\text{cm}^3$ , of  $X_2$  gas at the beginning?



- A. 20
- B. 40
- C. 60
- D. 120

26. What is the volume of nitrogen dioxide, in  $\text{cm}^3$ , produced at STP when 1.28 g of copper reacts with excess nitric acid?



Molar volume of an ideal gas at STP is  $22.7 \text{ dm}^3 \text{ mol}^{-1}$

- A. 227
- B. 456
- C. 684
- D. 914

3. How many ions are present in 0.20 mol of  $(\text{NH}_4)_2\text{SO}_4$ ?

A.  $0.20 \times 1 \times 6 \times 10^{23}$

B.  $0.20 \times 2 \times 6 \times 10^{23}$

C.  $0.20 \times 3 \times 6 \times 10^{23}$

D.  $0.20 \times 7 \times 6 \times 10^{23}$

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0020-0215

4. A container holds 30 g of argon and 60 g of neon.

What is the ratio of number of atoms of argon to number of atoms of neon in the container?

- A. 0.25
- B. 0.50
- C. 2.0
- D. 4.0

- 25.** The complete combustion of  $20.0\text{ cm}^3$  of a gaseous hydrocarbon,  $\text{C}_x\text{H}_y$ , produces  $80.0\text{ cm}^3$  of gaseous products. This volume reduces to  $40.0\text{ cm}^3$  when the water vapour present condenses. All volumes are measured at the same temperature and pressure.

What is the molecular formula of the hydrocarbon?

- A.  $\text{CH}_4$
- B.  $\text{C}_2\text{H}_2$
- C.  $\text{C}_2\text{H}_4$
- D.  $\text{C}_3\text{H}_6$