Atomic Foundations of Matter

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer 8 × 1 = 8 marks

1. The symbol of nitrogen is:

(a) N **(b)** He **(c)** Au **(d)** Fe

2. The atomicity of S_8 is:

(a) diatomic **(b)** triatomic

(c) polyatomic (8 atoms) **(d)** tetra-atomic

3. The law of conservation of mass says that in a chemical reaction:

(a) mass always decreases

(b) only gases have mass

(c) mass always increases

(d) mass can neither be created nor destroyed

4. The formula of silver chloride is:

(a) AgCl **(b)** $AgCl_2$ **(c)** Ag_2Cl **(d)** Ag_2SO_4

5. The molecular mass of C_2H_5OH is: (Atomic masses: H = 1 u, C = 12 u, O = 16 u)

(a) 46 u **(b)** 45 u **(c)** 62 u **(d)** 92 u

6. In magnesium chloride ($MgCl_2$), the ratio of the mass of magnesium to the mass of chlorine is: (Atomic masses: Mg = 24 u, Cl = 35.5 u)

(a) 24 : 142 **(b)** 24 : 71 **(c)** 71 : 24 **(d)** 1 : 2

7. The charge on the nitrate ion (NO_3) is:

(a) 3+ **(b)** 1+ **(c)** 1− **(d)** 2+

8. Assertion (A): 12 g of hydrogen combines with 96 g of oxygen to form water.
Reason (R): The proportion by mass of elements in a compound depends on how it is prepared.

(a) Both A and R are true, and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false.

(d) A is false, but R is true.

Section B — Short answer 8 × 2 = 16 marks

9. Write the chemical formulas of (a) zinc sulphide and (b) copper nitrate.

10. In hydrogen sulphide, hydrogen and sulphur combine in the ratio 1 : 16 by mass. How much sulphur combines with 19 g of hydrogen? What mass of hydrogen sulphide forms?

11. Calculate the molecular (or formula unit) mass of Al_2O_3. (Atomic masses: O = 16 u, Al = 27 u)

12. State the law of constant proportions with an example.

13. In the reaction $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$, 34 g of $AgNO_3$, 11.7 g of NaCl, 28.7 g of AgCl are involved, and the reaction is complete. What mass of $NaNO_3$ is formed? Which law did you use?

14. Name the compound $(NH_4)_2S$ and write the ions it is made of, with their charges.

15. Write the symbols of sulphur, calcium, magnesium. Which of these symbols come from Latin names?

16. How many atoms of each element are there in one molecule or formula unit of O_3? How many atoms in all?

Section C — Word problems — 4 × 4 = 16 marks

17. State the postulates of Dalton's atomic theory.

18. Find the molecular (or formula unit) mass of K_2CO_3, and the percentage by mass of each element in it. (Atomic masses: C = 12 u, O = 16 u, K = 39 u)

19. In an experiment, 63.6 g of CuO and 1.6 g of H_2 reacted completely to give 50.8 g of Cu, 14.4 g of H_2O. Show that these results agree with the law of conservation of mass, and write the balanced equation.

20. Write the names and formulas of all four compounds formed by the cations NH_4 (1+) and Pb (2+) with the anions Cl (1−) and SO_4 (2−).

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Answer key

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Q	Answer	Working
1	**(a) N**	—
2	**(c) polyatomic (8 atoms)**	—
3	**(d) mass can neither be created nor destroyed**	—
4	**(a) AgCl**	Ag has valency 1, Cl has valency 1: cross them
5	**(a) 46 u**	2 × 12 + 6 × 1 + 1 × 16
6	**(b) 24 : 71**	compare the total masses of each element
7	**(c) 1−**	—
8	**(c) A is true, but R is false.**	A is true: the mass ratio in H_2O is 1 : 8, so 12 g needs 96 g. R is false.
9	**(a) ZnS; (b) $Cu(NO_3)_2$**	balance the valencies
10	**304 g of sulphur; 323 g of hydrogen sulphide**	19 × 16 ÷ 1; conservation of mass
11	**102 u**	2 × 27 + 3 × 16
12	**In a chemical substance the elements are always present in definite proportions by mass, e.g. in water, hydrogen and oxygen are always combined in the ratio 1 : 8 by mass.**	—
13	**17 g; the law of conservation of mass**	mass of reactants = mass of products
14	**Ammonium sulphide: NH_4 (1+) and S (2−)**	—
15	**sulphur: S; calcium: Ca; magnesium: Mg. From Latin: none**	—
16	**oxygen: 3; 3 atoms in all**	—
17	**All matter is made of tiny particles called atoms. Atoms are indivisible and cannot be created or destroyed in a chemical reaction. Atoms of an element are identical in mass and properties; atoms of different elements differ. Atoms combine in small whole-number ratios to form compounds. The relative number and kinds of atoms are constant in a given compound.**	—
18	**138 u; potassium: 56.52%; carbon: 8.70%; oxygen: 34.78%**	each element: its total mass ÷ molecular mass × 100

Q	Answer	Working
19	**Mass of reactants = 65.2 g; mass of products = 65.2 g; they are equal, so mass is conserved. $CuO + H_2 \rightarrow Cu + H_2O$**	—
20	**ammonium chloride: NH_4Cl; ammonium sulphate: $(NH_4)_2SO_4$; lead chloride: $PbCl_2$; lead sulphate: $PbSO_4$**	cross the valencies; bracket a polyatomic ion used more than once

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