Date: 24/9/2021

Q1. Define the atomic mass unit.

Q2. Why is not possible to see an atom with naked eyes?

Q3. Write down the names of compounds represented by the following formula:

(a) $Al_2(SO_4)_3$ (b) $CaCl_2$ (c) K_2SO_4 (d) KNO_3 (e) $CaCO_3$

Q4. Write the chemical formulae of the following:

(a) Magnesium chloride (b) Calcium oxide (c) Copper nitrate

(d) Aluminium chloride (e) Calcium carbonate

Q5. Hydrogen and oxygen combine in the ratio of 1 : 8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 g of hydrogen gas?

Q6. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass?

Q7. Which postulate of Dalton's atomic theory can explain the law of definite proportions?

Q8. Write down the formulae of :

(a) sodium oxide (b) aluminium chloride (c) sodium sulphide (d) magnesium hydroxide

Q9. What is meant by the term chemical formula?

Q10. How many atoms are present in a:

(a) H_2S molecule (b) PO_4^{3-} ion

Q11. What are polyatomic ions? Give examples.

Q12. Give the names of the elements present in the following compounds:

(a) Quick lime (b) Hydrogen bromide (c) Baking powder (d) Potassium sulphate

Q13. If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

Q14. What is the mass of: (a) 0.2 mole of oxygen atoms? (b) 0.5 mole of water molecules?

Q15. Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.

Q16. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g of water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

Sodium carbonate + ethanoic acid $\longrightarrow$ Sodium ethanoate + Carbon dioxide + Water

Q17. When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen. Which law of chemical combination will govern your answer?

Q18. Calculate the molecular masses of H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.

Q19. Calculate the formula unit masses of ZnO, Na_2O and K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u and O = 16 u.

Q20. Which has more number of atoms, 100 grams of sodium or 100 grams of iron? (Given atomic mass of Na = 23 u, Fe = 56 u).

Q21. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

Q22. Calculate the molar mass of the following substances:

(a) Ethyne, C_2H_2 (b) Sulphur molecule, S_8

(c) Phosphorus molecule, P_4 (Atomic mass of phosphorus = 31)

(d) Hydrochloric acid, HCl (e) Nitric acid, HNO_3

Q23. What is the mass of:

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

Q24. Convert into mole:

(a) 12 g of oxygen gas (b) 20 g of water (c) 22 g of carbon dioxide.

Q25. Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

[Hint: The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u)

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S1. Atomic mass unit (amu) may be defined as the mass unit exactly equal to one-twelfth (1/12th) of the mass of one atom of carbon-12.

S2. Human eyes can see an object with a minimum size of 100 nm (1 nanometre = 10^{-9} metre) or more. The size of an atom is much smaler, than anything that we can imagine. Hence, it is not possible to see an atom with naked eyes.

S3. (a) Aluminium sulphate (b) Calcium chloride (c) Potassium sulphate
(d) Potassium nitrate (e) Calcium carbonate

S4. (a) Magnesium chloride

Formula: $MgCl_2$

(b) Calcium oxide

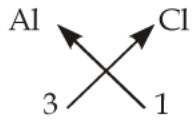
Formula: CaO

(Both the radicals have the same valency. Hence Ca_2O_2 will simply be written as CaO)

(c) Copper nitrate

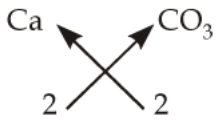
Formula: $Cu(NO_3)_2$

(d) Aluminium chloride



Formula: $AlCl_3$

(e) Calcium carbonate



Formula: $CaCO_3$

(Here both the radicals have the same valency. Hence $Ca_2(CO_3)_2$ will simply be written as $CaCO_3$)

S5. 1 g of hydrogen reacts with oxygen = 8 g
∴ 3 g of hydrogen reacts with oxygen = $8 \times 3 = 24$ g
Hence, mass of oxygen required is 24 g.

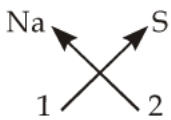
S6. Following postulate of Dalton's atomic theory is the result of the law of conservation of mass:
"Atoms are indivisible particles which can neither be created nor destroyed in a chemical reaction."

S7. The postulate of Dalton's atomic theory that relative number and kinds of atoms are constant in a given compound can explain the law of definite proportions.

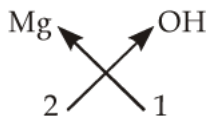
S8. (a) Sodium oxide (b) Aluminium chloride (c) Sodium sulphide (d) Magnesium hydroxide

Formula: Na_2O

Formula: $AlCl_3$



Formula: Na_2S



Formula: $Mg(OH)_2$

S9. The chemical formula is the symbolic representation of a molecule of an element or a compound. For example, the chemical formula of sodium carbonate is Na_2CO_3.

S10. (a) H_2S molecule has two hydrogen atoms and one sulphur atom.
(b) PO_4^{3-} ion has one phosphorus atom and four oxygen atoms.

S11. A group of atoms which carries a positive or negative charge is known as **polyatomic ion**. For example, ammonium ion (NH_4^+), nitrate ion (NO_3^-), carbonate ion (CO_3^{2-}) and sulphate ion (SO_4^{2-}) are polyatomic ions.

S12. (a) The elements present in quick lime (CaO) are calcium and oxygen.

(b) The elements present in hydrogen bromide (HBr) are hydrogen and bromine.

(c) The elements present in baking powder ($NaHCO_3$) are sodium, hydrogen, carbon and oxygen.

(d) The elements present in potassium sulphate (K_2SO_4) are potassium, sulphur and oxygen.

S13. According to mole concept:

$$1 \text{ mole of carbon atoms} = 6.022 \times 10^{23} \text{ atoms} = 12 \text{ g}$$

$\because$ 6.022×10^{23} atoms of carbon weigh = 12 g

$\therefore$ $$1 \text{ atom of carbon weighs} = \frac{12}{6.022 \times 10^{23}} = 1.99 \times 10^{-23} \text{ g}.$$

S14. (a) $$\text{Mass} = \text{Number of moles} \times \text{Atomic mass}$$

$\therefore$ Mass of oxygen atoms = $0.2 \times 16 = 3.2$ g

(b) Mass of water molecules = Number of moles × Molar mass of water (H_2O)

$= 0.5 \times (2 \times 1 + 16) = 0.5 \times 18 = 9.0$ g.

S15. Molecular mass of $S_8 = 8 \times$ Atomic mass of sulphur $= 8 \times 32 = 256$ g

$\because$ 256 g of sulphur (S_8) = 1 mole

$\therefore$ $$16 \text{ g of solid sulphur} = \frac{1 \times 16}{256} = \frac{1}{16} \text{ mole}.$$

By avogadro number, we know that

1 mole of sulphur (S_8) contains = 6.022×10^{23} molecules

$\therefore$ $\frac{1}{16}$ mole of sulphur (S_8) contains = $6.022 \times 10^{23} \times \frac{1}{16}$ molecules

Hence, 16 g of solid sulphur has $0.376 \times 10^{23} = 3.76 \times 10^{22}$ molecules.

S16. In this reaction the reactants are:

Sodium carbonate and ethanoic acid

$\therefore$ Mass of reactants = Mass of sodium carbonate + Mass of ethanoic acid

$= 5.3 \text{ g} + 6 \text{ g} = 11.3 \text{ g}$ ... (i)

The products are sodium ethanoate, carbon dioxide and water

$\therefore$ Mass of products = Mass of sodium ethanoate + Mass of carbon dioxide + Mass of water

$= 8.2 \text{ g} + 2.2 \text{ g} + 0.9 \text{ g} = 11.3 \text{ g}$ ... (ii)

S17. The reaction of burning of carbon in oxygen may be written as:

$$\underset{\substack{\text{Carbon}\\ 1 \text{ mole}\\ 12 \text{ g}}}{C} + \underset{\substack{\text{Oxygen}\\ 1 \text{ mole}\\ 2 \times 16 = 32 \text{ g}}}{O_2} \longrightarrow \underset{\substack{\text{Carbon dioxide}\\ 1 \text{ mole}\\ 12 + 2 \times 16 = 44 \text{ g}}}{CO_2}$$

It shows that 12 g (1 mole) of carbon burns in 32 g (1 mole) of oxygen to form 44 g (1 mole) of carbon dioxide. Therefore, 3 g of carbon reacts with 8 g of oxygen to form 11 g of carbon dioxide.

It is given that, 3.0 g of carbon is burnt in 8.0 g of oxygen to produce 11.0 g of carbon dioxide. Consequently 11.0 g of carbon dioxide will be formed when 3.0 g of carbon is burnt in 50.0 g of oxygen consuming 8 g oxygen, leaving behind 50 – 8 = 42.0 g of oxygen.

This answer is governed by the law of constant or definite proportion.

S18. Atomic masses H = 1, C = 12, N = 14, O = 16, Cl = 35.5

Molecular mass of $H_2 = 2 \times 1 = 2\,u$

Molecular mass of $O_2 = 2 \times 16 = 32\,u$

Molecular mass of $Cl_2 = 2 \times 35.5 = 71\,u$

Molecular mass of $CO_2 = 12 + 2 \times 16 = 44\,u$

Molecular mass of $CH_4 = 12 + 4 \times 1 = 16\,u$

Molecular mass of $C_2H_6 = 2 \times 12 + 6 \times 1 = 30\,u$

Molecular mass of $C_2H_4 = 2 \times 12 + 4 \times 1 = 28\,u$

Molecular mass of $NH_3 = 14 + 3 \times 1 = 17\,u$

Molecular mass of $CH_3OH = 12 + 3 \times 1 + 16 + 1 = 32\,u$

S19. Formula unit masses are as under:

ZnO = Atomic mass of zinc + Atomic mass of oxygen

$= 65\,u + 16\,u = 81\,u$

Na_2O = (2 × Atomic mass of sodium) + (Atomic mass of oxygen)

$= 2 \times 23\,u + 16\,u = 62\,u$

K_2CO_3 = (2 × Atomic mass of K) + (Atomic mass of C) + (3 × Atomic mass of O)

$= 2 \times 39\,u + 12\,u + 3 \times 16\,u = 138\,u.$

S20. **To calculate number of atoms in 100 g of sodium**

$\because$ 23 g of sodium = 1 mole

$\therefore$ 100 g of sodium = $\frac{1 \times 100}{23} = \frac{100}{23}$ mole

Now, 1 mole of sodium contains $= 6.022 \times 10^{23}$ atoms

$\therefore$ $\frac{100}{23}$ mole of sodium contain = $6.022 \times 10^{23} \times \frac{100}{23} = 26.18 \times 10^{23}$ atoms

To calculate number of atoms in 100 g of iron

56 g of iron = 1 mole

$\therefore$ 100 g of iron = $\frac{1}{56} \times 100 = \frac{100}{56}$ mole

Now, 1 mole of iron contains = 6.022×10^{23} atoms

$\therefore$ $\frac{100}{56}$ mole of iron contain = $\frac{6.022 \times 10^{23} \times 100}{56} = 10.75 \times 10^{23}$ atoms

Hence, 100 g of sodium has more number of atoms than 100 g of iron.

S21. Mass of the sample of compound = 0.24 g

Mass of boron in the compound = 0.096 g

Mass of oxygen in the compound = 0.144 g

To find percentage of boron by weight

$\because$ 0.24 g of compound contains = 0.096 g boron

$\therefore$ 100 g of compound contain = $\frac{0.096 \times 100}{0.24} = 40$ g boron

To find percentage of oxygen by weight

$\because$ 0.24 g of compound contains = 0.144 g oxygen

$\therefore$ 100 g of compound contain = $\frac{0.144 \times 100}{0.24} = 60$ g oxygen

Hence, the percentage compositions is : boron = 40% and oxygen = 60%.

S22. (a) Molar mass of ethyne, C_2H_2 = (2 × Atomic mass of carbon) + (2 × Atomic mass of hygrogen)
= (2 × 12) + (2 × 1) = 26 u

(b) Molar mass of sulphur, S_8 = 8 × Atomic mass of sulphur = 8 × 32 = 256 u

(c) Molar mass of phosphorus molecule, P_4 = 4 × Atomic mass of phosphorus = 4 × 31 = 124 u

(d) Molar mass of hydrochloric acid, HCl = Atomic mass of hydrogen + Atomic mass of chlorine
= 1 + 35. 5 = 36.5 u

(e) Molar mass of nitric acid, HNO_3 = (Atomic mass of H) + (Atomic mass of N)
+ (3 × Atomic mass of O)
= 1 + 14 + (3 × 16) = 63 u

S23. (a) Mass = Number of moles × Atomic mass

∴ Mass of 1 mole of nitrogen atoms = 1 × 14 = 14 g

(b) Mass of 4 moles of aluminium atoms
= Number of moles × Atomic mass of aluminium
= 4 × 27 = 108 g

(c) Mass of 10 moles of sodium sulphite (Na_2SO_3)
= 10 × Molar mass of sodium sulphite (Na_2SO_3)
= 10 × (2 × Atomic mass of Na + Atomic mass of S + 3 × Atomic mass of O)
= 10 × (2 × 23 + 32 + 3 × 16) = 10 × 126 = 1260 g

S24. (a) 1 mole of oxygen gas (O_2) = 2 × 16 = 32 g

∵ 32 g of oxygen = 1 mole

∴ 12 g of oxygen = $\frac{1 \times 12}{32}$ = 0.375 mole

Hence, 12 g of oxygen gas contain 0.375 mole.

(b) 1 mole of water (H_2O) = 2 × Atomic mass of H + Atomic mas of O
= 2 × 1 + 16 = 18 g

∵ 18 g of water = 1 mole

∴ 20 g of water = $\frac{1 \times 20}{18} = \frac{10}{9}$ = 1.1 mole

Hence, 20 g of water contain 1.1 mole.

(c) 1 mole of carbon dioxide (CO_2) = Atomic mass of C + 2 × Atomic mass of O = 12 + 2 × 16 = 44 g

∵ 44 g of carbon dioxide = 1 mole

∴ 22 g of carbon dioxide = $\frac{1 \times 22}{44}$ = 0.5 mole

Hence, 22 g of carbon dioxide contain 0.5 mole.

S25. To find mass of Al in 0.051 g of aluminium oxide

Molecular mass of aluminium oxide (Al_2O_3) = 2 × Atomic mass of Al + 3 × Atomic mass of oxygen

$= 2 \times 27 + 3 \times 16 = 102\,u$

We know that: Al_2O_3 contains 2Al or $Al_2O_3 = 2Al$

$\because$ 102 g of aluminium oxide (Al_2O_3) contains = 2 × Atomic mass of Al

$= 2 \times 27 = 54$ g of Al

$\therefore$ 0.051 g of aluminium oxide contains = $\frac{54}{102} \times 0.051 = 0.027$ g of Al

To find number of aluminium ions

$\because$ 27 g (1 mole) of Al has = 6.022×10^{23} ions

$\therefore$ 0.027 g of aluminium has = $\frac{6.022 \times 10^{23} \times 0.027}{27}$ ions

$= 6.022 \times \frac{10^{23}}{1000} = 6.022 \times 10^{20}$ ions

Hence, Number of aluminium ions = 6.022×10^{20} ions.