

Some Basic Concepts of Chemistry

Question1

Which of the following methods of expressing concentration are unitless?

KCET 2025

Options:

A.

Mole fraction and Mass percent (W/W)

B.

Molality and Mole fraction

C.

Mass percent (W/W) and Molality

D.

Molality and Molarity

Answer: A

Solution:

Option A is correct: mole fraction and mass percent (w/w) are both unitless.

Mole fraction

$$x_i = \frac{n_i}{\sum_j n_j}$$

It's simply a ratio of moles, so no units.

Mass percent (w/w)



$$\text{mass \%} = \frac{\text{mass of solute}}{\text{total mass of solution}} \times 100\%$$

Again, a ratio of masses, giving a percentage without units.

By contrast, molality has units of mol/kg and molarity has mol/L, so neither is unitless.

Question2

Select the **INCORRECT** statement/s from the following:

- (a) 22 books have infinite significant figures
- (b) In the answer of calculation 2.5×1.25 has four significant figures,.
- (c) Zero's preceding to first non-zero digit are significant
- (d) In the answer of calculation $12.11 + 18.0 + 1.012$ has three significant figures

KCET 2025

Options:

- A. b, c and d
- B. b and c only
- C. b and d only
- D. a and b only

Answer: B

Solution:

Let's check each statement:

(a) "22 books have infinite significant figures."

• A counted quantity is exact \Rightarrow effectively infinite sig figs. \Rightarrow **Correct**



(b) "In the answer of 2.5×1.25 there are four significant figures."

• 2.5 has 2 sig figs, 1.25 has 3 \Rightarrow product limited to 2 sig figs \Rightarrow **Incorrect**

(c) "Zeros preceding the first non-zero digit are significant."

• Leading zeros are not significant \Rightarrow **Incorrect**

(d) "In $12.11 + 18.0 + 1.012$ the result has three significant figures."

• Add \rightarrow match decimal places (fewest is 1 place) \Rightarrow result $\approx 31.1 \Rightarrow$ 3 sig figs \Rightarrow **Correct**

Incorrect statements are (b) and (c) only \Rightarrow **Option B**.

Question3

0.48 g of an organic compound on complete combustion produced 0.22 g of CO_2 . The percentage of C in the given organic compound is

KCET 2024

Options:

A. 25

B. 50

C. 12.5

D. 87.5

Answer: C

Solution:

To determine the percentage of carbon in the given organic compound, follow these steps:

Amount of Carbon in CO_2 :

The molecular weight of CO_2 is calculated as follows:

Carbon (C): 12 g/mol

Oxygen (O): 16 g/mol (so, O_2 is 32 g/mol)

Therefore, the molecular weight of CO_2 is:



$$12 + 32 = 44 \text{ g/mol}$$

The amount of carbon in CO_2 is given by the ratio of the atomic weight of carbon to the molecular weight of carbon dioxide:

$$\text{Fraction of Carbon in } \text{CO}_2 = \frac{12}{44}$$

Calculate the Mass of Carbon:

Given that 0.22 g of CO_2 is produced, the mass of carbon from CO_2 is:

$$\text{Mass of Carbon} = 0.22 \times \frac{12}{44} = 0.06 \text{ g}$$

Calculate the Percentage of Carbon:

The percentage of carbon in the original organic compound (0.48 g) is:

$$\text{Percentage of Carbon} = \left(\frac{0.06}{0.48} \right) \times 100 = 12.5\%$$

Therefore, the percentage of carbon in the organic compound is **12.5%** (Option C).

Question4

An aqueous solution of alcohol contains 18 g of water and 414 g of ethyl alcohol. The mole fraction of water is

KCET 2022

Options:

A. 0.4

B. 0.7

C. 0.9

D. 0.1

Answer: D

Solution:

Given, amount of ethylalcohol = 414 g

Amount of water = 18 g

Molar mass of water = 18

Molar mass of ethyl alcohol = 46

Mole of $C_2H_3OH = \frac{414}{46} = 9$

Mole of $H_2O = \frac{18}{18} = 1$

Mole fraction of $H_2O = \frac{1}{10} = 0.1$

Question5

A pure compound contains 2.4 g of C, 1.2×10^{23} atoms of H, 0.2 moles of oxygen atoms. Its empirical formula is

KCET 2021

Options:

A. C_2HO

B. $C_2H_2O_2$

C. CH_2O

D. CHO

Answer: D

Solution:

Moles of carbon = $\frac{w}{M} = \frac{2.4}{12} = 0.2 \text{ mol}$

$$\begin{aligned} \text{Moles of H in } 1.2 \times 10^{23} \text{ atoms of H} &= \frac{1.2 \times 10^{23}}{6 \times 10^{23}} \\ &= 0.2 \text{ mol} \end{aligned}$$

Moles of oxygen atoms = 0.2 moles

Now, simplest ratio of the moles of C, H and O is as follows

$$\begin{aligned} &= C : H : O \\ &= 0.2 : 0.2 : 0.2 = CHO \end{aligned}$$

Thus, the empirical formula of the compound is CHO.



Question6

0.4 g of dihydrogen is made to react with 7.4 g of dichlorine to form hydrogen chloride. The volume of hydrogen chloride formed at 273 K and 1 bar pressure is

KCET 2020

Options:

A. 9.08 L

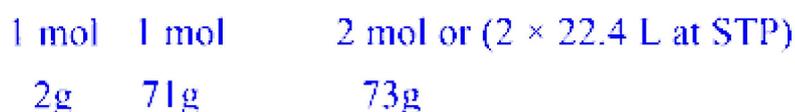
B. 4.67 L

C. 90.8 L

D. 45.4 L

Answer: B

Solution:



71 gCl₂ requires 2 gH₂, than 7.4 gCl₂ will require, how much gram H₂.

$$\therefore \text{H}_2 \text{ required} = \frac{2 \times 7.4}{71} = 0.208 \text{ gm}$$

\therefore Cl₂ is limiting reagent [\because H₂ is in excess]

\therefore Amount of HCl formed will depend on Cl₂ gas

71 gm Cl₂ 44.8 L HCl

7.4 gm Cl₂ x L HCl

$$\therefore x = \frac{7.4 \times 44.8}{71}$$

$x = 4.67$ L of HCl gas is formed.



Question7

A gas mixture contains 25% He and 75% CH₄ by volume at a given temperature and pressure. The percentage by mass of methane in the mixture is approximately _____.

KCET 2020

Options:

- A. 75%
- B. 25%
- C. 92%
- D. 8%

Answer: C

Solution:

Gas mixture contains 25% He and 75% CH₄ by volumes. We have to calculate the mass percentage of methane in the mixture.

molar mass of He = 4 molar mass of CH₄ = 16

∴ Mass percentage of methane in the mixture shall be = $\frac{75 \times 16}{25 \times 4 + 75 \times 16} \times 100 = 92\%$

Question8

A metal exists as an oxide with formula $M_{0.96}O$. Metal, M can exist as M^{2+} and M^{3+} in its oxide $M_{0.96}O$. The percentage of M^{3+} in the oxide is nearly

KCET 2020

Options:

A. 8.3%

B. 4.6%

C. 5%

D. 9.6%

Answer: A

Solution:

We are given metal oxide with formula $M_{0.96}O$. Here, M can exist as M^{2+} as well as M^{3+} . Here, for every 100 oxide ions there are 96M ions. Let out of this 96M ions, M^{2+} exists = x and M^{3+} will be = $(96 - x)$.

Total positive charge on 96M-atoms = $2 \times x + 3 \times (96 - x)$

Total negative charge on 100O-atoms = 100×2

= 200

As per electrical neutrality concept

$$2x + 3(96 - x) = 200$$

$$2x + 288 - 3x = 200$$

$$-x = 200 - 288$$

$$-x = -88 \text{ or } x = 88$$

$$96 - 88 = 8$$

So, the ratio of M^{3+} will be $\frac{8}{96} \times 100 = 8.3\%$

Question9

The mass of AgCl precipitated when a solution containing 11.70 g of NaCl is added to a solution containing 3.4 g of AgNO₃ is [Atomic mass of Ag = 108, Atomic mass of Na = 23]

KCET 2019

Options:

A. 5.74 g

B. 1.17 g

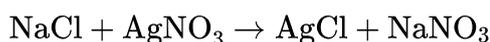
C. 2.87 g

D. 6.8 g

Answer: C

Solution:

To determine the mass of AgCl precipitated, we need to analyze the reaction between NaCl and AgNO₃. The balanced chemical equation for the reaction is:



From the equation, we can see that one mole of NaCl reacts with one mole of AgNO₃ to produce one mole of AgCl.

First, we need to find the number of moles of NaCl and AgNO₃ present in the given masses.

The molar mass of NaCl is:

$$M_{\text{NaCl}} = 23 + 35.5 = 58.5 \text{ g/mol}$$

So, the number of moles of NaCl in 11.70 g is:

$$n_{\text{NaCl}} = \frac{11.70 \text{ g}}{58.5 \text{ g/mol}} = 0.20 \text{ mol}$$

The molar mass of AgNO₃ is:

$$M_{\text{AgNO}_3} = 108 + 14 + (3 \times 16) = 108 + 14 + 48 = 170 \text{ g/mol}$$

So, the number of moles of AgNO₃ in 3.4 g is:

$$n_{\text{AgNO}_3} = \frac{3.4 \text{ g}}{170 \text{ g/mol}} = 0.02 \text{ mol}$$

Since the ratio of NaCl to AgNO₃ in the reaction is 1:1, the limiting reagent is AgNO₃, because it has fewer moles (0.02 moles) compared to NaCl (0.20 moles).

Now, we calculate the mass of AgCl produced from 0.02 moles of AgNO₃.

The molar mass of AgCl is:

$$M_{\text{AgCl}} = 108 + 35.5 = 143.5 \text{ g/mol}$$

So, the mass of AgCl produced from 0.02 moles is:

$$m_{\text{AgCl}} = 0.02 \text{ mol} \times 143.5 \text{ g/mol} = 2.87 \text{ g}$$

Therefore, the mass of AgCl precipitated is 2.87 g, making the correct answer:

Option C: 2.87 g



Question10

1.0 g of Mg is burnt with 0.28 g of O₂ in a closed vessel. Which reactant is left in excess and how much?

KCET 2018

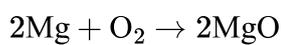
Options:

- A. Mg, 5.8 g
- B. Mg, 0.58 g
- C. O₂, 0.24 g
- D. O₂, 2.4 g

Answer: B

Solution:

The burning of magnesium (Mg) occurs according to the following reaction:



From the balanced equation, we see:

Molar mass of Mg: 24 g/mol

Molar mass of O₂: 32 g/mol

48 g of Mg (2 moles) reacts with 32 g of O₂ (1 mole).

To find how much magnesium is needed to react with 0.28 g of O₂:

$$\frac{48 \text{ g Mg}}{32 \text{ g O}_2} = x \text{ g Mg} / 0.28 \text{ g O}_2$$

Solving for x :

$$x = \frac{48 \times 0.28}{32} = 0.42 \text{ g Mg}$$

Since only 0.42 g of Mg is required to completely react with 0.28 g of O₂, and we started with 1.0 g of Mg, the amount of magnesium left in excess is:

$$1.0 \text{ g Mg} - 0.42 \text{ g Mg} = 0.58 \text{ g Mg}$$

Therefore, magnesium is the reactant left in excess, with 0.58 g remaining.

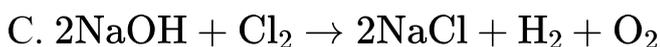
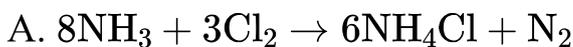
Question11



Select wrong chemical reaction among the following.

KCET 2017

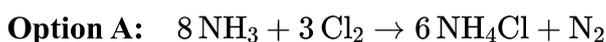
Options:



Answer: C

Solution:

Let's examine each reaction step by step:



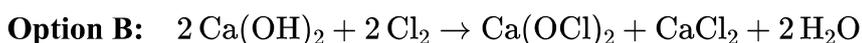
Checking the atom counts:

Nitrogen: Left has 8 (from 8 NH_3); Right has 6 (from 6 NH_4Cl) + 2 (from N_2) = 8.

Hydrogen: Left has $8 \times 3 = 24$; Right has $6 \times 4 = 24$.

Chlorine: Left has $3 \times 2 = 6$; Right has 6 (from 6 NH_4Cl).

This reaction is correctly balanced and is known to occur under certain conditions where chlorine reacts with ammonia to yield ammonium chloride and nitrogen.



Checking the atom counts:

Calcium: 2 on both sides.

Chlorine: Left has $2 \times 2 = 4$; Right has 2 (in $\text{Ca}(\text{OCl})_2$) + 2 (in CaCl_2) = 4.

Oxygen: Left has $2 \times 2 = 4$ (from $\text{Ca}(\text{OH})_2$); Right has 2 (from $\text{Ca}(\text{OCl})_2$) + 2 (from 2 H_2O) = 4.

Hydrogen: Left has $2 \times 2 = 4$; Right has $2 \times 2 = 4$.

This reaction is balanced and represents a known process for producing bleaching powder (calcium hypochlorite).



Checking the atom counts:

Sodium: 2 on both sides.

Chlorine: Left has 2 (from Cl_2); Right has 2 (from 2 NaCl).

Oxygen: Left has 2 (from 2 NaOH); Right has 2 (from O₂).

Hydrogen: Left has 2 (from 2 NaOH); Right has 2 (from H₂).

Although the equation is balanced in terms of atoms, it is not chemically plausible. In reality, when chlorine reacts with sodium hydroxide, the typical reactions are:

Under cold conditions:



Under hot or concentrated conditions:



There is no common or accepted reaction where sodium hydroxide and chlorine yield hydrogen gas (H₂) and oxygen gas (O₂) as the sole products. Thus, Option C is not a valid reaction under normal conditions.



Checking the atom counts:

Manganese: 1 on both sides.

Oxygen: 2 (from MnO₂) equals 2 (from 2 H₂O).

Hydrogen: 4 (from 4 HCl) equals 4 (from 2 H₂O).

Chlorine: 4 (from 4 HCl) equals 2 (from MnCl₂) + 2 (from Cl₂) = 4.

This is a well-known reaction where manganese dioxide oxidizes chloride ions in acid, releasing chlorine gas.

Based on the above analysis, the incorrect (or wrong) chemical reaction is:

Option C

Question 12

If 3.01×10^{20} molecules are removed from 98 mg of H₂SO₄, then number of moles of H₂SO₄ left are

KCET 2017

Options:

A. 0.1×10^{-3} mol

B. 9.95×10^{-2} mol

C. 0.5×10^{-3} mol



D. 1.66×10^{-3} mol

Answer: C

Solution:

To determine the number of moles of H_2SO_4 left after removal of molecules, we start by considering the initial amount.

Initial Calculation:

Given 98 mg of H_2SO_4 , the number of molecules is 6.02×10^{20} .

Molecules Removed:

The problem states that 3.01×10^{20} molecules are removed.

Molecules Remaining:

Calculation:

$$6.02 \times 10^{20} - 3.01 \times 10^{20} = 3.01 \times 10^{20}$$

Finding Moles of H_2SO_4 Remaining:

Using the formula $n = \frac{N}{N_A}$, where n is the number of moles, N is the number of molecules, and N_A (Avogadro's number) is 6.02×10^{23} .

Substitute the values in:

$$n = \frac{3.01 \times 10^{20}}{6.02 \times 10^{23}}$$

Simplifying the expression gives:

$$n = 0.5 \times 10^{-3} \text{ mol}$$

Thus, the number of moles of H_2SO_4 left after removing 3.01×10^{20} molecules is 0.5×10^{-3} mol.

