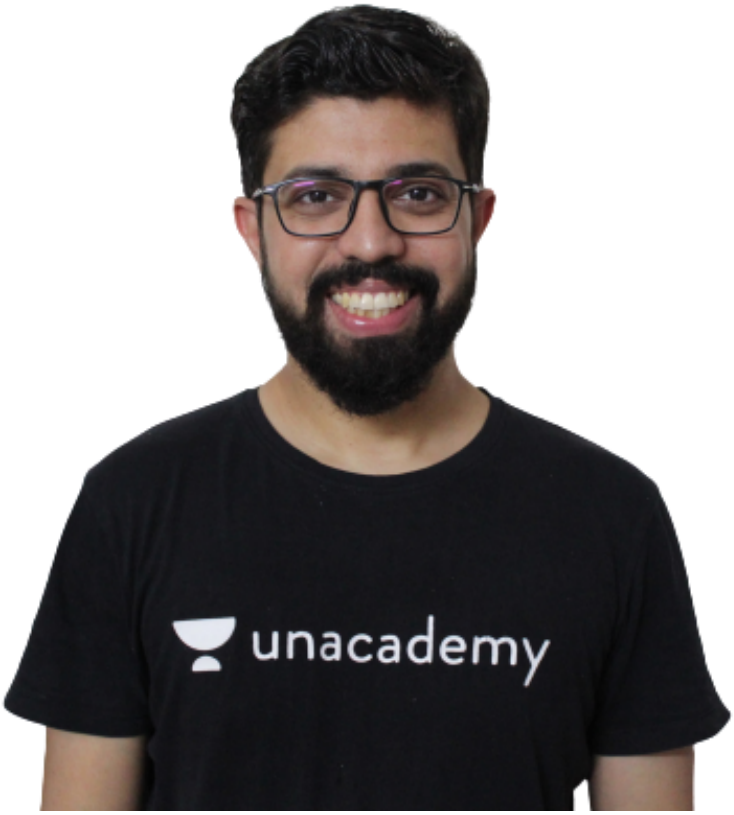
Mole Concept

DPP-3 Solutions



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1. 343.93 Kg

Sol. $2\ NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl.$

250kg (94.5%)

wt. of pure NaCl = $250 \times 10^3 \times 0.945$

$= 236.25 \times 10^3 g$

$\therefore$ moles of NaCl taken = $\frac{236.25\times10^3}{58.5}$

$= 4.04 \times 10^3$ moles

$\therefore$ moles of Na_2SO_4 formed = 2.02×10^3 moles

$\therefore$ wt. of pure Na_2SO_4 formed = $2.02 \times 10^3 \times 142$

$= 286.84 \times 10^3 g$

$\therefore$ Total wt. of Na_2SO_4 formed = $\frac{286.84}{0.834} kg$

$= 343.93$ Kg

2. 262.91kg

Sol. $5C + 2SO_2 \rightarrow CS_2 + 4CO$

540kg

Moles of SO_2 = $\frac{540}{64}\times10^3 = 8.4375\times10^3$ moles

$\therefore$ Moles of $CS_2 = 4.21875 \times 10^3$

$\because$ % yield = 82%

$\therefore$ Actual moles of CS_2 produced

$= 4.21875 \times 10^3 \times 0.82$

$= 3459.375$ moles

$\therefore$ wt. of $CS_2 = 3459.375 \times 76$

$= 262.91kg$

3. (a) 4.56g, (b) 50%

Sol. (a) $Pb \xrightarrow{HNO_3} Pb(NO_3)_2 \xrightarrow[NH_4Cl]{HCl,Cl_2} (NH_4)_2 PbCl_6.$

Conserving Pb $\rightarrow$

moles of Pb taken = Moles of Pb in product

= Moles of product

$\therefore$ moles of product = $\frac{2.07}{207} = 0.01$

$\therefore$ wt. of product = $0.01 \times (28+8+207+213)g$

$= 4.56g$

(b) wt. of product = 2.28g

wt. of product expected = 4.56g

% yield = $\frac{2.28}{4.56}\times100 = 50\%$

4. 2.5M

Sol. $M = \frac{16}{32\times0.2} = 2.5M$

5. 5×10^{-3} M

Sol. $M = \frac{90\times10^{-3}}{180\times0.1} = 5\times10^{-3}M$

6. 83.33 mL

Sol. $\rho = \frac{mass}{volume}$

$1.2 = \frac{100}{V} \Rightarrow V = 83.33$ mL

7. 7g

Sol. 1mL of solution has = 70mg of NH_4Cl

$\Rightarrow$ 100 mL of solution has = 7000 mg = 7g

8. (a) 1M, (b) 1.25M, (c) 0.5M, (d) 0.37M

Sol. (a) $\frac{166}{166} = 1M$

(b) $\frac{33}{132\times0.2} = 1.25M$

(c) $\frac{12.5}{249.5\times0.1} = 0.5M$

(d) $\frac{10\times10^{-3}}{27\times10^{-3}} = 0.37M$

9. 1039 kg/m^3

Sol. 10^{-3} m^3 of milk weighs = 1.032 kg

$1m^3$ of milk weighs = 1032kg

$V_{fat} = 0.04\ m^3$

$\rho_{fat} = 865\ kg/m^3$

$\Rightarrow m_{fat} = 865 \times 0.04 = 34.6kg$

$\rho_{fat\ free\ milk} = \frac{1032-34.6}{1-0.04}$

$= 1039\ kg/m^3.$

10. 0.173g/mL

Sol. 18.6g NH_3 is present in 100g solution.

$\rho_{soln.} = \frac{mass\ of\ solution}{volume\ of\ solution}$

$0.93 = \frac{100}{V_{soln.}}$

$\Rightarrow V_{soln.} = 107.53$ mL

$\therefore$ Mass of NH_3 in 1mL of solution $= \frac{18.6}{107.53}$

$= 0.173g/mL$

11. 0.029M

Sol. moles of sugar $= \frac{20}{342}$

Molarity = $\frac{20}{342\times 2} = 0.029M$

12. 15.379 g

Sol. moles of CH_3COONa = 0.5 × 0.375 = 0.1875

mass of CH_3COONa = 0.1875 × 82.0245g

= 15.379g

13. 15.44M

Sol. 69g HNO_3 in 100g solution

mol of HNO_3 = $\frac{69}{63} = 1.095$

$V_{solution} = \frac{\text{mass of solution}}{\text{density}}$

$\Rightarrow \frac{100}{1.41} = 70.92\ mL$

Molarity = $\frac{1.095}{70.92\times 10^{-3}} = 15.44M$

14. 25.22 mL

Sol. moles of methanol (CH_3OH) = 0.25 × 2.5

= 0.625

mass of methanol = 0.625 × 32 = 20g

$\rho_{methanol}$ = 0.793 kg/L

= 0.793 g/mL

$V_{methanol} = \frac{20}{0.793}$ = 25.22mL

15. (i) 15×10^{-4} % (ii) 1.2577×10^{-4} m

Sol. (i) Concentration = 15ppm.

$\frac{\text{mass of solute}}{\text{mass of solution}} \times 10^6 = 15$

Let mass of solution = 1g

mass of $CHCl_3$ = 15 × 10^{-6} g

$\text{mass\%} = \frac{15\times 10^{-6}}{1} \times 100$

= 15 × 10^{-4}%

(ii) molality = $\frac{\text{moles of } CHCl_3}{\text{mass of solvent in kg}}$

moles of $CHCl_3$ = $\frac{15\times 10^{-6}}{119.5}$

= 1.255 × 10^{-7}

molality = $\frac{1.255\times 10^{-7}}{(1-15\times 10^{-6})\times 10^{-3}}$

= 1.2577×10^{-4} m

16. 2.09M

Sol. Let 0.04 moles of solute are present in 1 mole of solution.
Let density of solution = 1g/mL (approximating it with density of solvent, water)
moles of solute = 0.04
mass of solute, C_2H_5OH = 0.04 × 46 = 1.84g
moles of solvent = 1 – 0.04 = 0.96
mass of solvent = 0.96 × 18 = 17.28g
mass of solution = 1.84 + 17.28 = 19.12g

$V_{solution} = \frac{19.12}{1} = 19.12\ mL$

Molarity = $\frac{0.04}{19.12\times 10^{-3}} = 2.09M$

17. (a)

Sol. Mass of H_2O = 1 × 0.0018 = 0.0018g

18g of H_2O has = 6.02 × 10^{23} molecules

0.0018g of H_2O has = 6.02 × 10^{19} molecules

18. (d)

Sol. $\rho_{H_2O} = \frac{\text{mass of } H_2O}{\text{volume of } H_2O}$

$\Rightarrow$ Mass of H_2O = 100g

18g H_2O has = N_A molecules

1000g H_2O has = 55.55 N_A molecules

19. (b)

Sol. $KClO_3 \longrightarrow KCl + 3/2\ O_2$

22.4L ≡ 1 mol of O_2

11.2L $\Rightarrow$ 0.5 mol of O_2

1.5 mol O_2 ≡ 1 mol $KClO_3$

0.5 mol O_2 ≡ 1/3 mol $KClO_3$

20. (a)

Sol. 1 mol N_2 ≡ $2N_A$ atoms

0.5 mol N_2 ≡ N_A atoms

12g C ≡ N_A atoms

21. (d)

Sol. CO_2 + 2NaOH $\longrightarrow$ Na_2CO_3 + H_2O

moles of NaOH = 20/40 = 0.5 mole

CO = x mole

CO_2 = (1 – x) mole

2 moles of NaOH combine with = 1 mole of CO_2

0.5 mole of NaOH combine with = 0.25 moles of CO_2

1 – x = 0.25

x = 0.75 moles

$CO + \frac{1}{2} O_2 \longrightarrow CO_2$

Now moles of CO = moles of CO_2

Total moles of CO_2 = 0.75 moles

$CO_2 + 2NaOH \longrightarrow Na_2CO_3 + H_2$

1 mole of CO_2 ≡ 2 moles of NaOH

0.75 moles of CO_2 ≡ 1.5 moles of NaOH

so we need 1.5 moles more

22. (b)

Sol. Let 0.2 moles of I_2 are present in 1mol solution

$\Rightarrow$ moles of solute (I_2) = 0.2 mol

moles of solvent (C_6H_6) = 1 – 0.2

= 0.8 moles

mass of solvent = 0.8 × 78g
= 62.4g
= 0.0624 kg

molality = $\frac{0.2}{0.0624} = 3.2m$

23. (c)

Sol. 55.85g Fe ≡ N_A atoms

558.5g Fe ≡ $10N_A$ atoms

(c) 12 g C ≡ N_A

60 g C ≡ 5 N_A ⇒ atoms = half of $10N_A$ atoms.

24. (b)

Sol. $M = \frac{moles}{v(L)} \Rightarrow 0.4 = \frac{600 \times 10^{-3}}{56 \times V}$

V = 26.78 mL

25. (b)

Sol. 50g NaCl is present in 100 mL solution

∴ moles of NaCl = 50/58.5 = 0.855

$V_{solution}$ = 0.1L

Molarity = $\frac{0.855}{0.1} = 8.55M$

$\rho_{solution} = \frac{\text{mass of solution}}{\text{volume of solution}}$

$1.25 = \frac{\text{mass of solution}}{100}$

mass of solution = 125g

mass of solvent = 125 – 50 = 75g

molality = $\frac{0.855}{75 \times 10^{-3}} = 11.4m$

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

$= \frac{50}{125} \times 100 = 40\%$