Class:- 9

IIT Foundation Plus

Solutions

Teaching Task.

Q1) Ans:- B.

Solution:-

25% of solute in 200gms of solution = 50gms → A

40% of solute in 300gms of solution = 120gms → B

30% of solute in 400gms of solution = 120gms → C

Total solute = 50+120+120 = 290gms.

Total weight of solution = 200+300+400 = 900gms.

$$\% \text{ of solute} = \frac{290}{900} \times 100 = 32.22\%$$

$$\% \text{ of solvent} = 100 - (\% \text{ of solute})$$

$$= 100 - 32.22 = 67.78\%$$

Q2) Ans:- C

Solution:- Given solute = 25 g, $(w/w)\% = 10\%$

$$\text{Mass percentage } \left(\frac{w}{w}\right)\% = \frac{\text{weight of solute}}{\text{wt. solution}} \times 100.$$

$$10 = \frac{25}{\text{wt. solution}} \times 100$$

$$\text{wt. solution} = 250.$$

Q3) Ans:- A

Solution:- PPb means parts per billion.

density = 1.0 g/mL

i.e, 1 L of solution has a mass of 1000gms

Concentration in µg/L = Concentration in ppb × $\frac{\text{mass of solution (kg)}}{\text{volume of solution (L)}}$

75 ppb = 75 µg/L

Q4) Ans:- A

Solution:- Molarity = 0.1 M.

Volume = 10mL = 0.01 Litres.

No. of moles = Molarity × Volume (in Litres)

$= 0.1 \times 0.01 = 10^{-3}$

No. of molecules = No. of moles × Avagadro number

$= 10^{-3} \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{20}$ molecules

Q5) Ans:- A

Solution:- 1 µg = 10^{-6} gms

2.4 ppb = 2.4×10^{-6} g/L.

Molarity = $\frac{\text{Mass of solute}}{\text{Molar mass of solute}} = \frac{2.4 \times 10^{-6}\ g/L}{207\ g/mol}$

$= 1.16 \times 10^{-8}$ M.

$\simeq 1.2 \times 10^{-8}$ M

Q6) Ans:- A

Solution:- Phenol concentration = 45 ppm

i.e, 45mg of phenol per 1kg (1000g) of solution.

→ Density of solution = 1.0 g/mL

→ This means 1gm of solution corresponds to 1mL

45 mg per 1000mL = 45 µg/mL

Q7) Ans:- C

Solution:- Solution mass = 100 gms.

mass percentage $\frac{w}{w}$ = 1%

This means 1.00gm of sodium carbonate (Na_2CO_3) per 100gms of solution.

Molar mass of Na_2CO_3 = 106 gms

Molar mass of $Na_2CO_3 \cdot 7H_2O$ = 106 + (7 × 18)

= 232 g/mol.

Mass of $Na_2CO_3 \cdot 7H_2O = \frac{1 \times 232}{106}$ = 2.188 g.

≅ 2.19 gms

Q8) Ans:- B.

Solution:- Molarity of solution

$$M = \frac{w_B \times 1000}{m_B \times V} = \frac{2.65 \times 1000}{106 \times 250} = 0.1$$

$M_1V_1 = M_2V_2$

$0.1 \times 10 = 0.001 (10 + x)$

$x = 990$ mL.

Q9) Ans:- B

Solution:- Molarity $= \frac{\text{wB}}{\text{GMW}} \times \frac{1000}{V}$

$= \frac{10.6}{106} \times \frac{1000}{100} = 1\ M.$

$M_1V_1 = M_2V_2$

$\Rightarrow 1 \times 10 = M_2(1000)$

$M_2 = \frac{10}{1000}$

$M_2 = 10^{-2}\ M.$

Q10) Ans:- B

Solution:- 100 mL of solution $= 6.023 \times 10^{21}$ molecules

1000mL of solution $= 6.023 \times 10^{21}$ molecules

10mL of solution $= x$

$1000x = 10 \times 6.023 \times 10^{21}$

$x = \frac{6.023 \times 10^{21}}{100} = 6.023 \times 10^{19}.$

Q11) Ans:- B.

Solution:- $M_1 = \frac{2.65}{106} \times \frac{1000}{250} = 0.1\ M.$

$M_1V_1 = M_2V_2$

$0.1 \times V_1 = (10+15)\ 0.001$

$0.1 \times 10 = 0.01 + 0.001x$

$1 - 0.01 = 0.001x$

$x = \frac{0.99}{0.001} = 990$

Q12) Ans:- B.

Solution:- Specific gravity = density = 1.8g.

Mass of H_2SO_4 = $1.8 \times \frac{9.8}{100} = 0.1764$ g/mL.

No. of moles = $\frac{w}{GMW} = \frac{0.1764}{98} = 0.0018$ mol/mL

Total no. of moles required for 1000mL of 0.18M solution.

Total moles = Molarity × Volume in litres

$= 0.18 \times 1 = 0.18$ mol.

$V = \frac{\text{Total moles}}{\text{moles per mL}} = \frac{0.18}{0.0018} = 100$mL

Q13) Ans:- D.

Solution:- $M = \frac{10g}{GM.wt} = \frac{10 \times 3.65}{36.5} = 1.$

$M_1V_1 = M_2V_2$

$1 \times 10 = M_2 \times 1000$

$M_2 = \frac{10}{1000} = 10^{-2}$ M.

Q14) Ans:- B

Solution:- Given $V_1 = x$L, $V_2 = y$L, $V = 2$ litres.

$M_1 = 1$M, $M_2 = 5$M, $M = 2$M.

$MV = M_1V_1 + M_2V_2$

$2 \times 2 = 1x + 5y.$

$4 = x + 5y \Rightarrow 4 = x + 5(2-x)$

$4 = x + 10 - 5x \Rightarrow 4 = 10 - 4x \Rightarrow 4x = 6 \Rightarrow x = 1.5$ L

$x + y = 2$ litres

$y = 2 - x.$

then $y = 0.5$

Q15) Ans:- B, C

Solution:

A) Concentration = $\frac{\text{Amount of solute}}{\text{volume of solution}}$ ✓

B) ppb = $\frac{\text{mass of solute}}{\text{total mass of solution}} \times 10^9$.

C) weight % = $\frac{\text{weight of solute}}{\text{weight of solution}} \times 100$.

Q16) Ans:- D

Solution:- $M = \frac{w}{GMW} \times \frac{1000}{V}$

$= \frac{222.6}{62} \times \frac{1000}{V_{solvent}}$

$= \frac{222.6}{62} \times \frac{1000}{200}$

$= 17.95$

Ethylene glocol

$C_2H_6O_2$

$= (2\times12) + 6 + 32$

$= 24 + 38 = 62$

$V_{water} = ?$

$d = \frac{m}{V}$

$V = 200 \times 1 = 200ml$.

Q17) Ans:- C

Solution:- $MV = M_1V_1 + M_2V_2$

$M(1000) = 1.5(480) + 1.2(520)$

$= 720 + 624$

$M = \frac{1344}{1000}$

$= 1.344$

$V = V_1 + V_2$

$V = 480 + 520 = 1000ml$.

Q18) Ans:- B

Solution:- To determine concentration, calculate molarity.

a) 5.3 gm of Na_2CO_3 in 500ml solution.

$Na_2CO_3 = 46+12+48 = 106$ gm

$$M = \frac{5.3}{106} \times \frac{1000}{500} = 0.1M.$$

b) 5 gm of NaOH in 100ml solution.

$$M = \frac{5}{40} \times \frac{1000}{100} = \frac{5}{4} = 1.25\ M$$

c) 3.65 gm of HCl in 750ml solution

$$M = \frac{3.65}{36.5} \times \frac{1000}{750} = \frac{4}{10 \times 3} = 0.133\ M$$

D) 4.9 gm of H_2SO_4 in 1000ml solution

$$M = \frac{4.9}{98} \times \frac{1000}{1000} = 0.05M$$

Q19) Ans:- A

Solution:- Weight of solute = 1 mg $= \frac{1}{1000} = 10^{-3}$ gm.

weight of solvent = 10 gm

$$w\% = \frac{10^{-3}}{10+0.001} \times 100 = \frac{1}{1000(10.001)} \times 100$$

$$= \frac{1}{100.01} = 0.00999$$

$$\cong 0.01$$

$$= 0.01$$

Matrix Matching

Q20) Ans:- A

Solution:-

1) Proton con. of 1 litre made solution with 200ml of 1M H_2SO_4, 300ml 3M HCl & 100ml of 2M HCl. → Q) 1.5 M.

In H_2SO_4

Moles = $2 \times 0.2 = 0.4$ moles

300ml of 3M HCl.

$3 \times 0.3 = 0.9$ moles.

100ml of 2M HCl

$2 \times 0.1 = 0.2$ moles.

Total moles = $0.4 + 0.9 + 0.2$

$= 1.5$ moles

$M = \frac{\text{moles}}{L} = \frac{1.5}{1} = 1.5M.$

2) Molarity of mixing of 100ml of 1M Hcl, 200ml 2M HCl, & 300ml of 3M Hcl. → R) 2.33 M.

$MV = M_1V_1 + M_2V_2 + M_3V_3$

$M = \frac{(100 \times 1) + (2 \times 200) + (3 \times 300)}{600}$

$= 2.33M.$

3) Molarity of 200ml of HCl solution which can neutralise 10.6g. of anhydrous Na_2CO_3 → S) 1M.

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

0.1 mole, 0.2 moles.

$M = \frac{\text{no. of moles}}{V} = \frac{0.2}{0.2} = 1M.$

4) Molarity of 0.6ml $Ca(OH)_2$ solution which can neutralise 100ml of 10^{-4} M H_3PO_4. → P) 0.025M.

$2H_3PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 6H_2O.$

2 moles H_3PO_4 react with 3 moles of $Ca(OH)_2$

Moles of $Ca(OH)_2 = \frac{3}{2} \times 10^{-5}$

$M = \frac{1.5 \times 10^{-5}}{0.0006} = 0.025M.$

Q21) Ans:- D

Solution:-

D) No. of moles of Solute present in v ml of solution → Q) $n = \frac{V \times M}{1000}$

2) GMW → P) $= \frac{10 \times S.P.gr \times \left(\frac{w}{w}\right)\%}{M.}$

3) Strength → S) $= \frac{\text{Mass of solute in grams}}{\text{volume of solution in litres}}$

4) w (of solute) → R) $W = M \times V \times GMW.$

Learners Task

Q1) Ans:- B

Solution:- $w_{Glucose} = 16 gms$ $w_{Water} = 64 gms$

$\frac{w}{w}\%$ of Glucose $= \frac{16}{80} \times 100 = 20\%.$

water $\% = 100 - 20 = 80\%.$

Q2) Ans:- A

Solution:- $\% w/v = \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$

$= \frac{16}{50} \times \frac{2}{100} = 32\%$

Q3) Ans:- B

Solution:- Units of Molarity are moles/litres

moles. Litre^{-1}.

Q4) Ans:- D

Solution:- If we double the total volume of solution, molarity is halved.

Q5) Ans:- A

Solution:- $CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$

1 mole $CaCl_2$ → 3 moles of ions

Given $M = 0.1M$, $V = 1ml = 0.001\ L$

Moles $= M \times V = 0.1 \times 0.001 = 1.0 \times 10^{-4}$ moles

Moles of ion $= 1.0 \times 10^{-4} \times 3 = 3 \times 10^{-4}$ moles

Moles to no. of ions

$= 3 \times 10^{-4} \times N_A$

$= 3 \times 10^{-4} \times 6 \times 10^{23}$

$= 18 \times 10^{19} = 1.8 \times 10^{20}$

Q6) Ans:- A

Solution:- $\frac{w}{v}\% = 18\%$.

$C_6H_{12}O_6$

GMW $= 72 + 12 + 96 = 180$

$\text{Molarity} = \frac{w}{GMW} \times \frac{1000}{V}$

$V = 100\ mL = 0.1\ L$.

$M = \frac{18}{180} \times \frac{1}{0.1} = \frac{18}{18} = 1M$.

Q7) Ans:- B

Solution:- $Zn + \underset{1\ mole}{CuSO_4} \rightarrow ZnSO_4 + \underset{1\ mole}{Cu}$.

$M = 0.05$, $V = 100mL = 0.1L$

Moles of $CuSO_4 = M \times V = 0.1 \times 0.05 = 0.005$

Cu & $CuSO_4$ are 1:1 ratio.

0.005 moles of Cu $= 0.005 \times 63.54 = 0.3177$ gms

Q8) Ans:- B.

Solution:- Mass of solute = 10.6 g.

$$\text{No. of moles} = \frac{\text{mass}}{\text{GMM}} = \frac{10.6}{106} = 0.1 \text{ moles.}$$

$$\text{Molarity} = \frac{\text{moles}}{\text{volume (L)}} = \frac{0.1}{0.1} = 1M$$

10mL of this 1M solution is taken & diluted to 1000mL (1L)

$$M_1V_1 = M_2V_2$$

$M_1 = 1M$, $V_1 = 10mL = 0.01L$

$M_2 = ?$, $V_2 = 1000mL$

$$1 \times 0.01 = M_2 \times 1000 \text{ (1 Litres)}$$

$$M_2 = \frac{0.01}{\frac{1000}{1000} \text{ 1 Litres}} = \frac{0.01}{1} = 10^{-2} M.$$

Q9) Ans:- B.

Solution:- $M_1 = 10M$, $V_1 = ?$

$M_2 = 5M$ $V_2 = 2dm^3 = 2L$

$$M_1V_1 = M_2V_2$$

$$10V_1 = 5 \times 2$$

$$V_1 = \frac{10}{10} = 1L.$$

Q10) Ans:- C

Solution:-

A) 2.12, 0.05

$$2 = M \times \text{Molar mass} \times V$$

$$M = \frac{x}{\text{GMM} \times V} = \frac{2.12}{106 \times 0.1} = 0.2M.$$

B) 1.06, 0.2

$$M = \frac{1.06}{106 \times 0.1} = \frac{0.01}{0.1} = 0.1M$$

C) 1.06, 0.1

$$M = \frac{1.06}{106 \times 0.1} = \frac{0.01}{0.1} = 0.1M$$ ✓

D) 2.12, 0.1

$$M = \frac{2.12}{106 \times 0.1} = \frac{0.02}{0.1} = 0.2M.$$

JEE Main Level Questions

Q1) Ans:- A.

Solution:- 100ml of 0.3M = $\frac{100 \times 0.3}{1000}$ = 0.03 moles of NaCl

100ml of 0.4M = $\frac{100 \times 0.4}{1000}$ = 0.04 moles of NaCl.

Moles of NaCl to be added = 0.04 − 0.03
= 0.01 mole

NaCl → 1 mole → 58.5 gms.
0.01 moles → x x = 0.585 gms

Q2) Ans:- B.

Solution:- $H_2SO_4 \rightarrow 2H_3O^+ + SO_4^{2-}$

1 mole of H_2SO_4 produces 2 moles of H_3O^+ and 1 mole of SO_4^{2-}

Moles in 2L = 0.020 × 2 = 0.040 moles of H_2SO_4.

1 mole of H_2SO_4 produces 2 moles of H_3O^+,

0.04 × 2 = 0.080 moles of H_3O^+.

1 mole of H_2SO_4 produces 1 mole of SO_4^{2-},

So 0.040 moles of SO_4^{2-}

Q3) Ans:- B

Solution:- $CaCl_2 \rightarrow Ca^{+2} + 2Cl^-$
1 mole → 1 mole, 2 moles.

$CaCl_2$
1 mole → 111 gms
x → 11.1 gms
x = 0.1 moles

Molarity = $\frac{\text{moles}}{\text{volume(L)}}$
= $\frac{0.1}{0.1}$
= 1M

For 1 M $CaCl_2$ → 2 M Cl^- ions produced.

Q4) Ans:- B.

Solution:- $AgNO_3 + NaCl \rightarrow AgCl\downarrow + NaNO_3$.

→ 100 ml (0.1 L) of 1M $AgNO_3$

Moles of NO_3^- = $1 \times 0.1 = 0.1$ moles.

→ 100 ml (0.1 L) of 1M NaCl does not contribute to NO_3^- ions.

Total volume = 100 ml + 100 mL = 200 mL = 0.2 L

$$\text{Molarity} = \frac{\text{Moles of } NO_3^-}{\text{Total volume (L)}} = \frac{0.1}{0.2} = 0.5\ M.$$

Q5) Ans:- C

Solution:- $MV = M_1V_1 + M_2V_2$

$$M = \frac{1.5(480) + 1.2(520)}{1000}$$

$$= \frac{720 + 624}{1000} = 1.344$$

Q6) Ans:- D.

Solution:- $2KMnO_4 + 3H_2SO_4 + 5\,COOH \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$

$$\frac{M_1V_1}{n_1}[KMnO_4] = \frac{M_2V_2}{n_1}[COOH]$$

$$\frac{10^{-4} \times V_1}{2} = \frac{10^{-2} \times 0.1}{5}$$

$$V_1 = \frac{2 \times 10^{-3}}{10^{-4}}$$

$$V_1 = \frac{2}{10^{-1}} = 20$$

Q7) Ans: C

Solution:-

(A) 1M K_2S + 1M HNO_3.

$K_2S \rightarrow 2K^+ + S^{2-}$

2M K^+ + 1M S^{2-}, Total ion = 3M.

$HNO_3 \rightarrow H^+ + NO_3^-$

1M + 1M = 2M.

Total ion = 3 + 2 = 5M

B) 2M HCl + 0.5M NH_4Cl.

$HCl \rightarrow H^+ + Cl^-$

2M + 2M = 4M.

$NH_4Cl \rightarrow NH_4^+ + Cl^-$

0.5 + 0.5 = 1M

Total ion = 4 + 1 = 5M

C) 2M K_2S + 2M K_2SO_4.

$K_2S \rightarrow 2K^+ + S^{2-}$

2x2=4 2M = 6M.

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

4M 2M = 6M

Total ion = 6 + 6 = 12M. ✓

D) 2M K_2SO_4 + 2M NH_4Cl.

$K_2SO_4 \rightarrow 2K^+ + SO_4^-$

4M 2 = 6M.

$NH_4Cl \rightarrow NH_4^+ + Cl^-$

2M 2M = 4M

Total ion = 6 + 4 = 10M

Q8) Ans:- B, C

Solution:

A) If volume increases x times, molarity decreases x times.

B) 1 mole = 1000 millimoles.

Millimoles = M × V (in mL)

C). As temperature increases, the solution expands, leading to decrease in molarity.

D) Added volume = $V_2 - V_1 = \frac{M_1V_1}{M_2} - V_1$.

Q9) Ans:- B.

Solution:- $w/w\ \% = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$.

Q10) Ans:- A B, C

Solution:-

A) $M\% = \frac{6.5}{456.5} \times 100 = 1.424\%$.

B) Total mass = 1.0 g.

$x(106) + (100-x)(84) = 1$.

$x = \frac{1.0}{190} = 0.00526$ moles

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$

$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$

Na_2CO_3 needs 2 moles of HCl per mole $\rightarrow 2 \times 0.00526 = 0.01052$

$NaHCO_3$ needs 1 mole of HCl per mole $\rightarrow 0.00526$.

Total moles = 0.01052 + 0.00526 = 0.01578 mole.

$M = \frac{\text{moles}}{\text{litre}} \Rightarrow 0.1 = \frac{0.01578}{V} \Rightarrow V = 157.9\ mL$

C). Moles = $0.5 \times \frac{500}{1000} = 0.25$ moles of $CaCl_2$

$CaCl_2 \rightarrow Ca^{+} + 2Cl^{-}$

1 mole of $CaCl_2$ produces 2 moles of Cl^-

0.25 moles of $CaCl_2$ produce $\rightarrow 0.25 \times 2 = 0.5$ moles of Cl^-

Q11) Ans:- A

Solution: Molarity = $\frac{\text{Moles of Solute}}{\text{Volume of Solution in Litres}}$

When temperature increases, the solution expands, increasing volume changes with temperature

Q12) Ans:- D.

Solution:- $2KMnO_4 + 5H_2C_2O_4 + 6H_2SO_4 \rightarrow 2MnSO_4 + 10CO_2 + 8H_2O$

$2\ KMnO_4 : 5\ H_2C_2O_4$.

$2 \rightarrow 5$

$2 \rightarrow 20$ $\quad x = \frac{40}{5}$

For 20 mL we need 0.0008 moles of $KMnO_4$.

$\text{Volume} = \frac{\text{Moles}}{\text{Molarity}} = \frac{0.0008}{0.1} = 0.008\ L = 8\ mL$

A is incorrect

B) 2 moles of $KMnO_4$ → React with 5 moles of H_2SO_4

B is correct

Q13) Ans:- B.

Solution:- $\frac{w}{v}\% = \frac{w}{v} \times 100$.

$5\% = \frac{w}{250} \times 100$

$125 = 10w$

$w = \frac{125}{10} = 12.5\ g$.

Integer Type

Q14) Ans:- 1

Solution:- $M = \frac{w}{GMW} \times \frac{1000}{V_{mL}}$

$= \frac{18}{18} \times \frac{1000}{1000} = 1M.$

Q15) Ans:- 1

Solution:- $M = \frac{w\%.xd \times 10}{Mol.wt}$

$5 = \frac{20 \times d \times 10}{40}$

$20 = 20 \times d$

$d = \frac{20}{20} = 1$

Q16) Ans:- 1

Solution:- $M_1V_1 = M_2V_2$

$M_1 = 5M,\ V_1 = 2,\ M_2 = 10$

$V_2 = \frac{M_1V_1}{M_2} = \frac{5 \times 2}{10} = 1$ litre

Q17) Ans:- 5

Solution:- $AgNO_3 + NaCl \rightarrow AgCl\downarrow + NaNO_3$.

(1 mole of $AgNO_3$ reacts with 1 mole of NaCl)

Total volume = 100 + 100 = 200mL

100mL of 1M $AgNO_3$ was initially present 0.1 moles of $NaNO_3$ formed.

$M = \frac{Moles}{V(L)} = \frac{0.1}{0.2} = 0.5M$

$= 5 \times 10^{-1} M.$