Model answer lesson 4 chapter 2

Question	Answer	Question	Answer
1	D	21	C(Steps)
2	D	22	C(Steps)
3	D	23	C(Steps)
4	A	24	A(Steps)
5	B	25	C(Steps)
6	B	26	D(Steps)
7	D	27	A(Steps)
8	A(Steps)		
9	D (Steps)		
10	A(Steps)		
11	C(Steps)		
12	B(Steps)		
13	A(Steps)		
14	B(Steps)		
15	C(Steps)		
16	B(Steps)		
17	A(Steps)		
18	A(Steps)		
19	B(Steps)		
20	B(Steps)		

Steps:

8) $H_3PO_4+3NaOH \rightarrow Na_3PO_4+3H_2O$

Acid (H_3PO_4)	Base (NaOH)
M_a= X	M_b=0.25M
V_a=750 x10^{-3} L	V_b=125x10^{-3} L
n_a=1	n_b=3

$$\frac{Ma \times Va}{na} = \frac{Mb \times Vb}{nb}$$

$$\frac{X \times 750 \times 10^{-3}}{1} = \frac{0.25 \times 125 \times 10^{-3}}{3}$$

M_a= 0.014 M

9) $H_2SO_4+2NaOH \rightarrow Na_2SO_4+2H_2O$

Acid (H_2SO_4)	Base(NaOH)
M_a= 2 M	M_b=2 M
V_a= X	V_b=20 x10^{-3} L
n_a=1	n_b=2

$$\frac{Ma \times Va}{na} = \frac{Mb \times Vb}{nb}$$

$$\frac{2 \times X}{1} = \frac{2 \times 20 \times 10^{-3}}{2}$$

V_{acid} = 10 x 10^{-3} L = 10 ml

10) $H_3PO_4+3KOH \rightarrow K_3PO_4+3H_2O$

Acid (H_3PO_4)	Base (KOH)
Ma= 0.3 M	Mb=0.1 M
Va= 50 x10^{-3} L	Vb=100 x10^{-3} L
na=1	nb=3

$$\frac{Ma \times Va}{na} : \frac{Mb \times Vb}{nb}$$

$$\frac{0.3 \times 50 \times 10^{-3}}{1} : \frac{0.1 \times 100 \times 10^{-3}}{3}$$

Since, Acid > Base, Therefore, solution is acidic > yellow color

11) $2H_3PO_4 + 3Mg(OH)_2 \rightarrow Mg_3(PO_4)_2 + 6H_2O$

Acid (H_3PO_4)	Base($Mg(OH)_2$)
M_a= 0.6 M	M_b=0.6 M
V_a= 100x10^{-3}L	V_b=100 x10^{-3} L
n_a=2	n_b=3

$$\frac{Ma \times Va}{na} : \frac{Mb \times Vb}{nb}$$

$$\frac{0.6 \times 100 \times 10^{-3}}{2} : \frac{0.6 \times 100 \times 10^{-3}}{3}$$

Since, Acid > Base, Therefore, solution is acidic > red color

12) $H_2SO4+2NaOH \rightarrow Na_2SO_4+2H_2O$

Acid (H_2SO_4)	Base (NaOH)
Ma= 0.2M	Mb=0.1M
Va= 50 x10^{-3} L	Vb= 100 x10^{-3} L
na=1	nb=2

$$\frac{Ma \times Va}{na} : \frac{Mb \times Vb}{nb}$$

$$\frac{0.2 \times 50 \times 10^{-3}}{1} : \frac{0.1 \times 100 \times 10^{-3}}{2}$$

Since, Acid > Base, Therefore, solution is acidic > red color

13) $H_2SO4+2NaOH \rightarrow Na_2SO_4+2H_2O$

$$\frac{Ma \times Va}{na} : \frac{Mb \times Vb}{nb}$$

$$\frac{0.2 \times 10 \times 10^{-3}}{1} : \frac{0.1 \times 20 \times 10^{-3}}{2}$$

Acid (H_2SO_4)	Base (NaOH)
M_a= 0.2 M	M_b=0.1M
V_a= 10 x10^{-3} L	V_b=20 x10^{-3} L
n_a=1	n_b=2

Since, Acid > Base, Therefore, solution is acidic > red color

14) $HCl + NaOH \rightarrow NaCl + H_2O$

By supposing : equal volume

$$\frac{Ma \times Va}{na} : \frac{Mb \times Vb}{nb}$$

$$\frac{0.2 \times 1}{1} : \frac{0.25 \times 1}{1}$$

Acid (HCl)	Base (NaOH)
M_a= 0.2 M	M_b=0.25M
V_a= 1 L	V_b= 1 L
n_a=1	n_b=1

Since, Acid < Base, Therefore, solution is basic > blue color

15) Note : graduation of burette start from 0 & end with 15 ml

$HCl + KOH \rightarrow KCl + H_2O$

$$\frac{Ma \times Va}{na} = \frac{Mb \times Vb}{nb}$$

$$\frac{0.2 \times x}{1} = \frac{0.1 \times 10}{1}$$

Acid (HCl)	Base (KOH)
M_a= 0.2 M	M_b=0.1M
V_a= x ml	V_b= 10 ml
n_a=1	n_b=1

X = 5ml , as we start from 10 ml and we need 5 ml to reach end point so final volume reading is 15ml

16) $2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$

Acid (HCl)	Base (Na_2CO_3)
M_a= 0.1M	M_b=0.25M
V_a=xL	$V_b=25x10^{-3}$L
n_a=2	n_b=1

$$\frac{Ma \times Va}{na} = \frac{Mb \times Vb}{nb}$$

$$\frac{0.1 \times x}{2} = \frac{0.25 \times 25 \times 10^{-3}}{1}$$

V_{acid} = 0.125L = 125 ml

17) $H_2X+2NaOH \rightarrow Na_2X+2H_2O$

Acid (H_2X)	Base (NaOH)
M_a= x	M_b=0.1M
$V_a=25x10^{-3}$L	$V_b=20.2x10^{-3}$L
n_a=1	n_b=2

$$\frac{Ma \times Va}{na} = \frac{Mb \times Vb}{nb}$$

$$\frac{x \times 25 \times 10^{-3}}{1} = \frac{0.1 \times 20.2 \times 10^{-3}}{2}$$

M_{acid}=0.0404M

18) $H_2SO_4+Ca(OH)_2 \rightarrow CaSO_4+2H_2O$

from graph X is formed at V_a = 10 $x10^{-3}$ L

Acid (H_2SO_4)	Base ($Ca(OH)_2$)
M_a= 0.1 M	M_b= X M
V_a= 10 X 10^{-3}L Graph	$V_b=10 x10^{-3}$L
n_a=1	n_b=1

$$\frac{Ma \times Va}{na} = \frac{Mb \times Vb}{nb}$$

$$\frac{0.1 \times 10 \times 10^{-3}}{1} = \frac{x \times 10 \times 10^{-3}}{1}$$

M_{base} = 0.1 molar

19)

- Mass of washing soda crystals before heating= 5 g
- Mass after strong heating of soda crystals = 1.853 g
- So , water crystallization of washing soda = 5 – 1.853 = 3.147 g
- % water crystallization= $\frac{water\ crystallization\ of\ washing\ soda}{total\ mass} \times 100 = \frac{3.147}{5} \times 100 = 62.9\%$

20)

$Na_2CO_3.XH_2O \xrightarrow{\blacktriangle} Na_2CO_3 + XH_2O$

Mass of Na_2CO_3 = 10.6 g

Molar mass of Na_2CO_3 = (2×23) + 12+ (3×16) =106 g

Molar mass of water = (2×1) + 16 =18 g

Na_2CO_3	⟶	$X\,H_2O$
10.6 g	⟶	18 g
106 g	⟶	18X g

$18X = \frac{106 \times 18}{10.6} = 180$, $x = \frac{180}{18} = 10$

Chemical formula of salt = $Na_2CO_3.10H_2O$

21)

$Na_2CO_3.XH_2O \xrightarrow{\blacktriangle} Na_2CO_3 + XH_2O$

Mass of hydrated salt = 2.86 g

Mass of anhydrous salt =1.06 g

Mass of water = Mass hydrated – Mass anhydrate = 2.86 – 1.06 = 1.8 g

mass percentage of water = $\frac{mass\ of\ water}{mass\ of\ sample} \times 100$

mass percentage of water = $\frac{1.8}{2.86} \times 100 = 62.93\%$

Molar mass of Na_2CO_3 = (2×23) + 12+ (3×16) = 106 g

Molar mass of water = (2×1) + 16 =18 g

Na_2CO_3	⟶	**X H_2O**
1.06 g	⟶	1.8 g
106 g	⟶	18X g

$18X=\frac{106\times1.8}{1.06}=180$, $x=\frac{180}{18}=10$

Chemical formula of salt = $Na_2CO_3.10H_2O$

22)

$MgSO_4.XH_2O \xrightarrow{\Delta} MgSO_4 + XH_2O$

Mass of hydrated salt = 49.2 g

Mass of anhydrous salt = 24 g

Mass of water = Mass hydrated – Mass anhydrate = 49.2 – 24 = 25.2 g

Molar mass of $MgSO_4$ = 120 g

Molar mass of water = (2×1) + 16 =18 g

$MgSO_4$	⟶	**X H_2O**
24 g	⟶	25.2 g
120	⟶	18X

$18X=\frac{120\times25.2}{24}=126$, $x=\frac{126}{18}=7$

Chemical formula of salt = $MgSO_4.7H_2O$

23)

$Na_2SO_4.XH_2O \xrightarrow{\Delta} Na_2SO_4 + XH_2O$

Mass of hydrated salt =2.68 g

Mass of water = 1.26 g

Mass of anhydrous salt = Mass hydrated – Mass water = 2.68 – 1.26 = 1.42g

Molar mass of Na_2SO_4 = (2×23) + 32+ (4×16) = 142g

Molar mass of water = (2×1) + 16 =18g

Na_2SO_4 ⟶ **X H_2O**

1.42g ⟶ 1.26g

142g ⟶ 18X

$18X=\frac{142\times1.26}{1.42}=126$, $x=\frac{126}{18}=7$

Chemical formula of salt = $Na_2SO_4.7H_2O$

24)

$CaCl_2.XH_2O \xrightarrow{\blacktriangle} CaCl_2 + XH_2O$

Molar mass of $CaCl_2.2H_2O$ = 40 + (2×35.5) + (2×18) = 147 g

Molar mass of water = (2×1) + 16 = 18 g

$CaCl_2.2H_2O$ ⟶ **2 H_2O**

147 g ⟶ 18x =2×(18) = 36 g

1.47 g ⟶ X g

$X=\frac{1.47\times36}{147}=0.36\ g$

25)

$XCl_2 + nH_2O \rightarrow XCl_2.nH_2O$

XCl_2 ⟶ **nH_2O**

0.1mole ⟶ 10.8g

1mole ⟶ 18X

Molar mass of water = (2×1) + 16 = 18 g

18X $= \frac{1\times10.8}{0.1} = 108$, x $= \frac{108}{18} = 6$

Chemical formula of salt = $XCl_2.6H_2O$

26)

$FeCl_3.XH_2O \rightarrow FeCl_3 + XH_2O$

Mass of hydrated salt =2.71 g

Mass of anhydrous salt = 1.625 g

Mass of water = Mass hydrated – Mass anhydrate = 2.71 – 1.625 = 1.085 g

Molar mass of $FeCl_3$ = 56 + (3×35.5) = 162.5 g

Molar mass of water = (2×1) + 16 =18 g

$FeCl_3$	⟶	**$X H_2O$**
1.625g	⟶	1.085g
162.5	⟶	18X

18X $= \frac{162.5\times1.085}{1.625} = 108.5$, x $= \frac{108.5}{18} = 6$

Chemical formula of salt = $FeCl_3.6H_2O$

27)

$MgSO_4.XH_2O \rightarrow MgSO_4 + XH_2O$

percentage of water crystallization (XH_2O) = 51.16%

Percentage of salt ($MgSO_4$) = 100% - 51.16% = 48.84%

Molar mass of $MgSO_4$ = 24+32+(4×16) = 120 g

Molar mass of H_2O = (2×1) +16 = 18 g

$MgSO_4$	⟶	**XH_2O**
48.84 g	⟶	51.16 g
120 g	⟶	18X

$18X = \frac{120 \times 51.16}{48.84} = 125.7$, $x = \frac{125.7}{18} \approx 7$

Formula of salt: $MgSO_4.7H_2O$