WOS-1 For 9th class

Task (calorimetry)

(1) Given

$m_1 = m_w = 200\ gm \quad m_2 = 200\ gm$

$\theta_1 = 30^\circ C \quad ; \quad \theta_2 = 60^\circ C$

$s_1 = s_2 = 1$

$$\theta_{mix} = \frac{m_1 s_1 \theta_1 + m_2 s_2 \theta_2}{m_1 s_1 + m_2 s_2}$$

$$\theta_{mix} = \frac{200 \times 30 \times 1 + 200 \times 60 \times 1}{200 \times 1 + 200 \times 1}$$

$$= 45^\circ$$

(2) Amount of heat absorbed by the body

$dQ = 1000\ cal ; \quad \theta_1 = 20^\circ \quad \theta_2 = 70$

water equivalent $= ms$

$$\Rightarrow m \frac{1}{m} \frac{dQ}{d\theta} = \frac{dQ}{d\theta}$$

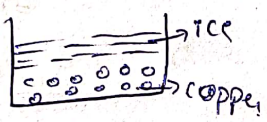
$$W = \frac{1000}{(70-20)} = \frac{1000}{50} = 20\ gm$$

(3) Given $m_c = 0.001\ kg$

$\theta_c = -34^\circ C$

$s_w = 400\ kJ/kg\,k$

$L_{ice} = 340\ kJ/kg$



$\theta_w = 0^\circ C$

$d\theta = (\theta_{ice} - \theta_c)$

$= (0 - (-34))$

$= 34^\circ C$

According to Principle of method of mixtures

Heat lost by hot body = Heat gained by cooled body

$$\Rightarrow m_{ice} L_{ice} = m_c d\theta_c s_c$$

$$\Rightarrow m_{ice} \times 340 = 0.001 \times 34 \times 4000$$

$$m_{ice} = 0.04\ gm$$

(4) $m_{w_1} = 20\ gm ; \quad \theta_{w_1} = 0^\circ C \quad m_{w_2} = 40\ gm \quad \theta_{w_2} = 10^\circ C$

$$\theta_{mix} = \frac{m_1 s_1 \theta_1 + m_2 s_2 \theta_2}{m_1 s_1 + m_2 s_2}$$

$$\theta_{mix} = \frac{20 \times 1 \times 0 + 40 \times 1 \times 10}{20 \times 1 + 40 \times 1}$$

$$\theta_{mix} = \frac{0 + 400}{20 + 40} = \frac{400}{60} = 6.66^\circ C$$

(5) According to Principle of method of mixtures

Heat lost by hot body = heat gained by cold body

$$m_s s d\theta + m_s L = m_1 s d\theta + m_{ice} L$$

$$\Rightarrow m \times 100 + 540 m = 3200 \times 80\ cal$$

$$\Rightarrow 640 m = 3200 \times 80$$

$$\Rightarrow m = \frac{3200 \times 80}{640} = 400 gm$$

(6) ice water

Heat lost by water = Heat gained by ice

$$\Rightarrow m_w s_w d\theta_w = m_{ice} d\theta_{ice} s_{ice}$$

$$\Rightarrow 100 = m_{ice}$$

$$\Rightarrow m_{ice} = 100\ gm$$

(7) $m_1 = ? \quad \theta_1 = 200^\circ C$

$m_2 = 50 gm ; \quad \theta_2 = 20^\circ C ; \quad \theta_{mix} = 70^\circ C$

$$\theta_{mix} = \frac{m_1 s_1 \theta_1 + m_2 s_2 \theta_2}{m_1 s_1 + m_2 s_2}$$

$$\Rightarrow 70 = \frac{200 m_1 s + 1000 s}{m_1 s + 50 s}$$

$$\Rightarrow 70 = \frac{s(200 m_1 + 1000)}{s(m_1 + 50)}$$

$$\Rightarrow 70(m_1 + 50) = 200 m_1 + 1000$$

$$\therefore m_1 = 18.29 gm.$$

(8) ice $\to -10^\circ C$ ↓ S_{ice}

ice $0^\circ C$ $\xrightarrow{L_{ice}}$ water $0^\circ C$ $\xrightarrow{S_w}$ water $100^\circ C$ $\xrightarrow{L_{steam}}$ steam $100^\circ C$

∴ Total heat required $dQ = m_{ice} S_{ice} d\theta_{ice} + m_{ice} L_{ice} + m_w S_w d\theta_w + m_s L_s$

$= 2 \times 0.5 \times 10 + 2 \times 80 + 2 \times 1 \times 100 + 2 \times 540$

$= 10 + 160 + 200 + 1080$

$= 1450$ kcal

(9) 800000000000 water equivalent $= m_t s_t$

$m_{ice} = 10$ gm; $\theta_1 = 0^\circ C$

$w = 55$ gm

$\theta_t = 40^\circ C$.

Heat lost by hot body = Heat gained by cold body.

$\Rightarrow m_t s_t d\theta_t = m_{ice} L_{ice} + m_w s_w d\theta_w$

$\Rightarrow 55 \times 1 \times (40 - \theta) = 10 \times 80 + 10 \times 1 \times \theta$

$\Rightarrow 2200 - 55\theta = 800 + 10\theta$

$\Rightarrow 65\theta = 1400$

$\Rightarrow \theta = 21.5^\circ C$

(10) $m_w = 4.075$ gm; $L_{ether} = 95$ cal/gm

$L_w = 80$ cal/gm

Heat gained by hot body = Heat lost by water

$\Rightarrow m L_{ether} = m_w L_{ice}$.

$\Rightarrow m \times 95 = 4.075 \times 80$

$\Rightarrow m \times 95 = 380$

$\Rightarrow m = 4$ gm.

L Taste

(1) $m_s = 5$ gm; $\theta = 100^\circ C$

$m_{ice} = 50$ gm $\theta_{ice} = 0^\circ C$.

Heat gained by ice $dQ_{ice} = m_{ice} \times L_{ice}$

$= 50 \times 80$

$= 4000$ cal

Heat lost by steam $dQ_s = m_s \times L_s$

$= 5 \times 540$

$= 2700$ cal

$dQ_{given} > dQ_{ice}$.

So some ice is melted

The resultant temp $= 0^\circ C$.

(2) Latent, specific

ice $0^\circ C$ $\to$ water $0^\circ C$ $\to$ water $20^\circ C$

$m_{ice} = 20$ gm.

Total heat required $dQ = dQ_{ice} + dQ_w$

$dQ = m L_{ice} + m s_w d\theta$.

$= 10 \times 80 + 10 \times 1 \times 20$

$= 800 + 200$

$dQ = 1000$ cal $= 1000 \times 4.2$ J

$= 4200$ J.

③ $\theta_1 = 100^\circ C$; $m_{ice} = 3200\,gm$

ice at $-10^\circ c \longrightarrow$ ice at $0^\circ c \longrightarrow$ water at $0^\circ c$

heat gained by ice $dQ_{ice} = mL_{ice} + ms_{ice}d\theta$

$dQ_{ice} = 3200\times80 + 3200\times\frac{1}{2}\times10$

$dQ_{ice} = 2,72,000\ cal$

heat lost by the steam $dQ_s = m_s L_s$

$dQ_s = m_s \times 540$

According to Principle of methods of mixture $dQ_s = dQ_{ice}$

$\Rightarrow m_s \times 540 = 2,72,000$

$\Rightarrow m_s = 503.7\,gm.$

④ Given $\theta_1 = 100^\circ C$; $\theta_2 = t^\circ C$.

$\frac{m_1}{m_2} = \frac{1}{3}$, $\theta_{mix} = 37^\circ C$.

$\Rightarrow m_2 = 3m_1$.

$$\theta_{mix} = \frac{m_1 s_1\theta_1 + m_2 s_2 \theta_2}{m_1 s_1 + m_2 s_2}$$

$$\Rightarrow 37 = \frac{m_1\times1\times100 + 3m_1 t}{m_1\times1 + 3m_1\times t}$$

$$\Rightarrow 37 = \frac{m_1(100+3t)}{m_1(1+3)}$$

$\Rightarrow 4\times37 = 100+3t$

$\Rightarrow 3t = 48$

$t = 16^\circ C$

⑤ $m_{ice} = 1gm$, $m_s = 1gm$

ice $0^\circ c \rightarrow$ water $0^\circ c \rightarrow 100^\circ c$.

Heat gained by ice

$dQ_{ice} = mL_{ice} + ms_w d\theta$

$= 1\times80 + 1\times1\times100$

$= 80+100$

$= 180\ cal$

Heat lost by steam

$dQ_s = mL_s$

$= 1\times540$

$= 540\ cal$

$dQ_{steam} > dQ_{ice}$

~~Result~~

Remaining heat $= 360$

$ms\,d\theta = 360$

$\Rightarrow 2\times1\times d\theta = 360$

$\Rightarrow d\theta = 180^\circ c$

⑥ ice at $0^\circ c \xrightarrow{Lice}$ water at $0^\circ c \longrightarrow$ specific heat. water at $40^\circ c$.

Heat lost by ice

$dQ_{ice} = m_{ice}L_{ice} + ms_w d\theta$

$= 1\times80 + 1\times1\times(\theta-0)$

$dQ_{ice} = 80+\theta$

heat gained by water

$dQ = m_w s_w d\theta$

$= 1\times1\times(40-\theta)$

According to Principle of methods of mixture

$dQ_{ice} = dQ_{water}$

$\Rightarrow 80+\theta = 40-\theta$

$\Rightarrow 2\theta = 40$

$\Rightarrow \theta = 20^\circ c$

⑦ ice at $0^\circ c \xrightarrow{Later}$ water at $0^\circ c$

$+$ water at $80^\circ c$. $=$ water at $\theta^\circ c$.

gained

heat lost by ice

$dQ_{ice} = m_{ice}L_{ice} + m_w s_w d\theta$

$= 540\times80 + 540\times1\times\theta$

~~$= 4200$~~ $540(80+\theta)$

Heat lost by water

$dQ_w = m_w s_w d\theta$

$= 540 \times 1 \times (80-\theta)$

$= 540(80-\theta)$

∴ According to principle of method of mixture.

$dQ_{ice} = dQ_w$

$\Rightarrow 540(80+\theta) = 540(80-\theta)$

$\Rightarrow 2\theta = 80 - 80$

$\Rightarrow \theta = 0^\circ C$

(8) $m_{ice} = 15gm$ at $0^\circ C$ → water at $0^\circ C$

$m_w = 45gm$, $\theta = 100^\circ C$ → water at $\theta = ?$

Heat gained by ice $dQ_{ice} = m_{ice} L_{ice} + m_{ice} s d\theta$

$dQ_{ice} = 15 \times 80 + 15 \times 1 \times (\theta - 0)$

$= 15(80+\theta)$

Heat lost by water $dQ_w = m_w s_w dQ_w$

$dQ_w = 45 \times 1 \times (100-\theta)$

$= 45(100-\theta)$

According to calorimetry

$dQ_{ice} = -dQ_w$

$\Rightarrow 15(80+\theta) = -\frac{3}{5}(100-\theta)$

$\Rightarrow 80+\theta = 300-3\theta$

$\Rightarrow 4\theta = 220$

$\Rightarrow \theta = 55^\circ C$

(9) $m_{ice} = 1gm$ $0^\circ C$ → water at $0^\circ C$

$m_w = 1gm$ $\theta_w = 100^\circ C$ → water at $\theta = ?$

Heat gained by ice $dQ_{ice} = m_{ice} L_{ice} + m_{ice} s_w d\theta$

$dQ_{ice} = 1 \times 80 + 1 \times \theta \times 1$

$= 80 + \theta$

Heat lost by water $dQ_w = m_w s_w dQ_w$

$dQ_w = 1 \times 1 \times (100-\theta)$

According to principle of calorimetry

$dQ_{ice} = dQ_w$

$\Rightarrow 80+\theta = 100-\theta$

$\Rightarrow 2\theta = 20 \Rightarrow \theta = 10^\circ C.$

(10) $m_s = x gm$, $100^\circ C$ → $m_{ice} = 4gm$ at $0^\circ C$.

steam → water at $100^\circ C$; ice → water at $0^\circ C$

Heat lost by the steam

$dQ = m_s L_s + m_w s_w d\theta_w$

$dQ_s = x \times 540 + x \times 1 (100-100)$

$= x \times 540$

heat gained by ice $= m_{ice} L_{ice} + m_w s_w d\theta_w$

$= y \times 80 + y \times 1 \times (100-0)$

$= 80y + y(100) = 180y$

According to calorimetry

$dQ_s = dQ_{ice}$

$\Rightarrow x \times 540 = 180 y$

$\Rightarrow y = 3x.$

$\frac{x}{y} = \frac{1}{3} = \cdot$