WS-19 for class 6

T Bank

① Given $\gamma_g = 0.00027/°c$

$\alpha_g = 0.00009/°c$

$\gamma_r = \gamma_a + 3\alpha_g$

$\Rightarrow \gamma_a = \gamma_r - 3\alpha_g$

$= 0.00027 - 3(0.00009)$

$= 0$

② $V_1 = 100cc \rightarrow t_1 = 10°c$

$\Delta V = 2cc \rightarrow t_2 = 110°c$

From def of γ_a $\quad \gamma_a = \frac{\Delta V}{V \Delta t}$

$\Rightarrow \gamma_r - 3\alpha = \frac{\Delta V}{V \Delta t}$

$\Rightarrow \gamma_r - 3(11\times10^{-6}) = \frac{2}{100\times(110-10)}$

$\Rightarrow \gamma_r - 33\times10^{-6} = \frac{2}{100\times100}$

$\Rightarrow \gamma_r - 0.33\times10^{-4} = \frac{2}{10^4}$

$\Rightarrow \gamma_r - 0.33\times10^{-4} = 2\times10^{-4}$

$\Rightarrow \gamma_r = 2.33\times10^{-4}/°c$

③ $\gamma_r = \gamma_a + 1\%\,\gamma_a$

$\gamma_r = \gamma_a + \frac{1}{100}\gamma_a = \frac{101}{100}\gamma_a$

From Relation $\gamma_r = \gamma_a + 3\alpha_g$

$\Rightarrow \gamma_r - \gamma_a = 3\alpha_g$

$\Rightarrow \frac{101}{100}\gamma_a - \gamma_a = 3\alpha_g$

$\Rightarrow 3\alpha_g = \frac{\gamma_a}{100} \Rightarrow \alpha_g = \frac{1}{300}\gamma_a \Rightarrow \gamma_a = 300\alpha_g$

④ Given $h_{100} = h_0$

$h_0 = 75cm$

$h_0 = 76.35mm$

$\gamma_r = \frac{V_2 - V_1}{V_1(t_2 - t_1)} =$

$\Rightarrow \gamma_r = \frac{Ah_2 - Ah_1}{Ah_1(t_2 - t_1)}$ $\quad A\left[\frac{h_2 - h_1}{Ah_1(t_2 - t_1)}\right]$

$\Rightarrow \gamma_r = \frac{76.35 - 75}{75(100 - 0)}$

$= 1.8\times10^{-4}/°c$

⑤ $\frac{\Delta V}{V} = 4\% = 4\times10^{-2}$

$\Delta t = 100°c$

$\gamma_a = \frac{\Delta V}{V \Delta t} = \frac{4\times10^{-2}}{100}$

$= 4\times10^{-4}/°c$

⑥ Given $h_1 = 0.5m$; $h_2 = 0.509m$

$\gamma_r = \frac{V_2 - V_1}{V_1(t_2 - t_1)} = \frac{Ah_2 - Ah_1}{Ah_1(t_2 - t_1)}$

$\gamma_r = \frac{A(h_2 - h_1)}{Ah_1(t_2 - t_1)} = \frac{0.509 - 0.5}{0.5\times100}$

$\gamma_r = \frac{0.009}{0.5\times100} = \frac{9}{5}\times10^{-3}\times10^{-1}$

$\gamma_r = 1.8\times10^{-4}/°c$

⑦ $V_1 = 250cc \rightarrow t_1 = 20°c$

$\rightarrow t_2 = 110°c.$

$\gamma_r = 1.8\times10^{-4}/°c$

$\alpha_g = 9\times10^{-6}/°c$

$\gamma_r = \gamma_a + 3\alpha_g$

$\Rightarrow \gamma_a = \gamma_r - 3\alpha_g$

$\Rightarrow \gamma_a = 18\times10^{-5} - 3(9\times10^{-6})$

$\Rightarrow 18\times10^{-5} - 27\times10^{-6}$

$\gamma_a = 15.3\times10^{-5}/°c$

$\Rightarrow \frac{V_2 - V_1}{V_1(t_2 - t_1)} = 15.3\times10^{-5}$

$\Rightarrow V_2 - V_1 = 15.3\times10^{-5}\times V_1(t_2 -$

$\Rightarrow = 15.3\times10^{-5}\times250$ $\quad (110-20)$

$\Rightarrow \Delta V = 3.44\,C.$

⑧ Given $m_0 = 105gm \rightarrow t_1 = 0°C$

$m_{exp} = 5gm \rightarrow t_2 = 100°c.$

$m_{rem} = m_0 - m_{ex} = 105 - 5$

$= 100gm$

$\gamma_{app} = \frac{m_{exp}}{m_{rem} \times \text{rise in temp}}$

$\therefore \gamma_r = \frac{101}{100}\times300\alpha_g$

$\gamma_r = 303\,\alpha_g$

$\Rightarrow \alpha_g = \frac{\gamma_r}{303}$

$\gamma_{app} = \frac{5}{100\times100} = 5\times10^{-4}/°c.$

$\gamma_r = \gamma_a + 3\alpha$

$= 5\times10^{-4} + 3(9\times10^{-6})$

$\Rightarrow 5\times10^{-4} + 27\times10^{-6}$

$\Rightarrow 5.27\times10^{-4}/°c.$

(9) Given $h_0 = 100cm \rightarrow t_1 = 0°C$

$t_2 = 100°C.$

$\gamma_r = 18\times10^{-5}/°c.$

$\gamma_r = \frac{V_2 - V_0}{V_0(t_2-t_1)} = \frac{Ah_2 - Ah_0}{Ah_0(t_2-t_1)}$

$\gamma_r = \frac{h_2-h_0}{h_0\Delta t} =$

$h_2 - h_0 = \gamma_r h_0 \Delta t$

$= 18\times10^{-5}\times100\times100$

$= 1.8cm$

(10) $m_0 = 52$ gm

$m_{exp} = 2$ gm

$m_{rem} = m_{exp} - m_0$

$\Rightarrow 52-2$

$= 50$ gm

$\Delta t = t_2 - t_1 = 100-0$

$= 100°C$

$\gamma_a = \frac{m_{exp}}{m_0\Delta t}$

$\Rightarrow m_e \propto m_0\Delta t$

$\Rightarrow \frac{m_e}{m_e'} = \frac{m_0}{m_0'}\times\frac{\Delta t}{\Delta t'}$

$\Rightarrow \frac{2}{m_e'} = \frac{52}{104}\times\frac{100}{50}$

$\Rightarrow \boxed{m_0' = 104\ gm}$

$\therefore \frac{2}{m_e'} = 1$

$\Rightarrow m_e = 2gm$

(17) $V = Ah$

$V_1 = Ah_1 ; V_2 = Ah_2$

$\gamma_r = \frac{V_2 - V_1}{V_1(t_2-t_1)}$

$\gamma_r = \frac{Ah_2 - Ah_1}{Ah_1(t_2-t_1)}$

$\gamma_r = \frac{h_2-h_1}{h_1(t_2-t_1)}$

$\gamma_r = \frac{101.8-100}{100(100-0)}$

$\gamma_r = 1.8\times10^{-4}/°c$

(18) $m_1 = 55gm ; t_1 = 0°c$

$m_2 = 30\ gm ; t_2 = 50°c$

$m_3 = 35\ gm$

$\gamma_r = \frac{m_3 - m_2}{(m_1-m_3)(t_2-t_1)}$

$\gamma_r = \frac{35-30}{(55-35)(50-0)}$

$\gamma_r = \frac{5}{20\times50}$

$= 0.5\times10^{-3}/°c$

(19) $\gamma_a = \frac{5}{6}\gamma_r$

$\gamma_r = \gamma_a + \gamma_g$

$\Rightarrow \gamma_r = \frac{5}{6}\gamma_r + \gamma_g$

$\Rightarrow \gamma_g = \frac{1}{6}\gamma_r$

$\gamma_r = 6\gamma_g$

$\therefore \gamma_a = \frac{5}{6}\times6\gamma_g$

$\gamma_a = 5\gamma_g$

$\gamma_g = \frac{1}{5}\gamma_a$

LTask

(1) $\Delta V = 1cc$

$\alpha_g = 9\times10^{-6}/°c.$

$V_0 = 50\ cc$

$\gamma_a = \frac{\Delta V}{V\Delta t}$

$\Rightarrow \gamma_r - 3\alpha_g = \frac{1}{50\times40}$

$\Rightarrow \gamma_r - 3(9\times10^{-6}) = \frac{1}{2000}$

$\Rightarrow \gamma_r - 27\times10^{-6} = 0.5\times10^{-3}$

$\Rightarrow \gamma_r - 0.27\times10^{-4} = 5\times10^{-4}$

$\Rightarrow \gamma_r = 5.27\times10^{-4}/°c.$

(2) Given $\gamma_r = 5.97\times10^{-4}/°c$

$\alpha_g = 9\times10^{-6}/°c.$

$\gamma_r = \gamma_a + 3\alpha$

$\Rightarrow 5.97\times10^{-4} = \gamma_a + 3(9\times10^{-6}/°c)$

$\Rightarrow 5.97\times10^{-4} = \gamma_a + 27\times10^{-6}$

$\Rightarrow \gamma_a = 5.97\times10^{-4} - 0.27\times10^{-4}$

$= 5.7\times10^{-4}/°c.$

③ $h_1 = 70\text{cm}$ at $t_1 = 0^\circ C$

$h_2 = 71.26\text{cm}$ at $t_2 = 100^\circ C$.

$$\gamma_r = \frac{V_2 - V_1}{V_1(t_2 - t_1)} = \frac{Ah_2 - Ah_1}{Ah_1(t_2 - t_1)}$$

$$\gamma_r = \frac{h_2 - h_1}{h_1(t_2 - t_1)} = \frac{71.26 - 70}{70(100 - 0)}$$

$$\gamma_r = \frac{1.026}{70 \times 100} = \frac{1.026}{7 \times 10^3}$$

$$\Rightarrow 1.8 \times 10^{-4}/^\circ C.$$

④ Given $\gamma_r = 27 \times 10^{-4}/^\circ C$

$\alpha_g = 10 \times 10^{-5}/^\circ C$

$\gamma_r = \gamma_a + \gamma_g$

$= \gamma_a + 3\alpha_g$

$\Rightarrow 27 \times 10^{-4} = \gamma_a + 3 \times 10^{-4}$

$\Rightarrow \gamma_a = 27 \times 10^{-4} - 3 \times 10^{-4}$

$= 2.4 \times 10^{-3}/^\circ C$

⑤ $m_1 = 85\text{gm}$; $m_2 = 60\text{gm}$

$m_3 = 65\text{gm}$ $t_1 = 0^\circ C$; $t_2 = 100^\circ C$

$$\gamma_R = \frac{m_3 - m_2}{(m_3 - m_1)(t_2 - t_1)}$$

$$\gamma_R = \frac{5}{20 \times 100} = \frac{1 \times 10^{-2}}{4}$$

$$= 2.5 \times 10^{-3}/^\circ C$$

⑥ $\gamma_r = 7\gamma_g$

$\gamma_r = \gamma_a + \gamma_g$

$\Rightarrow 7\gamma_g = \gamma_a + \gamma_g$

$\Rightarrow 7\gamma_g - \gamma_g = \gamma_a$

$\Rightarrow 6\gamma_g = \gamma_a$

$$\therefore \frac{\gamma_r}{\gamma_a} = \frac{7\gamma_g}{6\gamma_g} = \frac{7}{6}$$

⑦ $h_1 = 20\text{cm} \rightarrow 0^\circ C$

$h_2 = 20.2\text{cm} \rightarrow 100^\circ C$

$$\gamma_R = \frac{h_2 - h_1}{h_1(t_2 - t_1)}$$

$$\gamma_R = \frac{20.2 - 20}{20(100 - 0)} = \frac{0.2}{2000}$$

$\Rightarrow 10^{-4}/^\circ C$

⑧ At $t_1 = 32^\circ F \rightarrow h_1 = 60\text{cm}$

$t_2 = 122^\circ F \rightarrow h_2 = 61\text{cm}$

$V_1 = Ah_1$; $V_2 = Ah_2$

$$\gamma_r = \frac{V_2 - V_1}{V_1(t_2 - t_1)} = \frac{Ah_2 - Ah_1}{Ah_1(t_2 - t_1)}$$

$$\gamma_r = \frac{h_2 - h_1}{h_1(t_2 - t_1)} = \frac{61 - 60}{60(122 - 32)}$$

$$\gamma_r = \frac{1}{60 \times 90} = \frac{1}{5400} = 0.000185/^\circ$$

⑨ $t_1 = 0^\circ C$; $t_2 = 100^\circ C$

$m_0 = 510\text{gm}$ $m_{exp} = 10\text{gm}$

$m_{rem} = 510 - 10 = 500\text{gm}$

$$\gamma_a = \frac{m_{exp}}{m_{rem} \times \text{rise in temp}}$$

$$\Rightarrow \gamma_a = \frac{10}{500 \times 100} = \frac{1}{5000}$$

$$\Rightarrow \gamma_a = \frac{1}{5} \times 10^{-3}$$

$\Rightarrow 2 \times 10^{-4}/^\circ C$

$\Rightarrow 0.0002/^\circ C$

⑩ Given $h_1 = 60\text{cm}$; $t_1 = 0^\circ C$

$h_2 = 65\text{cm}$; $t_2 = 100^\circ C$

$$\gamma_R = \frac{h_2 - h_1}{h_1(t_2 - t_1)}$$

$$\gamma_R = \frac{65 - 60}{60(100 - 0)}$$

$$\gamma_R = \frac{5}{60 \times 100} = \frac{5}{6 \times 10^3}$$

$$\gamma_R = \frac{5}{6000}/^\circ C.$$

⑯ At $t_1 = 0^\circ C \rightarrow h_1 = 60\text{cm}$

$t_2 = 100^\circ C \rightarrow h_2 = 62\text{cm}$

$$\gamma_R = \frac{V_2 - V_1}{V_1(t_2 - t_1)}$$

$$\Rightarrow \gamma_R = \frac{Ah_2 - Ah_1}{Ah_1(t_2 - t_1)}$$

$$\Rightarrow \gamma_R = \frac{A(h_2 - h_1)}{Ah_1(t_2 - t_1)}/^\circ C$$

$$\Rightarrow \gamma_R = \frac{62 - 60}{60(100 - 0)} = \frac{2}{60 \times 100}$$

$$= \frac{1}{3000} = 0.33 \times 10^{-3}$$

$\Rightarrow 3.3 \times 10^{-4}/^\circ C$

(17) $\frac{\Delta V}{V} = 8\% = \frac{8}{100}$

$\gamma_a = \frac{\Delta V}{V \Delta t} = \frac{8}{100 \times 100} = 8 \times 10^{-4} /^\circ C$

(18) $t_1 = 0^\circ C$

$\gamma_R = \frac{d_1 - d_2}{d_2 (t_2 - t_1)}$

$\Rightarrow d_1 - d_2 = \gamma_R d_2 \Delta t$

$\Rightarrow d_1 - \frac{49 d_1}{50} = \gamma_R \frac{49}{50} d_1 t$

$\Rightarrow \frac{1}{50} d_1 = \gamma_R \frac{49}{50} d_1 t$

$\Rightarrow t = \frac{1}{49 \gamma_R}$.

$d_2 = d_1 - \frac{2}{100} d_1$

$= d_1 - \frac{1}{50} d_1$

$d_2 = \frac{49}{50} d_1$.