EXERCISE – II MULTIPLE CHOICE QUESTIONS

1. (i) $y_{air} = y_{material}$
So Hollow feel more pressure from inside and increase more due to aire pressure

2 (a). $\frac{15\times60}{2}$ = 450 oscillation

(b). $T = k\sqrt{\ell}$

$$T' = k\sqrt{\ell+\Delta\ell} = k\sqrt{\ell}\left(1-\frac{\Delta\ell}{\ell}\right)^{1/2}$$

$$= k\sqrt{\ell}\left(1+\frac{1}{2}\frac{\Delta\ell}{\ell}\right)$$

$$T' = T\left(1+\frac{1}{2}\frac{\Delta\ell}{\ell}\right)$$

So T′ time = 1 oscillation

$$15\times60 \text{ sec} = \frac{1}{T'}\times15\times60$$

$$= \frac{15\times60}{2\left[1+\frac{1}{2}\left(2\times10^{5}\right)\times(40-20)\right]}$$

$$= \boxed{449.9}$$

(c). $\boxed{449.9}$ × 2 sec ahead

(d). (i) 2 sec extra = 1 oscillation extra
(ii) (450 + 1) Oscillation – 15 minutes

1 oscillation – $\frac{15\times60}{451}$ sec.

(d). (iii)

$$dT = \frac{T}{2}\propto\Delta\theta$$

$$\left[2-\frac{15\times60}{451}\right] = (1)\ 2\times10^{-5}\times\Delta\theta$$

$$\Delta\theta = \frac{1}{451\times10^{-5}}\text{ sec}$$

3 (a). $V_c' = Ah\,(1+3\propto_c\Delta t)$

3(b). $Ah_1' = Ah[\,1+y\Delta t]$
$h_1' = h[1+y\Delta t]$

(c). (i) $y_L < 3\propto_c$
(ii) $y_L > 3\propto_c$
(iii) $y_L = 3\alpha_c$

(d). $\Delta V = V_l' - V_c' = Ah[1+y_l\Delta\theta] - Ah[1-3\alpha_c\Delta\theta]$
$= Ah[y_l - 3\alpha_c]\,\Delta\theta$

3 (e). $A(h-h_1) = V_c' - V_l'$
$Ah - Ah_1 = Ah\,(1+3\alpha_c\Delta\theta) - Ah_1(1+\gamma_L\Delta\theta)$
$0 = h\,3\alpha_c - h_1\gamma_L$

(f) (i). (i) $Ah_1 = A'h$

$$h = \frac{Ah_1}{A'} = \frac{h_1}{(1+2\alpha_c\Delta\theta)}$$

Now $h = h_c'\,[1+\alpha_c\,\Delta\theta]$

So $\boxed{h_c' = \frac{h_1}{1+3\alpha_c\Delta\theta}}$

(f)(ii). $Ah_1 = V_0$
$V_0' = V_0\,[1+\gamma_L\,\Delta\theta]$
$Ah_1' = Ah_1\,[\,1+\gamma_L\,\Delta\theta]$
$h_1' = h_1\,[1+\gamma_L\,\Delta\theta]$

(f)(iii)
(1) $\gamma_L > 3\,\alpha_c$
(2) $\gamma_L < 3\alpha_c$
(3) $\gamma_L = 3\alpha_c$

4.

$$\rho_l = \frac{156.25-56.25}{Vg}\text{ at }15°C$$

$$\text{Now } \rho_l' = \frac{156.25-66.25}{V_g'}$$

$\rho_l' = \rho[1-\gamma_l\,\Delta t]$ at 52°C
$V_g' = V_g[1+\gamma_g\,\Delta t]$

$$\frac{156.25-66.25}{V_g(1+\gamma_g\Delta t)} = \frac{156.25-56.25}{V_g}[1-\gamma_l\,\Delta t]$$

$$\Rightarrow \frac{90}{1+3\times9\times10^{-6}\times37} = 100\,[1-\gamma_l\times37]$$

$$\gamma_l = \frac{1}{3700}\left[100-\frac{90}{1+37\times9\times3\times10^{-6}}\right]$$

$\Rightarrow \gamma_l = 2.72\times10^{-3}/°C$

5 (a)
initially $\rho_l = \rho_b = d_o$
$F_{thrust} = \rho_l'\,(V_0')g$
$= d_o\,(1-\gamma_l\,\Delta\theta)\,V_0(1+3\alpha_s\,\Delta\theta)g$

(b) (i) $3\alpha_s > y_L$
(ii) $3\alpha_s < y_L$
(iii) $3\alpha_s = y_L$

6. $T = k\sqrt{\ell}$

$$dT = \frac{k}{2}\frac{d\ell}{\sqrt{\ell}} = \frac{k}{2}\sqrt{\ell}\alpha\Delta\theta$$

$= \frac{T}{2}\alpha\,\Delta\theta$

In T + dT lag by = dT

In 10^6 slow by $= \frac{dT}{T+dT} \times 10^6$ sec

$= \frac{dT/T}{1+\frac{dT}{T}} \times 10^6$ Sec

$= \frac{\frac{1}{2}\alpha\Delta\theta}{\left(1+\frac{1}{2}\alpha\Delta\theta\right)} \times 10^6$ sec

$= \left(\frac{1}{2}\alpha\Delta\theta\right)\left(1-\frac{1}{2}\alpha\Delta\theta\right)\times 10^6$

$= \frac{1}{2}\alpha\,\Delta\theta \times 10^6$

$= \frac{1}{2} \times 10^{-6} \times (30 - 20) \times 10^6$

= 5 sec slow.

7. $F = Ay\frac{\Delta\ell}{\ell}$

$= Ay\,\alpha\,\Delta\theta$

$= 10^{-3} \times 10^{11} \times 10^{-6}\,(100 - 0°)$

= 10000 N

8. C.M $= y = \frac{h}{3}$ from 0

$dy = \frac{1}{3}dh$

$dy = \frac{1}{3}(h\,\alpha\,\Delta\theta)$

$\frac{dy}{d\theta} = \frac{1}{3}h\alpha = \frac{2}{3}(l\cos 30°)\alpha$

$= \left[\frac{1}{3}\times\frac{2\times\sqrt{3}}{2}\times 4\sqrt{3}\times 10^{-6}\right]$ m/°C

$= 4 \times 10^{-6}$ m/°C

9. $\Delta L = \Delta L_1 + \Delta L_2$

$(3L)\alpha_0\,\Delta\theta = L\alpha_1\,\Delta\theta + 2L\alpha_2\,\Delta\theta$

$3\alpha_0 = (\alpha_1 + 2\alpha_2)$

$\alpha_0 = \frac{1}{3}(\alpha + 42) = \frac{5\alpha}{3}$

10. $g_{eff} = g_R\left(1-\frac{2h}{R}\right)$

$T = k\sqrt{\frac{\ell}{g_{eff\,h}}}$ at 20°C and height h

$T' = k\sqrt{\frac{\ell[1+\alpha(30-20)]}{g_{eff\,h}}}$ at 30° at height h

$T'' = k\sqrt{\frac{\ell(1+\alpha(30-20)}{g_R}}$

T = T″

$\sqrt{\frac{1}{1-\frac{2h}{R}}} = \sqrt{1+\alpha(30-20)}$

$\alpha = \left[\frac{2h}{R-2h}\right]\frac{1}{10}$ R >>>> h

So $\alpha = \frac{h}{5R}$

11. $y_M = 20\,\alpha_g$

$V - V_0 = V' - V_0'$

$V - V_0 = V(1 + 3\,\alpha_g\,\Delta\theta) - V_0(1 + \gamma_m\,\Delta\theta)$

$0 = 3\alpha_g V - \gamma_m V_0$

$0 = 3\alpha_g V - 20\,\alpha_g V_0 \Rightarrow \boxed{V_0 = \frac{3V}{20}}$

12. $\frac{\Delta\ell}{\ell} = \alpha_A\,\Delta\theta \Rightarrow \frac{0.05}{25} = \alpha_A\,(100)$

and $\frac{00.4}{40} = \alpha_B\,(100)$

$\Delta\ell_c = \Delta\ell_A = \Delta\ell_B$

$0.03 = \ell_A\,\alpha_A\,(50) + (50 - \ell_A)\,\alpha_B\,50$

$\ell_A = \frac{0.03 - 2500\alpha_B}{(\alpha_A - \alpha_B)50}$

= 10cm

13 **(a)** $\left.\begin{array}{l} R_x = 70-(-20) = 90° \\ R_y = (90-0) = 90° \\ R_w = (120-30) = 90° \end{array}\right]$ same

(b) 50°w < 50°y < 50°x

14. $\frac{212-32}{100-0} \times$ T°C = T°F − 32

T = − 40