EXPANSION OF LIQUIDS

1. A block of wood is floating on water at 0^0 C with a certain volume V above water level. The temperature of water is slowly raised from 0^0C to 20^0C. How the volume V change with the rise of temperature

1) V will remain unchanged

2) V will go decreasing from beginning to the end

3) V will decrease till the temperature of water reaches at 4^0C and then it will go on decreasing.

4) V will increase till the temperature of water reaches to 4^0C and then it will go on decreasing

2. A liquid with coefficient of volume expansion γ is filled in a container of a material having the coefficient of linear expansion α . If the liquid overflows on heating

1) $\gamma = 3\alpha$ 2) $\gamma > 3\alpha$ 3) $\gamma < 3\alpha$ 4) $\gamma > 3\alpha^3$

3. When a liquid, taken in a long cylindrical vessel of material with linear coefficient of expansion 'α', is heated; the level of liquid did not change. The volume coefficient of expansion of liquid is

1) 3α 2) 2α 3) α 4) 4α

4. The surface water in a lake is going to freeze. Now the temperature of water at the bottom is

1) 274 K 2) 277 K 3) 100 K 4) 0K

5. Apparent expansion of a liquid depends upon

(a) Nature of liquid **(b) nature of vessel**

(c) Temperature rise **(d) scale of temperature**

1) Only (a) is true 2) (a) & (b) are true

3) (a), (b) & (c) are true 4) (a), (b), (c) & (d) are true

6.

List - I	**List - II**
a. Apparent expansion	**e. Nature of vessel & Liquid**
b. Real expansion	**f. Nature of liquid**
c. γ_a	**g. Vessel, Liquid & temperature**
d. γ_r	**h. liquid & temperature**

1) a - e, b - f, c - g, d - h 2) a - f, b - g, c - h, d - e

3) a - g, b - h, c - e, d - f 4) a - h, b - e, c - f, d – g

7. **List - I** | **List - II**

a. mass of liquid expelled on heating — **e.** $\frac{m_1}{1+\gamma_a \Delta t}$

b. corrected Barometric height — **f.** $\frac{d_1 - d_2}{d_2(t_2 - t_1)}$

c. coefficient of real expansion of a liquid — **g.** $\frac{\gamma_a m_1 \Delta t}{1+\gamma_a \Delta t}$

d. mass of liquid remaining on heating — **h.** $h_0[1-(\gamma_r - \alpha)\Delta t]$

1) a - g, b - h, c - f, d - e 2) a - h, b - e, c - g, d - h

3) a - e, b - f, c - g, d - h 4) a - f, b - g, c - h, d – e

8. **List - I** | **List - II**

a. γ_g **is +ve &** $< \gamma_r$ — **e. liquid level does not change**

b. γ_g **is -ve** — **f. liquid level increases continuously**

c. $\gamma_g = \gamma_r$ — **g. liquid level decreases**

d. $\gamma_g > \gamma_r$ — **h. liquid level first decreases and then increases**

1) a - g, b - e, c - f, d - h 2) a - h, b - f, c - e, d - g

3) a - e, b - f, c - g, d - h 4) a - f, b - g, c - h, d – e

9. **List - I** | **List - II**

a. Temperature of water at the bottom of a lake — **e. 273K**

b. γ_r **of water is -ve between** — **f. 277K**

c. γ_r **of water is positive** — **g. above 277K**

d. Temperature of water just below ice layer in a Lake — **h. 273K and 277K**

1) a - g, b - h, c - e, d - f 2) a - h, b - e, c - f, d - g

3) a - e, b - f, c - g, d - h 4) a - f, b - h, c - g, d – e

10. **A): Real expansion of liquid does not depend upon material of container**

R): Liquids have no definite shape. They acquire the shape of their containers.

1) Both ‘A’ and ‘R’ are true and ‘R’ is the correct explanation of ‘A’

2) Both ‘A’ and ‘R’ are true and ‘R’ is not the correct explanation of ‘A’

3) ‘A’ is true and ‘R’ is false 4) ‘A’ is false and ‘R’ is true

11. **A): A vessel is filled, with water, up to brim at 4^0C. It over flows when the system is cooled are heated**

R): Water has minimum volume at 4^0C.

1) Both ‘A’ and ‘R’ are true and ‘R’ is the correct explanation of ‘A’

2) Both ‘A’ and ‘R’ are true and ‘R’ is not the correct explanation of ‘A’

3) ‘A’ is true and ‘R’ is false 4) ‘A’ is false and ‘R’ is true

12. **A vessel is half filled with a liquid at 0°C. When the vessel is heated to 100°C, the liquid occupies 3/4 volume of the vessel. Coefficient of apparent expansion of the liquid is**
1) 0.5/°C 2) 0.05/°C 3) 0.005/°C 4) 0.0005/°C

13. γ_A **of liquid is 7/8 of** γ_R **of liquid.** α_g **of vessel is**
1) $\frac{\gamma_R}{8}$ 2) $\frac{\gamma_R}{12}$ 3) $\frac{\gamma_R}{24}$ 4) $\frac{\gamma_R}{36}$

14. **Co-efficient of apparent expansions of a liquid in Gold vessel is G and when heated in a silver vessel is S. If coefficient of linear expansion of Gold is A, coefficient of linear expansion of Silver is**
1) $\frac{G+S-3A}{3}$ 2) $\frac{G-S+3A}{3}$ 3) $\frac{G+S+3A}{3}$ 4) $\frac{G-S+A}{3}$

15. **A liquid occupies half of a vessel at a particular temperature. The volume of the unoccupied part remains constant at all temperatures. If** α **and** γ **are the coefficients of linear and real expansions of a vessel and liquid, then** γ **=**
1) 3 α 2) 3 α /2 3) 6 α 4) 9 α

16. **If on heating a liquid through 80^{0}C, the mass expelled is** $\frac{1}{100}th$ **of mass still remaining, the coefficient of apparent expansion of the liquid is**
1) $12.6\times10^{-4}/^0C$ 2) $0.8\times10^{-4}/^0C$ 3) $1.25\times10^{-5}/^0C$ 4) $1.25\times10^{-4}/^0C$

17. **A glass vessel just holds 50gm of a liquid at 0^{0}C. If the coefficient of linear expansion of glass is** $8\times10^{-6}/^0C$ **The mass of the liquid it holds at 80^{0}C is [coefficient of absolute expansion of liquid =** $5\times10^{-4}/^0C$ **]**
1) 46 gm 2) 48 gm 3) 51gm 4) 42 gm

18. **For a liquid when heated in a vessel it is found that** $\gamma_A=\frac{6}{7}\gamma_R$ **. Coefficient of linear expansion of the vessel is**
1) $\frac{\gamma_R}{21}$ 2) $\frac{\gamma_R}{11}$ 3) $\frac{\gamma_R}{12}$ 4) $\frac{\gamma_R}{14}$

19. **When a liquid in a glass vessel is heated, its apparent expansion is** $10.3\times10^{-4}/^0C$ **. Same liquid when heated in a metal, its apparent expansion is** $10.06\times10^{-4}/^0C$ **. The coefficient of linear expansion of the metal is (**α **of glass =** $9\times10^{-6}/^0C$ **)**
1) $51\times10^{-6}/^0C$ 2) $43\times10^{-6}/^0C$ 3) $25\times10^{-6}/^0C$ 4) $17\times10^{-6}/^0C$

20. **Two liter glass flask contains some mercury. It is found that at all temperatures the volume of the air inside the flask remains the same. The volume of the mercury inside the flask is (**α **for glass =** $9\times10^{-6}/^oC$ **, for mercury =**$1.8\times10^{-4}/^oC$ **)**
1) 1500cc 2) 150cc 3) 3000cc 4) 300cc

21. The co-efficient of real expansion of Hg is $0.18\times10^{-3}/^{0}C$. If the density of Hg at 0^{0}C is 13.6 gm/c.c its density at $200^{0}C$ will be

1) 13.3 gm/c.c 2) 13.13 gm/c.c 3) 13.6 gm/c.c 4) 13 gm/c.c

22. A mercury thermometer contains 2c.c. of Hg. at 0°C. Distance between 0°C and 100°C marks on the stem is 35cm and diameter of the bore is 0.02cm. γ_A of liquid is

1) 0.000055/°C 2) 0.000066/°C 3) 0.00055/°C 4) 0.000058/°C

23. Coefficient of real expansion of mercury is $0.18\times10^{-3}/^{0}C$. If the density of mercury at 0^{0}C is 13.6 gm/c.c., its density at 573K will be

1) 12.90 gm/c.c 2) 13.10 gm/c.c 3) 12.95 gm/c.c 4) 12.75 gm/c.c

24. A Pycnometer weights 40gm when empty and 1040 gm when filled with mercury at 0^{0}C. On heating to 100^{0}C 10 gm of mercury over flows if the coefficient of real expansion of mercury is $0.0002/^{0}$C The coefficient of cubical expansion of glass is

1) $0.00001/^{0}C$ 2) $0.0003/^{0}C$ 3) $0.0002/^{0}C$ 4) $0.0001/^{0}C$

25. When a block of iron floats in mercury at $0^{0}C$, a fraction K_1 of its volume is submerged, while at the temperature $60^{0}C$, a fraction K_2 is seen to be submerged. If the coefficient of volume expansion of iron is γ_{Fe} and that of mercury is γ_{Hg} then the ratio $\frac{K_1}{K_2}$ can be expressed as

1) $\frac{1+60\gamma_{Fe}}{1+60\gamma_{Hg}}$ 2) $\frac{1-60\gamma_{Fe}}{1+60\gamma_{Hg}}$ 3) $\frac{1+60\gamma_{Fe}}{1-60\gamma_{Hg}}$ 4) $\frac{1+60\gamma_{Hg}}{1+60\gamma_{Fe}}$

KEY

1) 4	2) 2	3) 1	4) 2	5) 4	6) 3	7) 1	8) 2
9) 4	10) 2	11) 1	12) 3	13) 3	14) 2	15) 3	16) 4
17) 2	18) 1	19) 4	20) 4	21) 2	22) 1	23) 1	24) 4
25) 1							

HINTS

12. $\gamma_A = \dfrac{V_2 - V_1}{V_1(t_2 - t_1)}$

$$\gamma_A = \frac{\frac{3}{4}V - \frac{V}{2}}{\frac{V}{2}\times 100} = 0.005\ /^0C$$

13. $r_R = r_a + 3\alpha_g$

$$3\alpha_g = \frac{1}{8}r_R$$

$$\alpha_g = \frac{1}{24}r_R$$

14. $r_R = r_A + 3\alpha_g = constant$

$$G + 3A = S + 3\alpha^1$$

$$\alpha^1 = \frac{G + 3A - S}{3}$$

15. $\gamma_g V_g = \gamma_L V_L \Rightarrow 3\alpha V = \gamma.\dfrac{V}{2} \Rightarrow \gamma = 6\alpha$

16. $\gamma_A = \dfrac{M_1 - M_2}{M_2(t_2 - t_1)} = \dfrac{\frac{1}{100}M_2}{M_2(80)} = 1.25 \times 10^{-4}\ /^0C$

17. $r_A = \dfrac{m_1 - m_2}{m_2 \times 80}$

$$5\times10^{-4} - 24\times10^{-6} = \frac{50 - x}{x\times 80}$$

x = 48 gm

18. $\gamma_R = \gamma_a + 3\alpha g \Rightarrow \gamma_R = \dfrac{6}{7}\gamma_R + 3\alpha_g \Rightarrow \alpha_g = \dfrac{1}{21}\gamma_R$

19. $\gamma_R = \gamma_a + 3\alpha$

$$\gamma_{a_g} + 3\alpha_g = \gamma_{a_m} + 3\alpha_m$$

$$10.3 \times 10^{-4} + 27 \times 10^{-6} = 10.06 \times 10^{-4} + 3\ \alpha_m$$

$$\therefore \alpha_m = \frac{0.51\times10^{-4}}{3} = 17\times10^{-6}\ /^0 C$$

20. $\gamma_g V_g = \gamma_L V_L$

$27 \text{ x } 10^{-6} \text{ x } 2 = 1.8 \text{ x } 10^{-4} V_L$

$\therefore V_L = \dfrac{27 \text{ x } 10^{-6} \text{ x} 2}{1.8 \text{ x } 10^{-4}} = 300cc$

21. $d_2 = \dfrac{d_1}{1 + \gamma_R (t_2 - t_1)}$

$\therefore d_2 = \dfrac{13.6}{1 + 0.18 \times 10^{-3} \times 200} = \dfrac{13.6}{1.036} = 13.13 gs/cc$

22. $\gamma_A = \dfrac{\Delta V}{V \Delta t} = \dfrac{\pi \rho^2 h}{V \Delta t}$

$= \dfrac{22}{7} \times \dfrac{10^{-4} \times 35}{2 \times 100} = 55 \text{ x } 10^{-6} / ^0C$

23. $d = \dfrac{d_0}{1 + rt} = \dfrac{13.6}{1 + 18 \times 10^{-5} \times 300} = 13.13 \text{ gm}$

24. $\gamma_R = \gamma_a + \gamma_g$

But $\gamma_a = \dfrac{x}{(M_1 - x)(t_2 - t_1)}$

$\gamma_a = \dfrac{x}{(1000 - 10)(100)}$

$\therefore \gamma_a = \dfrac{10}{(1000 - 10)(100)} \Rightarrow \gamma_g = 0.0001 / °C$

25. Weight of body = wt of liquid displaced. $V d_B g = V_m d_l g$

Fraction (F) = $\dfrac{V_{in}}{V} = \dfrac{d_B}{d_t}$

$a_1 = \left(\dfrac{d_B}{d_t}\right)_0$ & $a_2 = \left(\dfrac{d_B}{d_t}\right)_t$

$\dfrac{a_1}{a_2} = \left(\dfrac{d_B}{d_t}\right)_0 \left(\dfrac{d_t}{d_B}\right)_t = \left(\dfrac{1 + \gamma_{Fe} t}{1 + \gamma_{Hg} t}\right) = \left(\dfrac{1 + 60\gamma_{Fe}}{1 + 60\gamma_{Hg}}\right)$