DPP - Daily Practice Problems

Name : Date :

Start Time : End Time :

PHYSICS 22

SYLLABUS : Thermal Expansion, Calorimetry and Change of State

Max. Marks : 116 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 29 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.20) : There are 20 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 A glass flask is filled up to a mark with 50 cc of mercury at 18°C. If the flask and contents are heated to 38°C, how much mercury will be above the mark? (α for glass is 9×10^{-6}/°C and coefficient of real expansion of mercury is 180×10^{-6}/°C)

(a) 0.85 cc (b) 0.46 cc (c) 0.153 cc (d) 0.05 cc

Q.2 The coefficient of apparent expansion of mercury in a glass vessel is 153×10^{-6}/°C and in a steel vessel is 144×10^{-6}/°C. If α for steel is 12×10^{-6}/°C, then that of glass is

(a) 9×10^{-6}/°C (b) 6×10^{-6}/°C
(c) 36×10^{-6}/°C (d) 27×10^{-6}/°C

Q.3 An iron tyre is to be fitted on to a wooden wheel 1m in diameter. The diameter of tyre is 6mm smaller than that of wheel. The tyre should be heated so that its temperature increases by a minimum of (the coefficient of cubical expansion of iron is 3.6×10^{-5}/°C)

(a) 167°C (b) 334°C (c) 500°C (d) 1000°C

Q.4 A rod of length 20 cm is made of metal. It expands by 0.075 cm when its temperature is raised from 0°C to 100°C. Another rod of a different metal *B* having the same length expands by 0.045 cm for the same change in temperature. A third rod of the same length is composed of two parts, one of metal *A* and the other of metal *B*. This rod expands by 0.060 cm for the same change in temperature. The portion made of metal *A* has the length

(a) 20 cm (b) 10 cm (c) 15 cm (d) 18 cm

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

Space for Rough Work

Q.5 A glass flask of volume one litre at 0°C is filled, level full of mercury at this temperature. The flask and mercury are now heated to 100°C. How much mercury will spill out, if coefficient of volume expansion of mercury is 1.82×10^{-4}/°C and linear expansion of glass is 0.1×10^{-4}/°C?
(a) 21.2 cc (b) 15.2 cc (c) 1.52 cc (d) 2.12 cc

Q.6 The apparent coefficient of expansion of a liquid when heated in a copper vessel is C and when heated in a silver vessel is S. If A is the linear coefficient of expansion of copper, then the linear coefficient of expansion of silver is
(a) $\frac{C+S-3A}{3}$ (b) $\frac{C+3A-S}{3}$
(c) $\frac{S+3A-C}{3}$ (d) $\frac{C-S+3A}{3}$

Q.7 The coefficient of volumetric expansion of mercury is 18×10^{-5}/°C. A thermometer bulb has a volume 10^{-6} m^3 and cross section of stem is 0.004 cm^2. Assuming that bulb is filled with mercury at 0°C then the length of the mercury column at 100°C is
(a) 18.8 mm (b) 9.2 mm (c) 7.4 cm (d) 4.5 cm

Q.8 A piece of metal weight 46 gm in air, when it is immersed in the liquid of specific gravity 1.24 at 27°C it weighs 30 gm. When the temperature of liquid is raised to 42°C the metal piece weighs 30.5 gm, specific gravity of the liquid at 42°C is 1.20, then the linear expansion of the metal will be
(a) 3.316×10^{-5}/°C (b) 2.316×10^{-5}/°C
(c) 4.316×10^{-5}/°C (d) None of these

Q.9 2 kg of ice at – 20°C is mixed with 5 kg of water at 20°C in an insulating vessel having a negligible heat capacity. Calculate the final mass of water remaining in the container. It is given that the specific heats of water and ice are 1 kcal/kg /°C and 0.5 kcal/kg/°C while the latent heat of fusion of ice is 80 kcal/kg
(a) 7 kg (b) 6 kg (c) 4 kg (d) 2 kg

Q.10 A lead bullet at 27°C just melts when stopped by an obstacle. Assuming that 25% of heat is absorbed by the obstacle, then the velocity of the bullet at the time of striking (M.P. of lead = 327°C, specific heat of lead = 0.03 cal/gm°C, latent heat of fusion of lead = 6 cal/gm and J = 4.2 joule/cal)
(a) 410 m/sec (b) 1230 m/sec
(c) 307.5 m/sec (d) None of the above

Q.11 The temperature of equal masses of three different liquids *A*, *B* and *C* are 12°C, 19°C and 28°C respectively. The temperature when *A* and *B* are mixed is 16°C and when *B* and *C* are mixed is 23°C, The temperature when *A* and *C* are mixed is
(a) 18.2°C (b) 22°C (c) 20.2°C (d) 25.2°C

Q.12 50 gm of copper is heated to increase its temperature by 10°C. If the same quantity of heat is given to 10 gm of water, the rise in its temperature is (Specific heat of copper = 420 Joule-kg^{-1}°C^{-1})
(a) 5°C (b) 6°C (c) 7°C (d) 8°C

Q.13 A beaker contains 200 gm of water. The heat capacity of the beaker is equal to that of 20 gm of water. The initial temperature of water in the beaker is 20°C. If 440 gm of hot water at 92°C is poured in it, the final temperature (neglecting radiation loss) will be nearest to
(a) 58°C (b) 68°C (c) 73°C (d) 78°C

Q.14 One calorie is defined as the amount of heat required to raise temperature of 1g of water by 1°C and it is defined under which of the following condition
(a) From 14.5°C to 15.5°C at 760 mm of Hg
(b) From 98.5°C to 99.5°C at 760 mm of Hg
(c) From 13.5°C to 14.5°C at 76 mm of Hg
(d) From 3.5°C to 4.5°C at 76 mm of Hg

Q.15 A bullet moving with a uniform velocity *v*, stops suddenly after hitting the target and the whole mass melts be *m*, specific heat *S*, initial temperature 25°C, melting point 475°C and the latent heat *L*. Then *v* is given by
(a) $mL = mS(475-25)+\frac{1}{2}.\frac{mv^2}{J}$
(b) $mS(475-25)+mL = \frac{mv^2}{2J}$
(c) $mS(475-25)+mL = \frac{mv^2}{J}$
(d) $mS(475-25)-mL = \frac{mv^2}{2J}$

RESPONSE GRID					
	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ
	15. ⓐⓑⓒⓓ				

Space for Rough Work

Q.16 A stationary object at 4°C and weighing 3.5 kg falls from a height of 2000 m on a snow mountain at 0°C. If the temperature of the object just before hitting the snow is 0°C and the object comes to rest immediately? (g = 10m/s^2 and latent heat of ice = 3.5×10^5 joule/sec), then the object will melt

(a) 2 kg of ice (b) 200 gm of ice
(c) 20 gm of ice (d) 2 gm of ice

Q.17 Density of a substance at 0°C is 10 gm/cc and at 100°C, its density is 9.7 gm/cc. The coefficient of linear expansion of the substance will be

(a) 10^2 (b) 10^{-2} (c) 10^{-3} (d) 10^{-4}

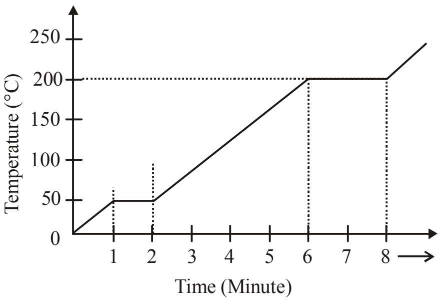
Q.18 The real coefficient of volume expansion of glycerine is 0.000597 per °C and linear coefficient of expansion of glass is 0.000009 per°C. Then the apparent volume coefficient of expansion of glycerine is

(a) 0.000558 per°C (b) 0.00057 per°C
(c) 0.00027 per°C (d) 0.00066 per°C

Q.19 A constant volume gas thermometer shows pressure reading of 50 cm and 90 cm of mercury at 0°C and 100°C respectively. When the pressure reading is 60 cm of mercury, the temperature is

(a) 25°C (b) 40°C (c) 15°C (d) 12.5°C

Q.20 A student takes 50gm wax (specific heat = 0.6 kcal/kg°C) and heats it till it boils. The graph between temperature and time is as follows. Heat supplied to the wax per minute and boiling point are respectively.



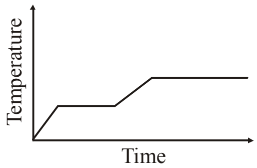
(a) 500 cal, 50°C (b) 1000 cal, 100°C
(c) 1500 cal, 200°C (d) 1000 cal, 200°C

DIRECTIONS (Q.21-Q.23) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.21 Heat is supplied to a certain homogenous sample of matter, at a uniform rate. Its temperature is plotted against time, as shown. Which of the following conclusions can be drawn?



(1) Its specific heat capacity is greater in the liquid state than in the solid state
(2) Its latent heat of vaporization is greater than its latent heat of fusion
(3) Its specific heat capacity is greater in the solid state than in the liquid state
(4) Its latent heat of vaporization is smaller than its latent heat of fusion

Q.22 A bimetallic strip is formed out of two identical strips, one of copper and other of brass. The coefficients of linear expansion of the two metals are α_C and α_B. On heating, the temperature of the strip goes up by ΔT and the strip bends to form an arc of radius of curvature R. Then R is

(1) inversely proportional to ΔT
(2) proportional to $|\alpha_B - \alpha_C|$
(3) inversely proportional to $|\alpha_B - \alpha_C|$
(4) proportional to ΔT

Q.23 A bimetallic strip is heated. Choose wrong statements.

(1) does not bend at all
(2) gets twisted in the form of an helix
(3) bends in the form of an arc with the more expandable metal inside.
(4) bend in the form of an arc with the more expandable metal outside

RESPONSE GRID	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ		

Space for Rough Work

DIRECTIONS (Q.24-Q.26) : Read the passage given below and answer the questions that follows :

In a thermally insulated tube of cross sectional area $4 cm^2$ a liquid of thermal expansion coefficient $10^{-3} K^{-1}$ is flowing. Its velocity at the entrance is 0.1 m/s. At the middle of the tube a heater of a power of 10kW is heating the liquid. The specific heat capacity of the liquid is 1.5 kJ/(kg K), and its density is 1500 kg/m^3 at the entrance.

Q.24 The rise in temperature of the liquid as it pass through the tube is

(a) $\frac{1000}{9}$°C (b) $\frac{1}{9}$°C (c) $\frac{500}{9}$°C (d) None

Q.25 What is the density of liquid at the exit ?

(a) 1450 kg/m^3 (b) 1400 kg/m^3
(c) 1350 kg/m^3 (d) None of these

Q.26 How much bigger is the volume rate of flow at the end of the tube than at the entrance in cubic meters ?

(a) 9×10^{-5} (b) $\frac{1}{3} \times 10^{-5}$
(c) $\frac{4}{9} \times 10^{-5}$ (d) None

DIRECTIONS (Q. 27-Q.29) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement -1 is False, Statement-2 is True.
(d) Statement -1 is True, Statement-2 is False.

Q.27 **Statement-1 :** Fahrenheit is the smallest unit measuring temperature.
Statement-2 : Fahrenheit was the first temperature scale used for measuring temperature.

Q.28 **Statement-1 :** A brass disc is just fitted in a hole in a steel plate. The system must be cooled to loosen the disc from the hole.
Statement-2 : The coefficient of linear expansion for brass is greater than the coefficient of linear expansion for steel.

Q.29 **Statement-1 :** Latent heat of fusion of ice is 336000 J kg^{-1}.
Statement-2 : Latent heat refers to change of state without any change in temperature.

RESPONSE GRID	
	24. ⓐⓑⓒⓓ 25. ⓐⓑⓒⓓ 26. ⓐⓑⓒⓓ 27. ⓐⓑⓒⓓ 28. ⓐⓑⓒⓓ 29. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 22 - PHYSICS			
Total Questions	29	Total Marks	116
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	28	Qualifying Score	42
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS 22

1. (c) Due to volume expansion of both mercury and flask, the change in volume of mercury relative to flask is given by $\Delta V = V_0[\gamma_L - \gamma_g]\Delta\theta = V[\gamma_m - 3\alpha_g]\Delta\theta$

$= 50[180 \times 10^{-6} - 3 \times 9 \times 10^{-6}]\,(38 - 18)$
$= 0.153$ cc

2. (a) $\gamma_{real} = \gamma_{app.} + \gamma_{vessel}$

So $(\gamma_{app.} + \gamma_{vessel})_{glass} = (\gamma_{app.} + \gamma_{vessel})_{steel}$

$\Rightarrow 153 \times 10^{-6} + (\gamma_{vessel})_{glass} = (144 \times 10^{-6} + \gamma_{vessel})_{steel}$

Further, $(\gamma_{vessel})_{steel} = 3\alpha = 3 \times (12 \times 10^{-6}) = 36 \times 10^{-6}/°C$

$\Rightarrow 153 \times 10^{-6} + (\gamma_{vessel})_{glass} = 144 \times 10^{-6} + 36 \times 10^{-6}$

$\Rightarrow (\gamma_{vessel})_{glass} = 3\alpha = 27 \times 10^{-6}/°C$

$\Rightarrow \alpha = 9 \times 10^{-6}/°C$

3. (c) Initial diameter of tyre = (100 – 6) mm = 994 mm,

So, initial radius of tyre $R = \frac{994}{2} = 497\text{mm}$

and change in diameter ΔD = 6 mm, so

$\Delta R = \frac{6}{2} = 3\,\text{mm}$

After increasing temperature by $\Delta\theta$, tyre will fit onto wheel

Increment in the length (circumference) of the iron tyre

$\Delta L = L \times \alpha \times \Delta\theta = L \times \frac{\gamma}{3} \times \Delta\theta \qquad [\text{As } \alpha \times \frac{\gamma}{3}]$

$2\pi\Delta R = 2\pi R\left(\frac{\gamma}{3}\right)\Delta\theta$

$\Delta\theta \Rightarrow \frac{3}{\gamma}\frac{\Delta R}{R} = \frac{3 \times 3}{3.6 \times 10^{-5} \times 497}$

$\Rightarrow \Delta\theta = 500°C$

4. (b) $\Delta L = L_0\alpha\Delta\theta$

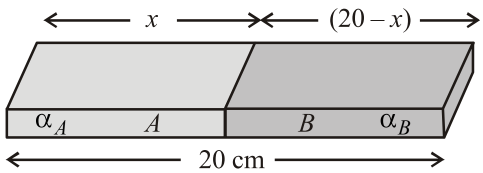
Rod A : $0.075 = 20 \times \alpha_A \times 100$

$\Rightarrow \alpha_A = \frac{75}{2} \times 10^{-6}/°C$

Rod B : $0.045 = 20 \times \alpha_B \times 100$

$\Rightarrow \alpha_B = \frac{45}{2} \times 10^{-6}/°C$

For composite rod: x cm of A and $(20 - x)$ cm of B we have



$0.060 = x\,\alpha_A \times 100 + (20 - x)\,\alpha_B \times 100$

$= x\left[\frac{75}{2} \times 10^{-6} \times 100 + (20 - x) \times \frac{45}{2} \times 10^{-6} \times 100\right]$

On solving we get $x = 10$ cm.

5. (b) Due to volume expansion of both liquid and vessel, the change in volume of liquid relative to container is given by $\Delta V = V_0[\gamma_L - \gamma_g]\Delta\theta$

Given $V_0 = 1000\,cc$, $\alpha_g = 0.1 \times 10^{-4}/°C$

$\therefore \gamma_g = 3\alpha_g = 3 \times 0.1 \times 10^{-4}/°C = 0.3 \times 10^{-4}/°C$

$\therefore \Delta V = 1000[1.82 \times 10^{-4} - 0.3 \times 10^{-4}] \times 100 = 15.2cc$

6. (b) $\gamma_r = \gamma_a + \gamma_v$; where γ_r = coefficient of real expansion, γ_a = coefficient of apparent expansion and γ_v = coefficient of expansion of vessel.

For copper $\gamma_r = C + 3\alpha_{Cu} = C + 3A$

For silver $\gamma_r = S + 3\alpha_{Ag}$

$\Rightarrow C + 3A = S + 3\alpha_{Ag} \Rightarrow \alpha_{Ag} = \frac{C - S + 3A}{3}$

7. (d) $V = V_0(1 + \gamma\Delta\theta) \Rightarrow$ Change in volume

$V - V_0 = \Delta V = A.\Delta l = V_0\gamma\Delta\theta$

$\Rightarrow \Delta l = \frac{V_0.\Delta\theta}{A} = \frac{10^{-6} \times 18 \times 10^{-5} \times (100 - 0)}{0.004 \times 10^{-4}}$

$= 45 \times 10^{-3}\text{m} = 4.5$ cm

8. (b) Loss of weight at 27°C is

$= 46 - 30 = 16 = V_1 \times 1.24\,\rho_1 \times g$ ...(i)

Loss of weight at 42°C is

$= 46 - 30.5 = 15.5 = V_2 \times 1.2\,\rho_1 \times g$ ...(ii)

Now dividing (i) by (ii), we get

$\frac{16}{15.5} = \frac{V_1}{V_2} \times \frac{1.24}{1.2}$

But $\frac{V_2}{V_1} = 1 + 3\alpha(t_2 - t_1) = \frac{15.5 \times 1.24}{16 \times 1.2} = 1.001042$

$\Rightarrow 3\alpha\,(42° - 27°) = 0.001042$

$\Rightarrow \alpha = 2.316 \times 10^{-5}/°C$

9. (b) Heat lost in t sec = mL or heat lost per sec = $\frac{mL}{t}$. This must be the heat supplied for keeping the substance in molten state per sec.

$\therefore \frac{mL}{t} = P \quad or \quad L = \frac{Pt}{m}$

10. (b) Initially ice will absorb heat to raise it's temperature to 0°C then it's melting takes place

If m_1 = Initial mass of ice, m_1' = Mass of ice that melts and m_W = Initial mass of water

By Law of mixture

Heat gained by ice = Heat lost by water $\Rightarrow m_1 \times (20) + m_1' \times L = m_W c_W[20]$

$\Rightarrow 2 \times 0.5\ (20) + m_1' \times 80 = 5 \times 1 \times 20$

$\Rightarrow m_1' = 1$ kg

So final mass of water = Initial mass of water + Mass of ice that melts = 5 + 1 = 6 kg.

11. (a) If mass of the bullet is m gm,

then total heat required for bullet to just melt down

$Q_1 = mc\Delta\theta + mL = m \times 0.03\ (327 - 27) + m \times 6$

$= 15m$ cal $= (15m \times 4.2)$J

Now when bullet is stopped by the obstacle, the loss in its mechanical energy $= \frac{1}{2}(m\times10^{-3})v^2 J$

(As m gm $= m \times 10^{-3}$kg)

As 25% of this energy is absorbed by the obstacle,

$$Q_2 = \frac{75}{100}\times\frac{1}{2}mv^2\times10^{-3} = \frac{3}{8}mv^2\times10^{-3} J$$

Now the bullet will melt if $Q_2 \ge Q_1$

i.e. $\frac{3}{8}mv^2\times10^{-3} \ge 15m\times4.2 \Rightarrow v_{min} = 410$ m/s

12. (c) Heat gain = heat lost

$$C_A(16-12) = C_B(19-16) \Rightarrow \frac{C_A}{C_B} = \frac{3}{4}$$

and $C_B(23-19) = C_C(28-23) \Rightarrow \frac{C_B}{C_C} = \frac{5}{4}$

$$\Rightarrow \frac{C_A}{C_C} = \frac{15}{16} \quad ....(i)$$

If θ is the temperature when A and C are mixed then,

$$C_A(\theta-12) = C_C(28-\theta) \Rightarrow \frac{C_A}{C_C} = \frac{28-\theta}{\theta-12} \quad ...(ii)$$

On solving equation (i) and (ii) θ = 20.2°C

13. (a) Same amount of heat is supplied to copper and water so $m_c c_c \Delta\theta_c = m_W c_W \Delta\theta_W$

$$\Rightarrow \Delta\theta_W = \frac{m_c c_c(\Delta\theta)_c}{m_W c_W} = \frac{50\times10^{-3}\times420\times10}{10\times10^{-3}\times4200} = 5°C$$

14. (b) Heat lost by hot water = Heat gained by cold water in beaker + Heat absorbed by beaker

$\Rightarrow 440\ (92 - \theta) = 200 \times (\theta - 20) + 20 \times (\theta - 20)$

$\Rightarrow \theta = 68°C$

15. (a)

16. (b) Firstly the temperature of bullet rises up to melting point, then it melts. Hence according to $W = JQ$.

$$\Rightarrow \frac{1}{2}mv^2 = J.[m.c.\Delta\theta + mL] = J[mS(475-25)+mL]$$

$$\Rightarrow mS(475-25)+mL = \frac{mv^2}{2J}$$

17. (b) Suppose m kg of ice melts then by using

$\underset{(Joules)}{W} = \underset{(Joules)}{H}$

$\Rightarrow Mgh = mL$

$\Rightarrow 3.5 \times 10 \times 2000 = m \times 3.5 \times 10^5$

$\Rightarrow m = 0.2$ kg = 200 gm

18. (d) Coefficient of volume expansion

$$\gamma = \frac{\Delta\rho}{\rho.\Delta T} = \frac{(\rho_1-\rho_2)}{\rho.(\Delta\theta)} = \frac{(10-9.7)}{10\times(100-0)} = 3\times10^{-4}$$

Hence, coefficient of linear expansion

$$\alpha = \frac{\gamma}{3} = 10^{-4}/°C$$

19. (b) As we know

$\gamma_{real} = \gamma_{app.} + \gamma_{vessel}$

$\Rightarrow \gamma_{app.} = \gamma_{glycerine} - \gamma_{glass}$

$= 0.000597 - 0.000027$

$= 0.00057$/°C

20. (a) $t = \frac{(P_t - P_0)}{(P_{100} - P_0)}\times100°C$

$$= \frac{(60-50)}{(90-50)}\times100 = 25°C$$

21. (c) Since specific heat = 0.6 kcal/gm × °C

= 0.6 cal/gm × °C

From graph it is clear that in a minute, the temperature is raised from 0°C to 50°C.

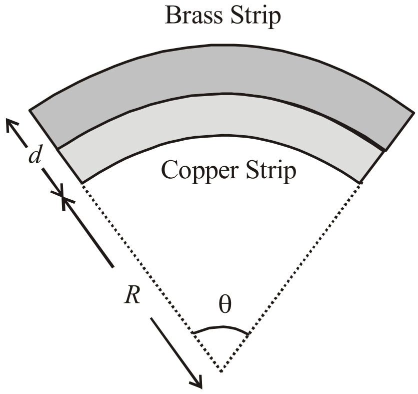
⇒ Heat required for a minute

= 50 × 0.6 × 50 = 1500 cal.

Also from graph, boiling point of wax is 200°C.

22. (b) The horizontal parts of the curve, where the system absorbs heat at constant temperature must depict changes of state. Here the latent heats are proportional to lengths of the horizontal parts. In the sloping parts, specific heat capacity is inversely proportional to the slopes.

23. (d) Let L_0 be the initial length of each strip before heating. Length after heating will be



$$L_B = L_0(1+\alpha_B\Delta T) = (R+d)\theta$$

$L_C = L_0(1+\alpha_C\Delta T) = R\theta$

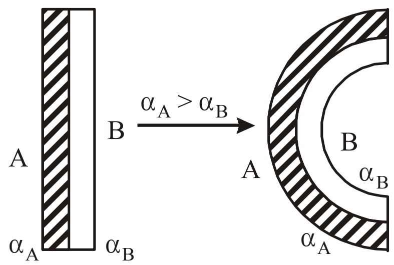
$\Rightarrow \dfrac{R+d}{R} = \dfrac{1+\alpha_B\Delta T}{1+\alpha_C\Delta T}$

$\Rightarrow 1+\dfrac{d}{R} = 1+(\alpha_B-\alpha_C)\Delta T$

$\Rightarrow R = \dfrac{d}{(\alpha_B-\alpha_C)\Delta T}$

$\Rightarrow R \propto \dfrac{1}{\Delta T}$ and $R \propto \dfrac{1}{(\alpha_B-\alpha_C)}$

24. **(a)** A bimetallic strip on being heated bends in the form of an arc with more expandable metal (A) outside (as shown) correct.



25. **(a)** **26.** **(c)** **27.** **(c)**

$\rho_1 v_1 A_1 = \rho_2 v_2 A_2$

$m = 1500\ \text{kg/m}^3 \times 0.1\ \text{m/s} \times 4\ (\text{cm})^2$

$ms\Delta T = 10000$

$1500 \times 0.1 \times 4 \times 10^{-4} \times 1500 \times \Delta T = 10000$

$\Delta T = \dfrac{10000}{90} = \dfrac{1000}{9}\ °C$

$\rho_2 = \dfrac{\rho_1}{(1+\gamma\Delta T)} = \dfrac{1500}{\left(1+1\times10^{-3}\times\dfrac{1000}{9}\right)} = 1350\ \text{kg/m}^3$

$\rho_2 v_2 A_2 = \rho_1 v_1 A_1$

$\Rightarrow 1350 \times v_2 = 1500 \times 0.1$

$v_2 = 1/9\ \text{m/s}$

$\therefore$ Volume rate of flow at the end of tube

$= A_2 v_2 = 4\times10^{-4}\times\dfrac{1}{9}$

$= \dfrac{4}{9}\times10^{-4}\ \text{m}^3 = \dfrac{40}{9}\times10^{-5}\ \text{m}^3$

Volume rate of flow at the entrance $= A_1 v_1$

$= 0.1 \times 4 \times 10^{-4} = 4 \times 10^{-5}\text{m}^3$

Hence, difference of volume rate of flow at the two ends

$= \left(\dfrac{40}{9}-4\right)\times10^{-5} = \dfrac{4}{9}\times10^{-5}\ \text{m}^3$

28. **(d)** Celsius scale was the first temperature scale and Fahrenheit is the smallest unit measuring temperature.

29. **(a)** Linear expansion for brass $(19\times10^{-4}) >$ linear expansion for steel (11×10^{-4}). On cooling the disk shrinks to a greater extent than the hole and hence it will get loose.

30. **(b)** The latent heat of fusion of ice is amount of heat required to convert unit mass of ice at 0°C into water at 0°C. For fusion of ice

$L = 80\ \text{cal/gm} = 80000\ \text{cal/gm} = 8000 \times 4.2\ \text{j/kg}$

$= 336000\ \text{J/kg}$.