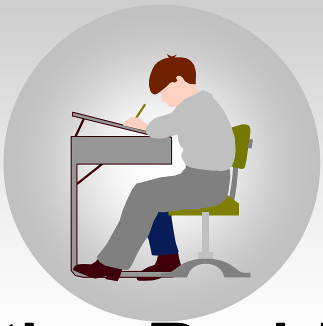


Practice Problems

Problems based on Thermometry

▶ Basic level

1. A centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registers 140°. What is the fall in temperature as registered by the Centigrade thermometer **[CBSE PMT 1992; AIIMS 1998]**

   (a) 30° (b) 40° (c) 60° (d) 80°

2. At what temperature the centigrade (Celsius) and Fahrenheit, readings are the same **[RPMT 1997]**

   (a) – 40° (b) + 40° (c) 36.6° (d) – 37°

3. Standardisation of thermometers is obtained with **[CPMT 1996]**

   (a) Jolly's thermometer (b) Platinum resistance thermometer
   (c) Thermocouple thermometer (d) Gas thermometer

4. The gas thermometers are more sensitive than liquid thermometers because **[CPMT 1993]**

   (a) Gases expand more than liquids (b) Gases are easily obtained
   (c) Gases are much lighter (d) Gases do not easily change their states

5. Mercury thermometers can be used to measure temperatures upto

   (a) 100°*C* (b) 212°*C* (c) 360°*C* (d) 500°*C*

6. 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*

7. The relation that converts temperature in Celsius scale to temperature in Fahrenheit scale is

   (a) $t°F = \frac{5}{9}(t°C - 32°)$ (b) $t°F = \frac{5}{9}t°C + 32°$ (c) $t°F = \frac{9}{5}t°C + 32°$ (d) $t°F = \frac{9}{5}(t°C + 32°)$

8. A temperature difference of 5°*C* on Celsius scale corresponds to the following temperature difference in the Fahrenheit scale

   (a) 9° (b) 41° (c) 2.8° (d) 15°

9. Mercury boils at 367°*C*. However, mercury thermometers are made such that they can measure temperature up to 500°*C*. This is done by

   (a) Maintaining vacuum above mercury column in the stem of the thermometer
   (b) Filling nitrogen gas at high pressure above the mercury column
   (c) Filling nitrogen gas at low pressure above the mercury column
   (d) Filling oxygen gas at high pressure above the mercury column

▶▶ Advance level

10. Which of the following is the smallest temperature

    (a) 1°*R* (b) 1°*C* (c) 1°*F* (d) 1° *K*

Problems based on Expansion of Solids

▶ Basic level

11. At some temperature T, a bronze pin in a little large to fit into a hole drilled in a steel block. The change in temperature required for an exact fit is minimum when

(a) Only the block is heated (b) Both block and pin are heated together

(c) Both block and pin are cooled together (d) Only the pin is cooled

12. If the length of a cylinder on heating increases by 2%, the area of its base will increase by **[CPMT 1993]**

(a) 0.5% (b) 2% (c) 1% (d) 4%

13. A thin wire of length L increases in length by 1% when heated to a certain range of temperature. If a thin copper plate of area $2L \times L$ is heated through same range the percentage increase in area will be

(a) 3% (b) 2.5% (c) 1.5% (d) 2%

14. Two rods of length L_1 and L_2 are made of materials of coefficients of linear expansions α_1 and α_2 respectively such that $L_1\alpha_1 = L_2\alpha_2$. The temperature of the rods is increased by ΔT and correspondingly the change in their respective lengths be ΔL_1 and ΔL_2

(a) $\Delta L_1 \neq \Delta L_2$

(b) $\Delta L_1 = \Delta L_2$

(c) Difference in length $(L_1 - L_2)$ is a constant and is independent of rise of temperature

(d) Data is insufficient to arrive at a conclusion

15. A rod of length 40 *cm* has the coefficient of linear expansion $\alpha_1 = 6 \times 10^{-6} / °C$. Another rod of length l has the coefficient of linear expansion $\alpha_2 = 4 \times 10^{-6} / °C$. If the difference in length of the two rods always remain same at all temperatures, then the value of l is

(a) 26 *cm* (b) 60 *cm* (c) 80 *cm* (d) 32 *cm*

▶▶ Advance level

16. Two metal rods having same length and area of cross-section are fixed end to end between two rigid supports. The coefficients of linear expansion of the rods are α_1 and α_2 and their respective Young's moduli are Y_1 and Y_2. The system is now cooled and it is observed that the junction between the rods does not shift at all for the condition

(a) $Y_1\alpha_2 = Y_2\alpha_1$ (b) $Y_1\alpha_1^2 = Y_2\alpha_2^2$ (c) $Y_1\alpha_1 = Y_2\alpha_2$ (d) $Y_1\alpha_2^2 = Y_2\alpha_1^2$

17. The coefficient of linear expansion of crystal in one direction is α_1 and that in every direction perpendicular to it α_2. The coefficient of cubical expansion is

(a) $\alpha_1 + \alpha_2$ (b) $2\alpha_1 + \alpha_2$ (c) $\alpha_1 + 2\alpha_2$ (d) None of these

Problems based on Expansion of liquid

▶ Basic level

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

(a) $\gamma = 3\alpha$ (b) $\gamma > 3\alpha$ (c) $\gamma < 3\alpha$ (d) $\gamma = \alpha^3$

19. Water does not freeze at the bottom of the lakes in winter because

(a) Ice is a good conductor of heat (b) Ice reflects heat and light

(c) Of anomalous expansion of water between 4°*C* to 0°*C* (d) Nothing can be said

20. A one litre glass flask contains some mercury. It is found that at different temperatures the volume of air inside the flask remains the same. What is the volume of mercury in this flask if coefficient of linear expansion of glass is $9 \times 10^{-6} / °C$ while of volume expansion of mercury is $1.8 \times 10^{-4} / °C$

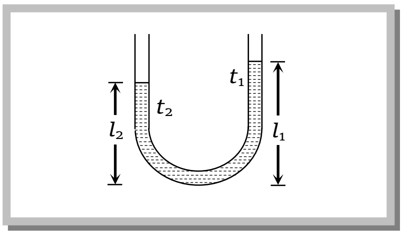
(a) 50 cc (b) 100 cc (c) 150 cc (d) 200 cc

▶▶ Advance level

21. A metal ball immersed in alcohol weighs W_1 at 0°*C* and W_2 at 59°*C*. The coefficient of cubical expansion of the metal is less than that of alcohol. Assuming that the density of metal is large compared to that of alcohol, it can be shown that **[CPMT 1998]**

(a) $W_1 > W_2$ (b) $W_1 = W_2$ (c) $W_1 < W_2$ (d) $W_2 = (W_1 / 2)$

22. In a vertical U-tube containing a liquid, the two arms are maintained at different temperatures t_1 and t_2. The liquid columns in the two arms have heights l_1 and l_2 respectively. The coefficient of volume expansion of the liquid is equal to



(a) $\dfrac{l_1 - l_2}{l_2 t_1 - l_1 t_2}$

(b) $\dfrac{l_1 - l_2}{l_1 t_1 - l_2 t_2}$

(c) $\dfrac{l_1 + l_2}{l_2 t_1 + l_1 t_2}$

(d) $\dfrac{l_1 + l_2}{l_1 t_1 + l_2 t_2}$

Problems based on Application of thermal expansion

▶ *Basic level*

23. Two spheres of same size are made of the same material but one is solid and the other is hollow. They are heated to the same temperature

(a) Both spheres expand equally (b) The solid sphere expands more

(c) The hollow sphere expands more (d) Data is insufficient to arrive at a conclusion

24. A bimetallic strip is made up of two metals with different α

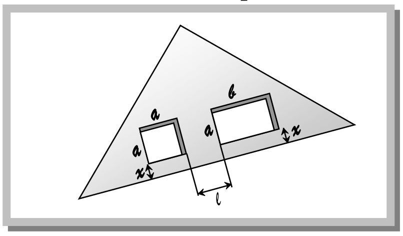
(a) On heating, it bends towards the metal with high α (b) On heating, it bends towards the metal with low α

(c) On cooling, it bends towards the metal with high α (d) On cooling, it bends towards the metal with low α

25. A metal rod of length L_0, made of material of Young's modulus Y, area A is fixed between two rigid supports. The coefficient of linear expansion of the rod is α. The rod is heated such that the tension in the rod is T

(a) $T \propto L_0$ (b) $T \propto A_0^0$ (c) $T \propto A$ (d) $T \propto L_0^0$

26. A triangular plate has two cavities, one square and one rectangular as shown. The plate is heated



(a) *a* increases, *b* decreases

(b) *a* and *b* both increase

(c) *a* and *b* increase, *x* and *l* decrease

(d) *a*, *b*, *x* and *l* all increase

27. The coefficient of volume expansion of a solid is *x* times the coefficient of linear expansion. Then *x* is

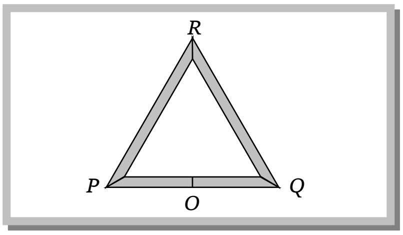
(a) 1.5 (b) 2 (c) 2.5 (d) 3

28. The metal of a pendulum clock has a coefficient of expansion as $2 \times 10^{-5} / K$. Its period is 2*s* at 15°*C*. If the temperature increases to 25°*C*, shall the clock

(a) Show correct time (b) Lose time (c) Gain time (d) First lose and then gain time

▶▶ *Advance level*

29. Three rods of equal length *l* are joined to form an equilateral triangle *PQR*. *O* is the mid point of *PQ*. Distance *OR* remains same for small change in temperature. Coefficient of linear expansion for *PR* and *RQ* is same *i.e.* α_2 but that for *PQ* is α_1. Then



(a) $\alpha_2 = 3\alpha_1$

(b) $\alpha_2 = 4\alpha_1$

(c) $\alpha_1 = 3\alpha_2$

(d) $\alpha_1 = 4\alpha_2$

Problems based on Specific heat, thermal capacity and water equivalent

Basic level

30. Amount of heat required to raise the temperature of a body through $1K$ is called its **[MH CET 2001]**

(a) Water equivalent (b) Thermal capacity (c) Entropy (d) Specific heat

31. The specific heat of metals at low temperature is

(a) Proportional to T (b) Proportional to T^2 (c) Proportional to T^3 (d) Independent of T

32. A body of mass m gram has specific heat c

(a) Heat capacity of the body is mc (b) Water equivalent of the body is m

(c) Water equivalent of the body is mc (d) Heat capacity of the body is c

Advance level

33. A system S receives heat continuously from an electrical heater of power 10 W. The temperature of S becomes constant at 50°C when the surrounding temperature is 20°C. After the heater is switched off, S cools from 35.1°C to 34.9°C in 1 *minute*. The heat capacity of S is

(a) $750\ J(°C)^{-1}$ (b) $1500\ J(°C)^{-1}$ (c) $3000\ J(°C)^{-1}$ (d) $6000\ J(°C)^{-1}$

Problems based on Latent heat

Basic level

34. A metallic ball and highly stretched spring are made of the same material and have the same mass. They are heated so that they melt, the latent heat required

(a) Are the same for both

(b) Is greater for the ball

(c) Is greater for the spring

(d) For the two may or may not be the same depending upon the metal

35. A mass of liquid with volume V_1 is completely changed into a gas of volume V_2 at a constant external pressure P and temperature T. If the latent heat of evaporation for the given mass is L, then the increase in the internal energy of the system is **[Roorkee 1999]**

(a) Zero (b) $P(V_2 - V_1)$ (c) $L - P(V_2 - V_1)$ (d) L

36. During the melting of a slab of ice at 273 K at atmospheric pressure

(a) Positive work is done by ice-water system on the atmosphere

(b) Positive work is done on the ice-water system by the atmosphere

(c) The internal energy of the ice-water system increases

(d) The internal energy of the ice-water system decreases

37. 1 gm steam at 100°C can melt how much ice at 0°C

(a) $\frac{80}{540}\ gm$ (b) $\frac{540}{80}\ gm$ (c) 8 gm (d) 8 kg

38. The melting of solids under atmospheric pressure is

(a) An isometric change (b) An isobaric change

(c) Both isobaric and isothermal change (d) An adiabatic change

39. 3.2 *kg* of ice at – 10°*C* just melts with a mass *m* of steam

(a) *m* = 400 *gm* (b) *m* = 800 *gm* (c) *m* = 500 *gm* (d) *m* = 900 *gm*

40. A 10 *kg* iron bar (specific heat 0.11 *cal/gm-°C*) at 80°*C* is placed on a block of ice. How much ice melts

(a) 1.1 *kg* (b) 10 *kg* (c) 16 *kg* (d) 60 *kg*

41. Water at 0°*C* was boiled away over a burner supplying heat at a constant rate. If the time to raise the temperature from 0°*C* to 100°*C* is 5 *min* and the time to boil away at 100°*C* is 28 *min*, then the specific latent heat of steam in $J\,g^{-1}$ is (take $s = 1.0\, cal\, g^{-1}\, K^{-1}$)

(a) 540 (b) 2250 (c) 2352 (d) 2392

▶▶ *Advance level*

42. An object of mass 3.5 *kg* is situated at a height of 2 *km* from the earth's surface at a temperature of –15°*C*. it is dropped from rest. It falls in a tube containing ice at 0°*C* and immediately comes to rest. During the journey its temperature becomes 0°*C* due to friction with air as it reaches the surface of the earth. If *g* is 10 m/s^2 and latent heat of ice is 3.5×10^5 *J/kg*, the object will melt

(a) 400 *gm* of ice (b) 300 *gm* of ice (c) 200 *gm* of ice (d) 100 *gm* of ice

43. An immersion heater takes time t_1 to raise the temperature of a mass *M* of a liquid from a temperature T_1 to its normal boiling point T_2. In a further time t_2, a mass *m* of the liquid is vaporized. If the specific heat capacity of the liquid is *c* and heat losses to the atmosphere and to the containing vessel are ignored, the specific latent heat of vaporisation is

(a) $\frac{Mc(T_2 - T_1)t_2}{mt_1}$ (b) $\frac{mc(T_2 - T_1)t_2}{MT_1}$ (c) $\frac{McT_1T_2}{mt_1}$ (d) $\frac{mt_1}{Mc(T_2 - T_1)t_2}$

Problems based on Caloriemetry

▶ *Basic level*

44. 100 *g* of ice is mixed with 100 *g* of water at 100°*C*. What will be the final temperature of the mixture**[SCRA 1996]**

(a) 10°*C* (b) 20°*C* (c) 30°*C* (d) 40°*C*

45. One *kg* of ice at 0°*C* is mixed with 1 *kg* of water at 10°*C*. The resulting temperature will be

(a) Between 0°*C* and 10°*C* (b) Equal to 0°*C* (c) Less than 0°*C* (d)

46. 1 *g* of ice at 0°*C* is mixed with 1*g* of steam at 100°*C*. After thermal equilibrium is attained the temperature of the mixture is

(a) 1°*C* (b) 50°*C* (c) 81°*C* (d) 100°*C*

47. A 50 *gm* piece of iron at 100°*C* is dropped into 100 *gm* water at 20°*C*. The temperature of mixture 25.5°*C*. The specific heat of iron in *Calorie/gm°C* will be

(a) 0.341 (b) 0.267 (c) 0.082 (d) 0.148

48. A mass *m* of steam at 100°*C* is to be passed into a vessel containing 10*g* of ice and 100*g* of water at 0°*C* so that all the ice is melted and the temperature is raised to5°*C*. Neglecting heat absorbed by the vessel, we get

(a) *m* = 2.1*g* (b) *m* = 4.2*g* (c) *m* = 6.3*g* (d) *m* = 8.4*g*

49. A ball of thermal capacity 10 *cal/°C* is heated to the temperature of furnace. It is then transferred into a vessel containing water. The water equivalent of vessel and the contents is 200 *gm*. The temperature of the vessel and its contents rises from 10°*C* to 40°*C*. What is the temperature of furnace

(a) 640°*C* (b) 64°*C* (c) 600°*C* (d) 100°*C*

▶▶ *Advance level*

50. 10 g of ice at $-20°C$ is dropped into a calorimeter containing 10 g of water at $10°C$. The specific heat of water is twice that of ice. When equilibrium is reached, the calorimeter will contain

(a) 10 g of ice and 10 g water (b) 20 g water

(c) 5 g ice and 15 g water (d) 20 g ice

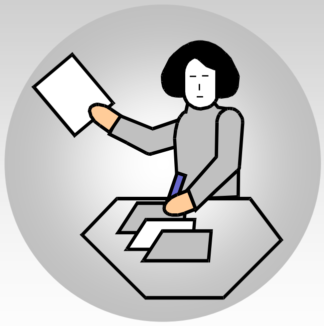
51. Three liquids of equal volumes are thoroughly mixed. If their specific heats are s_1, s_2, s_3 and their temperatures $\theta_1, \theta_2, \theta_3$ and their densities d_1, d_2, d_3 respectively, then the final temperature of the mixture is

(a) $\dfrac{s_1\theta_1 + s_2\theta_2 + s_3\theta_3}{d_1 s_1 + d_2 s_2 + d_3 s_3}$ (b) $\dfrac{d_1 s_1\theta_1 + d_2 s_2\theta_2 + d_3 s_3\theta_3}{d_1 s_1 + d_2 s_2 + d_3 s_3}$

(c) $\dfrac{d_1 s_1\theta_1 + d_2 s_2\theta_2 + d_3 s_3\theta_3}{d_1\theta_1 + d_2\theta_2 + d_3\theta_3}$ (d) $\dfrac{d_1\theta_1 + d_2\theta_2 + d_3\theta_3}{s_1\theta_1 + s_2\theta_2 + s_3\theta_3}$

52. Equal masses of three liquids A, B and C have temperatures $10°C$, $25°C$ and $40°C$ respectively. If A and B are mixed, the mixture has a temperature of $15°C$. If B and C are mixed, the mixture has a temperature of $30°C$. If A and C are mixed, the mixture will have a temperature of

(a) $16°C$ (b) $20°C$ (c) $25°C$ (d) $29°C$



Answer Sheet (Practice problems)

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**
b	a	d	a	c	a	c	a	b	c
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
a	d	d	b, c	b	c	c	b	c	c
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
c	a	c	b, c	c, d	d	d	b	d	b
31.	**32.**	**33.**	**34.**	**35.**	**36.**	**37.**	**38.**	**39.**	**40.**
c	a, c	b	a	a	b, c	b	c	c	a
41.	**42.**	**43.**	**44.**	**45.**	**46.**	**47.**	**48.**	**49.**	**50.**
c	c	a	a	b	d	d	a	a	a
51.	**52.**								
b	a								