PHYSICS

BOOKS - DISHA PHYSICS (HINGLISH)

THERMAL PROPERTIES OF MATTER

Others

1. The total radiant energy per unit area, normal to the direction of incidence, received at a distance R from the centre of a star of

radius r whose outer surface radiates as a black body at a temperature TK is given by (where σ is Stefan's constant)

A. $\frac{\sigma r^2 T^4}{R^2}$

B. $\frac{\sigma r^2 T^4}{4\pi r^2}$

C. $\frac{\sigma r^4 T^4}{r^4}$

D. $\frac{4\pi\sigma r^2 T^4}{R^2}$

Answer:

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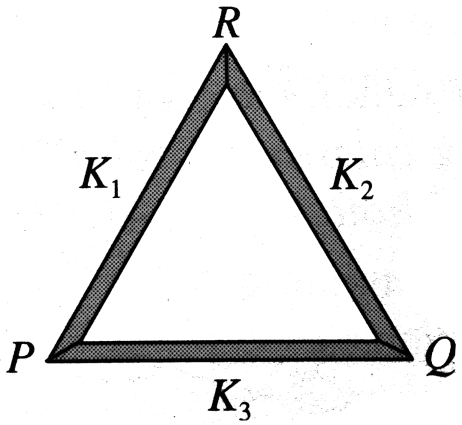

2.

Three rods of same dimensions are arranged as shown in Fig. They have thermal conductivities K_1,K_2 and K_3. The points P and Q are maintained at different temeperature for the heat to flow at the same rate along PRQ and PQ. Whi of the following options correct?

A. $K_3 = \frac{1}{2}(K_1 + K_2)$

B. $K_3 = K_1 + K_2$

C. $K_3 = \frac{K_1 K_2}{K_1 + K_2}$

D. $K_3 = -2(K_1 + K_2)$

Answer:

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3. The sprinkling of wate slightly reduces the temperature of a closed room because

A. temperature of water is less than that of the room

B. specific heat of water is high

C. water has large latent heat of vaporisation

D. water is a bad conductor of heat

Answer:

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4. The specific heat capacity of a metal at low temperature (T) is given as

$$C_p\left(kJK^{-1}kg^{-1}\right) = 32\left(\frac{T}{400}\right)^3$$

A 100 gram vessel of this metal is to be cooled from $20^\circ K$ to $4^\circ K$ by a special refrigerator operating at room temperaturte $(27^\circ C)$. The amount of work required to cool the vessel is

A. grater than 0.148kJ

B. between 0.148kJ and 0.028kJ

C. less than 0.028 kJ

D. equal to 0.002 kJ

Answer:

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5. The emissive power of a black body at $T = 300K$ is $100Wa/m^2$ consider a body B of area $A = 10m^2$ coefficient of reflectivity $r = 0.3$ and coefficient of transmission $t = 0.5$ its temperature is 300 K. then which of the followin is correct:

A. The emissive power of B is $20\ \mathrm{W/m^2}$

B. The emissive power of B is $200\ \mathrm{W/m^2}$

C. The power emitted by B is 200 Watts

D. The emissivity of B is 0.2

Answer:

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6. A solid cube and a solid sphere of the same material have equal surface area. Both are at the same temperature $120^\circ C$, then

A. both the cube and the sphere cool down at the same rate

B. the cube cools down faster than the sphere

C. the sphere cools down faster than the cube

D. whichever is having more mass will cool down faster

Answer:

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7. The density of water at $20^\circ \mathrm{C}$ is $998\ \mathrm{kg/m^3}$ and at $40^\circ \mathrm{C}$ $992\ \mathrm{kg/m^3}$. The coefficient of volume expansion of water is

A. $10^{-4}/^\circ \mathrm{C}$

B. $3 \times 10^{-4}/^\circ \mathrm{C}$

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

D. $6 \times 10^{-4}/^\circ \mathrm{C}$

Answer:

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8. A metallic rod l cm long, A square cm in cross-section is heated through $t^{\circ}\mathrm{C}$. If Young's modulus of elasticity of the metal is E and the mean coefficient of linear expansion is α per degree celsius, then the compressional force required to prevent the rod from expanding along its length is

A. $EA\alpha t$

B. $EA\alpha t/(1+\alpha t)$

C. $EA\alpha t/(1-\alpha t)$

D. $El\alpha t$

Answer:

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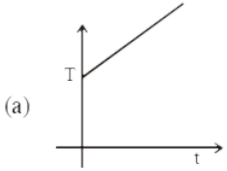
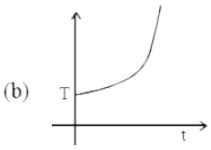
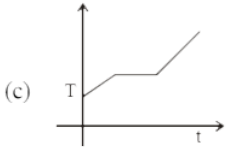
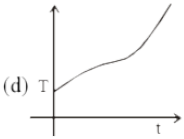
9. If liquefied oxygen at 1 atmospheric pressure is heated from 50K to 300k by supplying heat at constant rate. The graph of temperature vs time will be

A. 

B. 

C. 

D. 

Answer:

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10. If a bar is made of copper whose coefficient of linear expansion is one and a half times that of iron, the ratio of force developed in the copper bar to the iron bar of identical lengths and cross-sections, when heated through the same temperature range (Young's modulus of copper may be taken to be equal to that of iron) is

A. $3/2$

B. $2/3$

C. $9/4$

D. $4/9$

Answer:

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11. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absobed by the ice and all energy of ice gets converted into heat during its fall. The value of h is

[Latent heat of ice is $3.4 \times 10^5 J/kg$ and $g = 10N/kg$]

A. 34km

B. 544km

C. 136km

D. 68km

Answer:

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12. A body of mass 5 kg falls from a height of 20 metres on the ground and it rebounds to a height of 0.2 m. If the loss in potential energy is used up by the body, then what will be the temperature rise? $\left(\text{specific heat of material} = 0.09 \text{ cal gm}^{-1\circ}\text{C}^{-1}\right)$

A. 0°C

B. 4°C

C. 8°C

D. none of these

Answer:

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13. Two straight metallic strips each of thickness t and length l are rivetted together. Their coefficients of linear expansions are $\alpha_1 \text{and} \alpha_2$. If they are heated through temperature ΔT, the bimetallic strip will bend to form an arc of radius

A. $t/\{(\alpha_1 + \alpha_2)\Delta T\}$

B. $t/\{(\alpha_2 - \alpha_1)\Delta T\}$

C. $t(\alpha_1 - \alpha_2)\Delta T$

D. $t(\alpha_2 + \alpha_1)\Delta T$

Answer:

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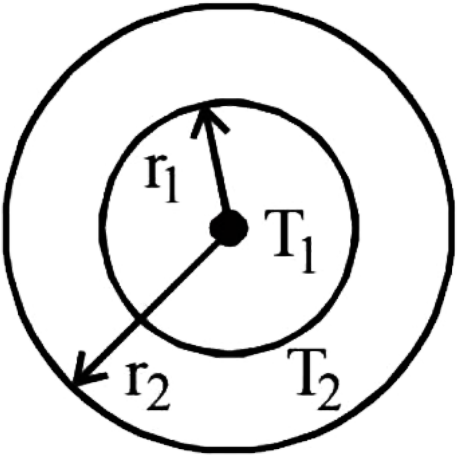
14. The figure shows a system of two concentric spheres of radii r_1 and r_2 are kept at temperature T_1 and T_2, respectively. The radial rate of flow of heat in a substance

between the two concentric spheres is proportional to



A. $\ln\left(\frac{r_2}{r_1}\right)$

B. $\frac{(r_2 - r_1)}{r_2 r_1}$

C. $r_2 - r_1$

D. $\frac{r_1 r_2}{(r_2 - r_1)}$

Answer:

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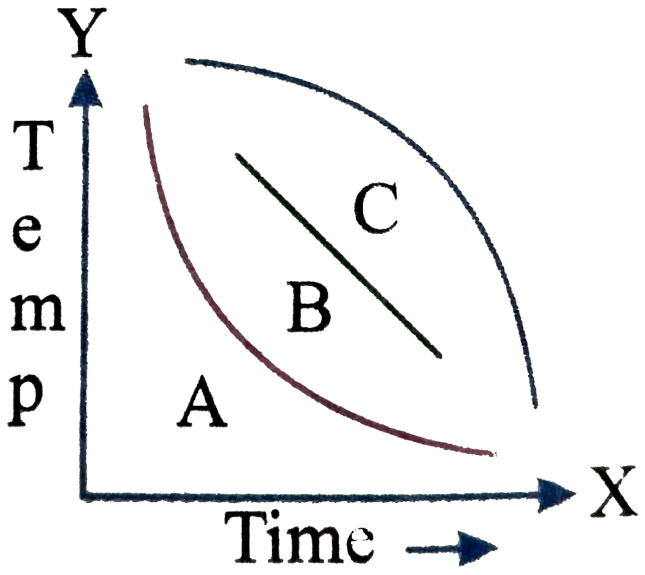
15. A block of steel heated to $100^{\circ} C$ is left in a room to cool Which of the curves shown in the represents the correct behaviour



A. A

B. B

C. C

D. none of these

Answer:

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16. Which of the following will expand the most for same rise in temperature?

A. Aluminium

B. Glass

C. Wood

D. All will expand same

Answer:

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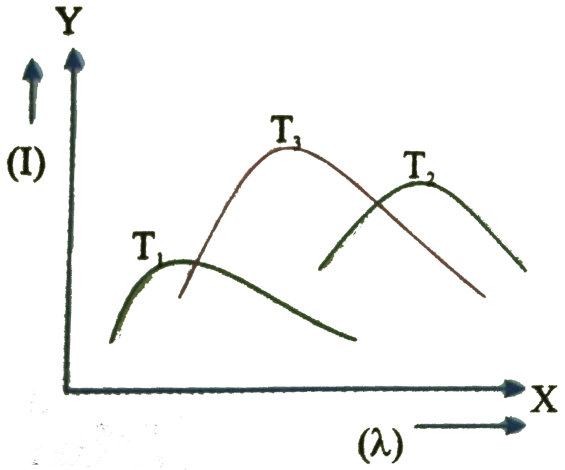
17. The plots of intensity versus wavelength for three black bodies at temperatures T_1, T_2 and T_3 respectively are shown in Their

temperatures are shown in How their temperatures are related ?



A. $T_1 > T_2 > T_3$

B. $T_1 > T_3 > T_2$

C. $T_2 > T_3 > T_1$

D. $T_3 > T_2 > T_1$

Answer:

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18. When the temperature of a rod increases from t to $r + \Delta t$, its moment of inertia increases from I to $I + \Delta I$. If α is the value of $\Delta I / I$ is

A. $2\alpha\Delta t$

B. $\alpha\Delta t$

C. $\frac{\alpha\Delta t}{2}$

D. $\frac{\Delta t}{\alpha}$

Answer:

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19. Two rods, one of aluminium and other made of steel, having initial lengths l_1 and l_2 are connected together to form a single rod of length $(l_1 + l_2)$. The coefficient of linear expansions for aluminium and steel are α_a and α_s respectively. If length of each rod

increases by same amount when their tempertures are raised by $t^{\circ}C$, then find the ratio $l_1(l_1 + l_2)$.

A. α_s / α_a

B. α_a / α_s

C. $\alpha_s / (\alpha_a + \alpha_s)$

D. $\alpha_a / (\alpha_a + \alpha_s)$

Answer:

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20. A polished metal plate with a rough black spot on it is heated to about $1400K$ and quickly taken into dark room Then .

A. The spot will appear brighter than the plate

B. The spot will appear darker than the plate

C. The spot and plate will appear equally bright

D. The spot and the plate will not be visible in the dark room

Answer:

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21. On observing light from three different stars P, Q and R, it was found that intensity of violet colour is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red

colour is maximum in the spectrum of Q. if T_P, T_Q and T_R are respective absolute temperature of P, Q and R. then it can be concluded from the above observation that

A. $T_P > T_R > T_Q$

B. $T_P < T_R < T_Q$

C. $T_P < T_Q < T_R$

D. $T_P > T_Q > T_R$

Answer:

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22. A partition wall has two layers of different materials A and B in contact with each other. They have the same thickness but the thermal conductivity of layer A is twice that of layer B. At steady state the temperature difference across the layer B is 50 K, then the corresponding difference across the layer A is

A. 50K

B. 12.5K

C. 25K

D. 60K

Answer:

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23. Which of the following statements is/are false about mode of heat transfer?

A. In radiation, heat is transfered from one medium to another without affecting the intervening medium

B. Radiation and convection are possible in vaccum while conduction requires material medium.

C. Conduction is possible in solids while convection occurs in liquids and gases.

D. All are correct

Answer:

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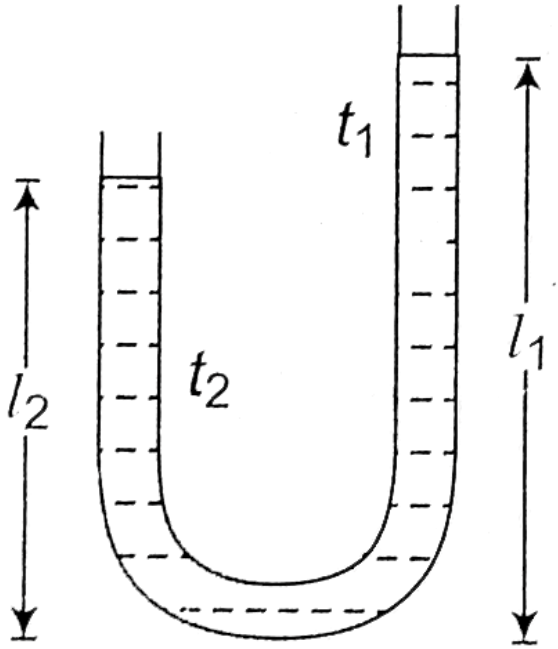
24. In a vertical U-tube containing a luquid, the two arms are maintained at different temperatures, t_1 and t_2 . The liquid coplumns in the two arms have heights l_1 and l_2 respectively. The coefficient of volume

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. $\frac{l_1 + l_2}{l_1 t_1 + l_2 t_2}$

Answer:

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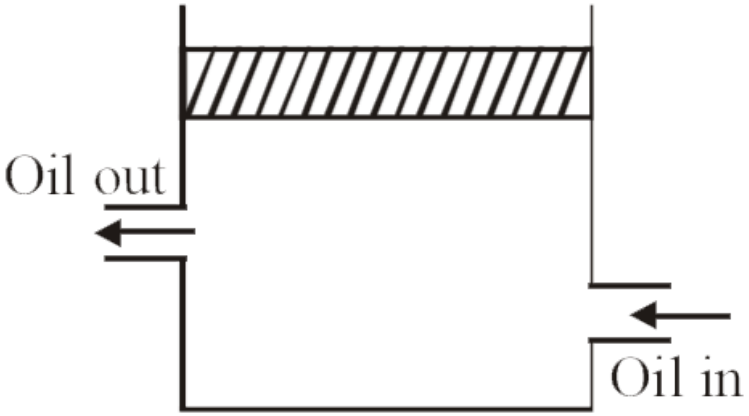
25. The top of an insulated cylindrical container is covered by a disc having emissivity 0.6 and conductivity 0.167 $\mathrm{WK}^{-1}m^{-1}$ and thickness 1 cm. The temperature is maintained by circulating oil as shown in figure. Find the radiation loss to the

surrounding in $\mathrm{Jm}^{-2}s^{-1}$ if temperature of the upper surface of the disc is $27^{\circ}\mathrm{C}$ and temperature of the surrounding is $27^{\circ}\mathrm{C}$.



A. $595\mathrm{Jm}^{-2}\mathrm{s}^{-1}$

B. $5545\mathrm{Jm}^{-2}\mathrm{s}^{-1}$

C. $495\mathrm{Jm}^{-2}\mathrm{s}^{-1}$

D. none of these

Answer:

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26. Wien's law is concerned with

A. relation between emissivity and absorptivity of a radiating surface

B. total radiation, emitted by a hot surface

C. an expression for spectral distribution of energy of a radiation from any source

D. a relation between the temperature of a black body and the wavelength at which there is maximum radiant energy per unit wavelength

Answer:

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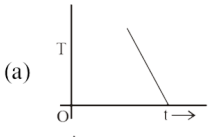
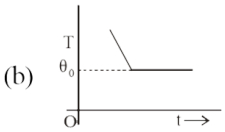
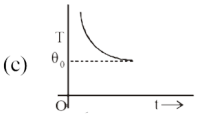
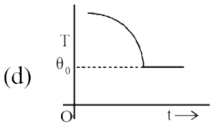
27. If a piece of metal is heated to temperature θ and the allowed to cool in a room which is at temperature θ_0, the graph between the

temperature T of the metal and time t will be closet to

A. 

B. 

C. 

D. 

Answer:

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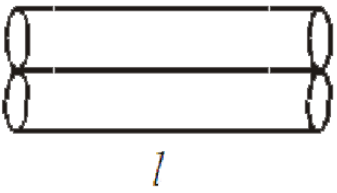
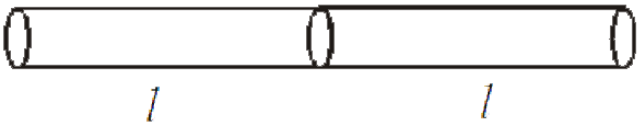
28. Two rods of same length and transfer a given amount of heat 12 second, when they are joined as shown in figure (i). But when they are joined as shwon in figure (ii), then they will transfer same heat in same conditions in





A. 24s

B. 13s

C. 15s

D. 48s

Answer:

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29. Consider a compound slab consisting of two different material having equal thickness and thermal conductivities K and $2K$

respectively. The equivalent thermal conductivity of the slab is

A. $\frac{4}{3}K$

B. $\frac{2}{3}K$

C. $\sqrt{3}K$

D. $3K$

Answer:

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30. The coefficient of thermal conductivity of copper, mercury and glass are respectively K_c, K_m and K_g that $K_c > K_m > K_g$. If the same quantity of heat is to flow per second per unit of each and corresponding temperature gradients are X_c, X_m and X_g, then

A. $X_c = X_m = X_g$

B. $X_c > X_m > X_g$

C. $X_c < X_m < X_g$

D. $X_m < X_c < X_g$

Answer:

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31. The radiation energy density per unit wavelength at a temperature T has a maximum at a wavelength λ_0. At temperature 2T, it will have a maximum wavelength

A. $4\lambda_0$

B. $2\lambda_0$

C. $\frac{\lambda_0}{2}$

D. $\frac{\lambda_0}{4}$

Answer:

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32. Assuming the Sun to be a spherical body of radius R at a temperature of TK, evaluate the total radiant powered incident of Earth at a distance r from the sun

where r_0 is the radius of the Earth and σ is Stefan's constant.

A. $4\pi r_0^2 R^2 \sigma \frac{T^4}{r^2}$

B. $\pi r_0^2 R^2 \sigma \frac{T^4}{r^2}$

C. $r_0^2 R^2 \sigma \frac{T^4}{4\pi r^2}$

D. $R^2 \sigma \frac{T^4}{r^2}$

Answer:

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33. A metal ball immersed in alcohol weights W_1 at $0^\circ C$ and W_2 at $50^\circ C$. The coefficient of expansion of cubical the metal is less than that of the alcohol. Assuming that the density of the metal is large compared to that of alcohol, it can be shown that

A. $W_1 > W_2$

B. $W_1 = W_2$

C. $W_1 < W_2$

D. $W_1 = (W_2/2)$

Answer:

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34. One end of thermally insulated rod is kept at a temperature T_1 and the other at T_2. The rod is composed of two section of length l_1 and l_2 thermal conductivities k_1 and k_2 respectively. The temerature at the interface of two section is

A. $\frac{(K_1 l_1 T_1 + K_2 l_2 T_2)}{(K_1 l_1 + K_2 l_2)}$

B. $\frac{(K_2 l_2 T_1 + K_1 l_1 T_2)}{(K_1 l_1 + K_2 l_2)}$

C. $\frac{(K_2 l_1 T_1 + K_1 l_2 T_2)}{(K_2 l_1 + K_1 l_2)}$

D. $\frac{(K_1 l_2 T_1 + K_2 l_1 T_2)}{(K_1 l_2 + K_2 l_1)}$

Answer:

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35. Two spheres of different materials one with double the radius and one-fourth wall thickness of the other are filled with ice. If the time taken for complete melting of ice in the

larger sphere is 25 minutes and for smaller one is 16 minutes, the ratio of thermal conductivities of the materials of larger sphere to that of smaller sphere is:

A. $4:5$

B. $5:4$

C. $25:8$

D. $8:25$

Answer:

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36. A black body has maximum wavelength λ_m at temperature $2000K$. Its corresponding wavelength at temperature 3000 will be

A. $\frac{3}{2}\lambda_m$

B. $\frac{2}{3}\lambda_m$

C. $\frac{4}{9}\lambda_m$

D. $\frac{9}{4}\lambda_m$

Answer:

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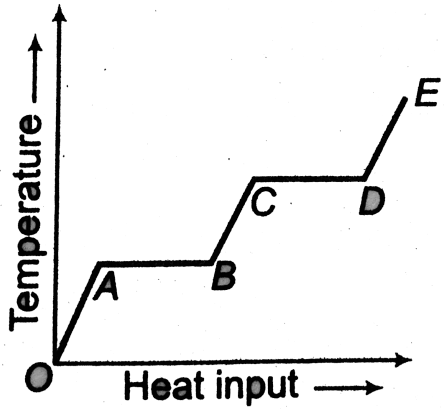
37. A solid material is supplied heat at a constant rate. The temperature of material is changing with heat input as shown in the figure. What does the slope of DE represent ?



A. AB and CD of the graph represent phase changes

B. AB represents the change of state from solid to liquid

C. latent heat of fusion is twice the latent heat of vaporization

D. CD represents change of state from liquid to vapour

Answer:

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38. 10 gm of ice cubes at $0^\circ \mathrm{C}$ are released in a tumbler (water equivalent 55 g) at $40^\circ \mathrm{C}$. Assuming that negligible heat is taken from the surroundings, the temperature of water in the tumbler becomes nearly$(\mathrm{L} = 80\ \mathrm{cal/g})$

A. $31^\circ \mathrm{C}$

B. $22^\circ \mathrm{C}$

C. $19^\circ \mathrm{C}$

D. $15^\circ \mathrm{C}$

Answer:

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39. In a surrounding medium of temperature $10^{\circ}\mathrm{C}$, a body takes 7 min for a fall of temperature from $60^{\circ}\mathrm{C}$ to $40^{\circ}\mathrm{C}$. In what time the temperature of the body will fall from $40^{\circ}\mathrm{C}$ to $28^{\circ}\mathrm{C}$

A. 7 min

B. 11 min

C. 14 min

D. 21 min

Answer:

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40. Two rods of same length and area of cross-section A_1 and A_2 have their ends at the same temperature. If K_1 and K_2 are their thermal conductivities, c_1 and c_2 are their specific heats and d_1 and d_2 are their

densities, then the rate of flow of heat is the same in both the rods if

A. $\frac{A_1}{A_2} = \frac{-k_1}{k_2}$

B. $\frac{A_1}{A_2} = \frac{k_1 c_1 d_1}{k_2 c_2 d_2}$

C. $\frac{A_1}{A_2} = \frac{k_2 c_1 d_1}{c_2 d_2 k_1}$

D. $\frac{A_1}{A_2} = \frac{k_2}{k_1}$

Answer:

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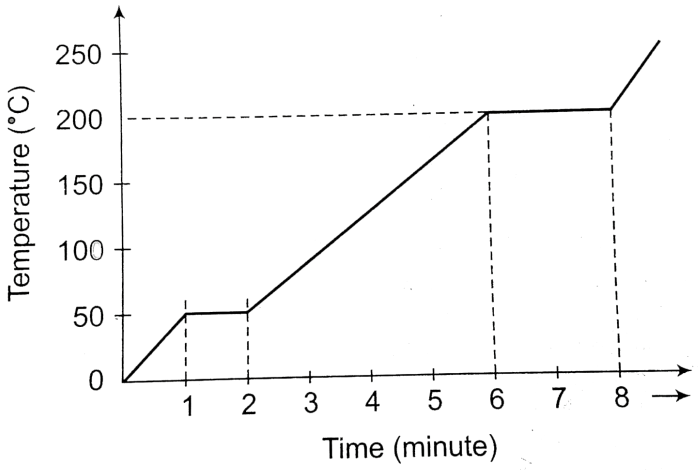

41.

A student takes 50 g wax (specific heat $= 0.6 kcal/kg^\circ C$) 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. $500 cal, 50^\circ C$

B. $1000 cal, 100^\circ C$

C. $1500cal, 200^\circ C$

D. $1000cal, 200^\circ C$

Answer:

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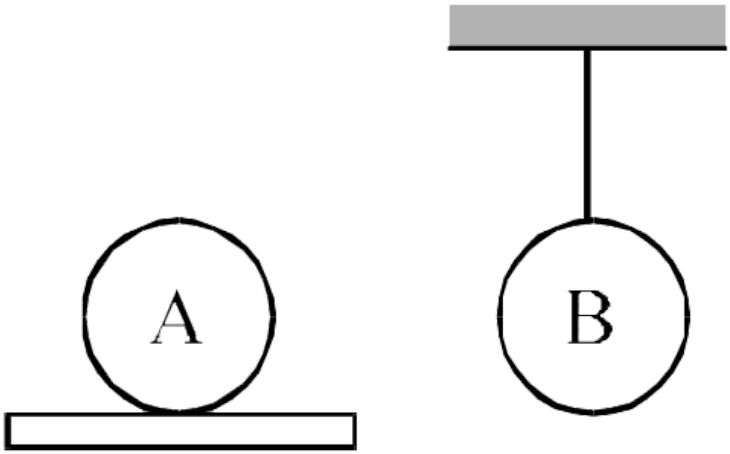
42. Consider two identical iron spheres , one which lie on a thermally insulating plate, while the other hangs from an insulatory thread. Equal amount of heat is supplied to the two

spheres, then



A. temperature of A will be greater than B

B. temperature of B will be greater than A

C. their temperature will be equal

D. can't be predicted

Answer:

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43. Stream at $100^\circ C$ is passed into 20 g of water at $10^\circ C$. When water acquires a temperature of $80^\circ C$, the mass of water present will be [Take specific heat of water $= 1 cal g^{-1}.^\circ C^{-1}$ and latent heat of steam $= 540 cal g^{-1}$]

A. 24g

B. 31.5g

C. 42.5g

D. 22.5g

Answer:

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44. Two solid spheres of radii R_1 and R_2 are made of the same material and have similar surfaces. These are raised to the same temperature and then allowed to cool under identical conditions. The ratio of their initial rates of loss of heat are

A. R_1^2 / R_2^2

B. R_1 / R_2

C. R_2 / R_1

D. R_2^2 / R_1^2

Answer:

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