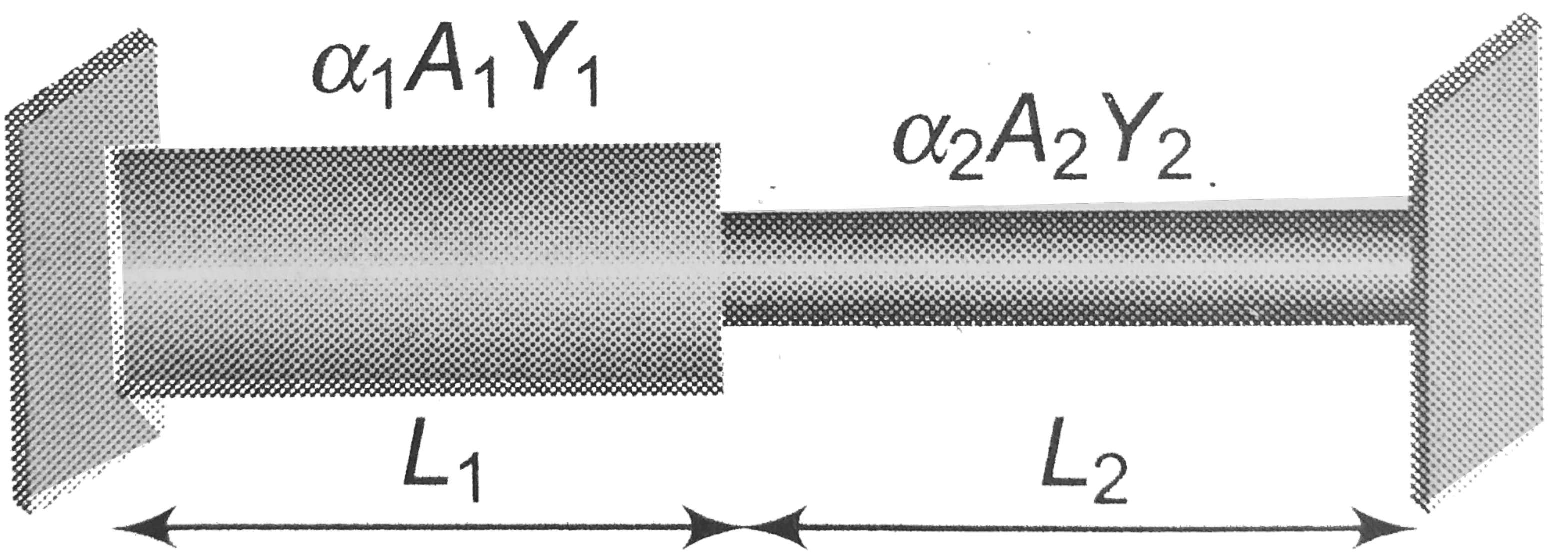
Q-1 - 11749616

Two rods are joined between fixed supports as shown in the figure. Condition for no change in the length of individual rods with the increase of temperature will be

($\alpha_1, \alpha_2 =$ linear expansion coefficient

$A_1, A_2 =$ Area of rods

$Y_1, Y_2 =$ Young modulus)



(A) $\dfrac{A_1}{A_2} = \dfrac{\alpha_1 Y_1}{\alpha_2 Y_2}$

(B) $\frac{A_1}{A_2} = \frac{L_1\alpha_1 Y_1}{L_2\alpha_2 Y_2}$

(C) $\frac{A_1}{A_2} = \frac{L_2\alpha_2 Y_2}{L_1\alpha_1 Y_1}$

(D) $\frac{A_1}{A_2} = \frac{\alpha_2 Y_2}{\alpha_1 Y_1}$

CORRECT ANSWER: D

SOLUTION:

$$Y = \frac{\text{Stress}}{\text{strain}} = \frac{T/A}{\Delta l/l}$$

$$T = \frac{Y \cdot \Delta l}{l} A = Y \cdot A\alpha\Delta T$$

In both the rods tension will be same so

$T_1 = T_2,$ Hence,

$Y_1 A_1 \alpha_1 \Delta T = Y_2 A_2 \alpha_2 \Delta T$

$$\frac{A_1}{A_2} = \frac{Y_2\alpha_2}{Y_1\alpha_1}.$$

Q-2 - 13076310

A uniform metal rod of length L and mass M is rotating about an axis passing throuth one of the ends perpendicular to the rod with angular speed ω. If the temperature increases by t^C then the change in its angular velocity is proportional to which of the following ? (Coefficient of linear expansion of rod $= \alpha$)

(A) $\sqrt{\omega}$

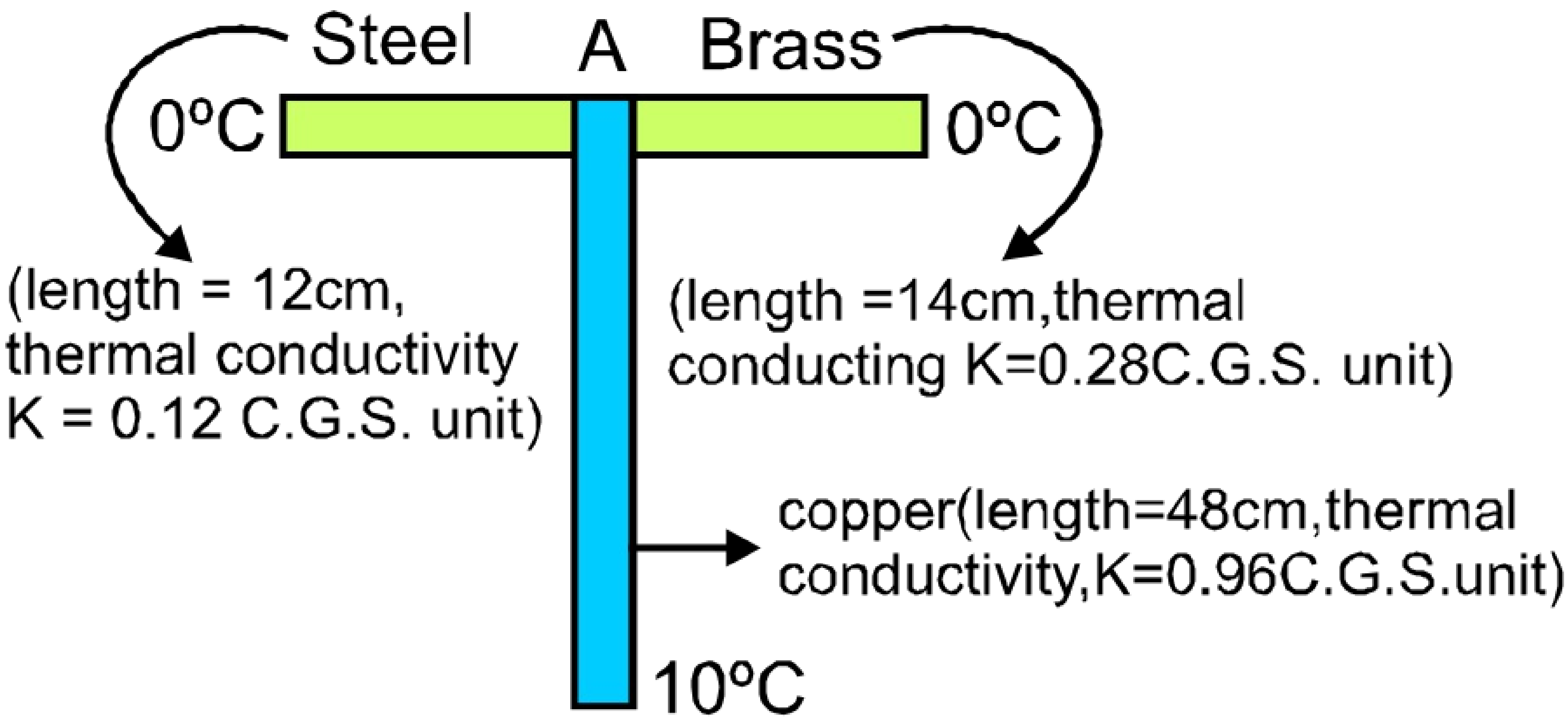
(B) ω

(C) ω^2

(D) $1/\omega$

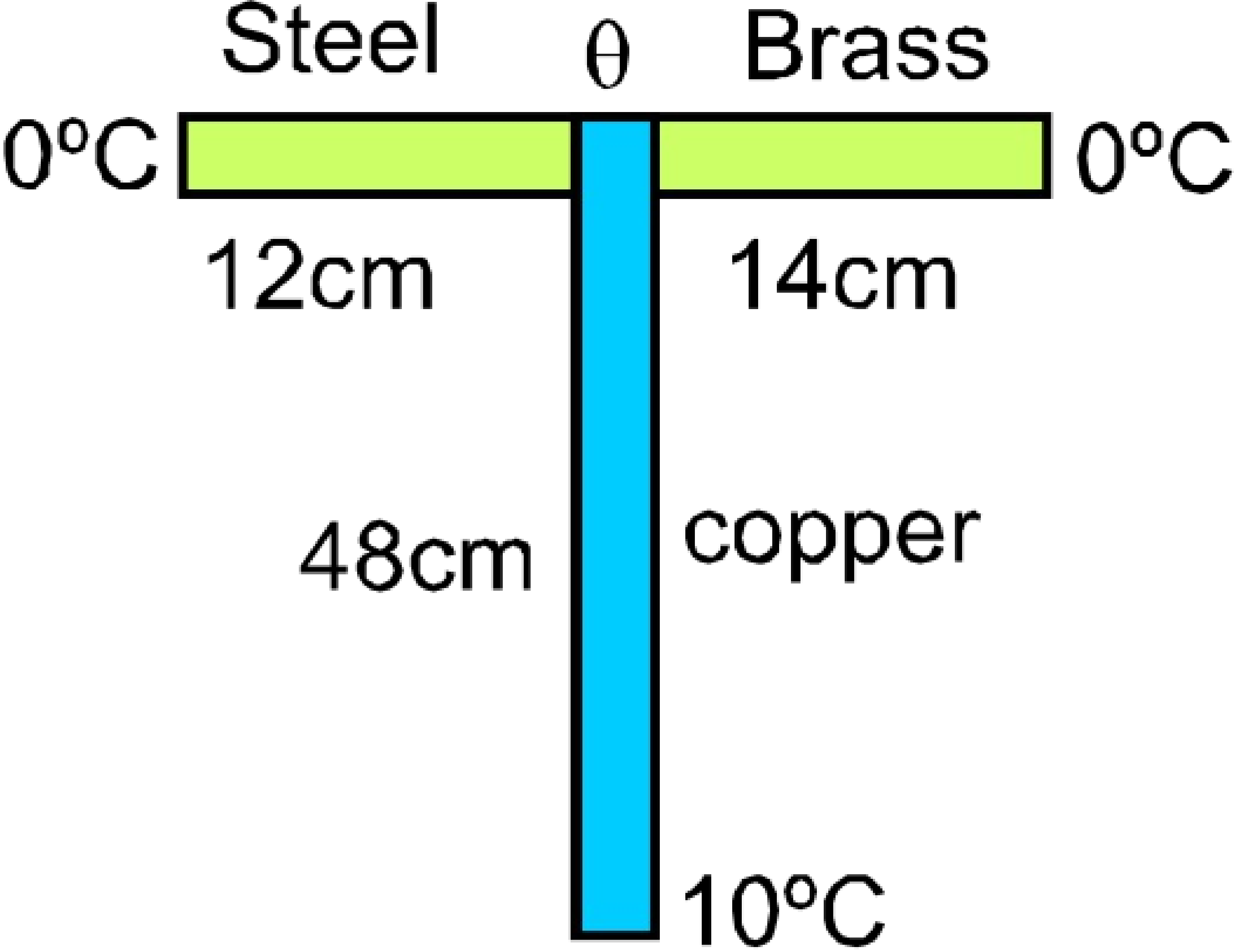
CORRECT ANSWER: B

Q-3 - 11805008



Three rods of copper, brass and steel are joined together to form T shape as shown in figure. The cross sectional area of each rod is $4cm^2$ the end of copper rod is maintained at $10C$ and the ends of brass and steel rods at $0C$ assume there is no loss of heat to surrounding. What is temperature of junction point A in . C

SOLUTION:



$$i = i_i + i_2$$

$$= \frac{0.96 \times 4 \times (10 - \theta)}{48}$$

$$= \frac{0.28 \times 4(\theta - 0)}{14}$$

$$+ \frac{0.12 \times 4 \times (\theta - 0)}{12}$$

$$0.02(10 - \theta) = 0.02\theta$$
$$+ 0.019$$

$$\theta = 4C$$

Q-4 - 11445837

An iron tyre is to be fitted onto a wooden wheel 1.0 m in diameter. The diameter of the tyre is 6 mm smaller than that of wheel the tyre should be heated so that its temperature increases by a minimum of (coefficient of volume expansion of iron is $3.6 \times 10^{-5} /^{C}$)

(A) $167^{\circ} C$

(B) $334^{\circ} C$

(C) $500^{\circ} C$

(D) $1000^{\circ} C$

CORRECT ANSWER: C

SOLUTION:

Initial diameter of tyre $= (100 - 6) mm, = 994 mm,$

so initial radius of tyre

$$R = \frac{994}{2} = 497mm$$

and change in diameter $\Delta D = 6mm$, so

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

Given that after increasing temperature by ΔT tyre will

fit onto wheel Increment in the length (circumference) of

the iron tyre

$$\Delta L = L \times \alpha \times \Delta T$$
$$= L \times \frac{\gamma}{3} \times \Delta T$$

$$\left(As \alpha = \frac{\gamma}{3}\right)$$
$$\Rightarrow 2\pi R = 2\pi R\left(\frac{\gamma}{3}\right)$$

$$\Delta T$$

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

[As $\Delta R = 3$ mm and $R = 497$ mm]

$\Rightarrow \Delta = 500^{C}$

Watch Video Solution On Doubtnut App

Q-5 - 13162964

Volume of the bulb of a mercury thermometer at $0C$ is V and area of cross section of the capillary tube is A_0, coefficient of linear expansion of glass is α_g, and the cubical expansion of mercury is γ_m. If the mercury fills the bulb at $0C$, find the length of mercury column in thermometer at TC

SOLUTION:

Expansion of mercury $= V_0 \gamma_m T$

Expansion in glass bulb $= V_0 3\alpha_g T$

Apparent expanion in mercury

$= V_0 \gamma_m T - V_0 3\alpha T$, i.e., $A_t l = V_0 T(\gamma_m - 3\alpha_g)$

$$l = \frac{V_0 T(\gamma_m - 3\alpha_g)}{A_t}$$

$$= \frac{V_0 T(\gamma_m - 3\alpha_g)}{A_0(1 + \gamma_g T)}($$

$$\therefore A_0 = A_t)$$

Watch Video Solution On Doubtnut App

Q-6 - 11445913

A glass cylinder contains $m_0 = 100g$ of mercury at a temperature of $t_0 = 0^C$. When temperature becomes $t_1 = 20^C$ the cylinder contains $m_1 = 99.7g$ of mercury The coefficient of volume expansion of mercury $\gamma_{He} = 18 \times (10^{-5} / C$ Assume that the temperature of the mercury is equal to that of the cylinder. The corfficient of linear expansion of glass α is

(A) $10^{-5} / {}^\circ C$

(B) $2 \times 10^{-5} / {}^\circ C$

(C) $3 \times 10^{-5} / ^\circ C$

(D) $6 \times 10^{-5} / ^\circ C$

CORRECT ANSWER: A

SOLUTION:

When the cylinder is heated its volume increases as

$V_t = V_0(1 + \gamma'_g t)$ ..(i)

If the densities of mercury at the temperatures t_0 and t_1

are denoted by ρ_0 and ρ_1

$m_0 = V_0\rho_0$ and $m_1 = V_1\rho_1$ (ii)

$m_t = m_0$

$\rho_t = \frac{\rho_0}{(1 + \gamma_{hg} t)}$.(iii)

γ_{glass}

$= \frac{m_t(1 + \gamma_{Hg} t_t) - m_0}{m_0 t_0}$

$$= \frac{99.7(1 + 18 \times 10^{-5} \times 20) - 100}{100 \times 20}$$

$$= 2.946 \times 10^{-5} / C$$

The coefficient of linear expansion of glass

$$\alpha_{\text{glass}} = \frac{\gamma_{\text{glass}}}{3} = 10^{-5} / C$$

Watch Video Solution On Doubtnut App

Q-7 - 10966000

Two marks on a glass rod $10cm$ apart are found to increase their distance by $0.08mm$ when the rod is heated from 0^{C}to100^{C}. A flask made of the same glass as that of rod measures a volume of $100at0^{C}$. The volume it measures at 100^{C} in (cc) is.

(A) 100.24

(B) 100.12

(C) 100.36

(D) 100.48

CORRECT ANSWER: A

SOLUTION:

$$(\Delta l) = (l\alpha\Delta\theta)$$

$$\therefore \alpha = \frac{\Delta l}{l\Delta\theta}$$

$$= \frac{0.008}{(10)(100)} = 8$$

$$\times 10^{-6} per^{C}$$

$$\gamma = 3\alpha = 2.4$$

$$\times 10^{-5} per^{C}$$

$$\Delta V = V\gamma\Delta\theta$$

$$= (100)\left(2.4\right.$$

$$\left.\times 10^{-5}\right)(100)$$

= 0.24

$$\therefore V' = V + \Delta V$$

$$= 100.24cc$$

.

Watch Video Solution On Doubtnut App

Q-8 - 13162999

The apparent coefficient of expansion of liquid, when heated a copper vessel is C and when heated in a silver vessel is S. If A is the linear coefficient of expansion of Copper, linear expansion coefficient of silver is

(A) $\dfrac{C+S-3A}{3}$

(B) $\dfrac{C+3A-S}{3}$

(C) $\dfrac{S+3A-C}{3}$

(D) $\dfrac{C+S+3A}{3}$

CORRECT ANSWER: B

SOLUTION:

For copper vessel $\gamma_R = (\gamma_A)_c + 3\alpha_c$

For silver vessel $\gamma_R = (\gamma_A)_s + 3\alpha_s$

Q-9 - 13162995

A liquid with coefficient of real volume expansion (γ) is filled in vessel of coefficient of linear expansion $\dfrac{\gamma}{3}$. When the systeam is heated then.

a) The volume of spece above liquid remains same.

b) The level of liquid relative to vessel reamins same.

c) The fraction of volume of liquid in vessel reamains same.

(A) Only (a) is correct

(B) Only b & c are correct

(C) Only (c) is true

(D) All are true

CORRECT ANSWER: D

Watch Video Solution On Doubtnut App

Q-10 - 30556355

At $50C$, a brass rod has a length 50 cm and a diameter 2 mm . It is joined to a steel rod of the same length and diameter at the same temperature . The change in the length of the composite rod when it is heated to $250C$ is (Coefficient of linear expansion of brass = $2.0 \times 10^{-5} C^{-1}$, coefficient of linear expansion of steel = $1.2 \times 10^{-5} C^{-1}$)

(A) 0.28 cm

(B) 0.30 cm

(C) 0.32 cm

(D) 0.34 cm

CORRECT ANSWER: C

SOLUTION:

Change in length of the brass rod is

$$\Delta L_b = \alpha_b L_b \Delta T$$
$$= 2.0 \times 10^{-5}.C^{-1} \times 50cm \times (250.C - 50.C)$$

$$= 0.2cm$$

Change in length of the steel rod is

$$\Delta L_S = \alpha_S L_S \Delta T$$

$$= 1.2 \times 10^{-5}. C^{-1} \times 50cm \times (250. C - 50C)$$

$$= 0.12cm$$

$\therefore$ Change in length of the combined rod

$$= \Delta L_b \times \Delta L_S$$
$$= 0.2cm + 0.12cm$$
$$= 0.32cm$$

Watch Video Solution On Doubtnut App

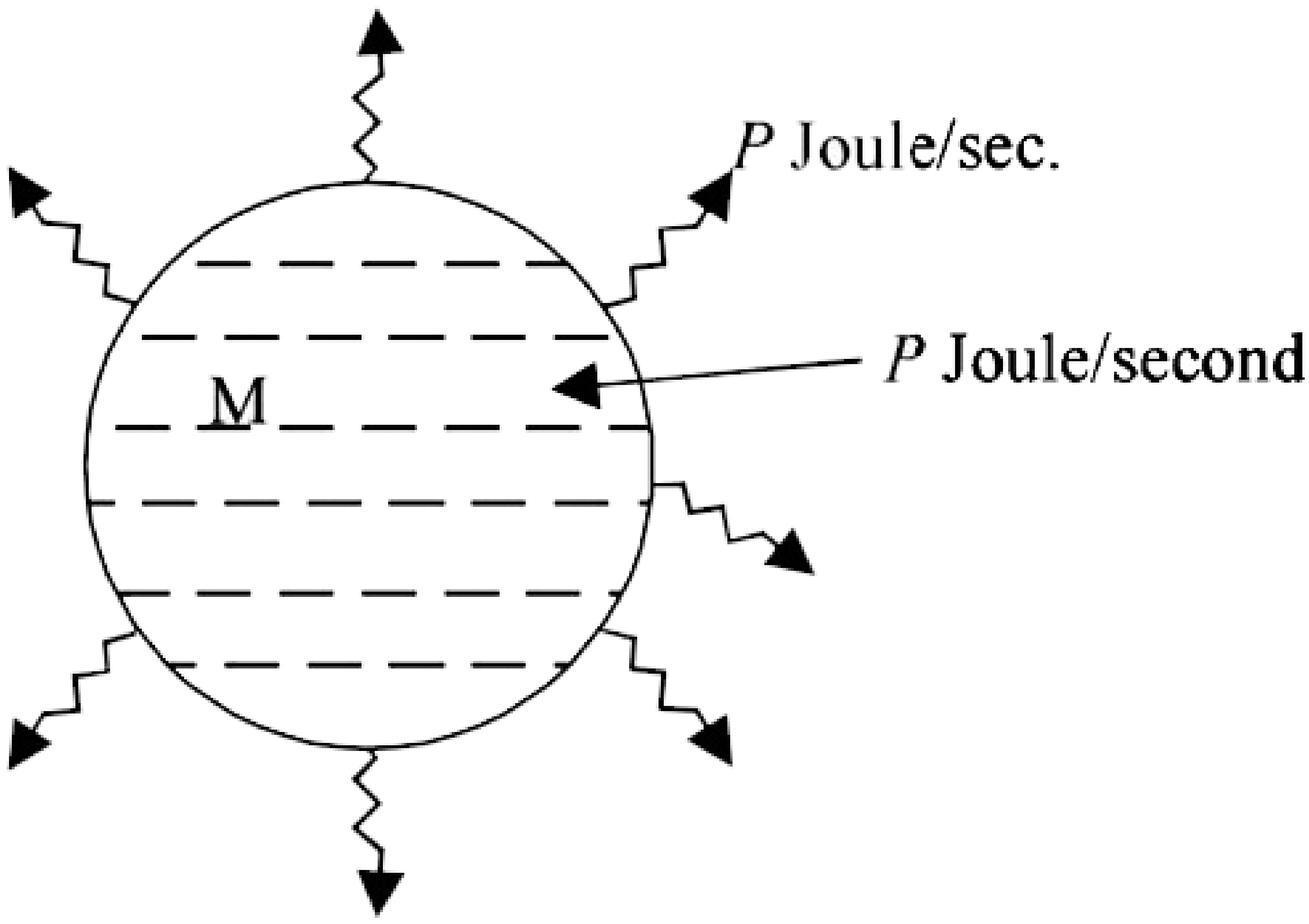
Q-11 - 10058977

A substance of mass M kg requires a power input of P wants to remain in the molten state at its melting point. When the power source is turned off, the sample completely solidifies in time t seconds. The latent heat of fussion of the substance is .

SOLUTION:

Since P jouls per second of heat is supplied to keep the substance in molten state, it means that the substance in the molten state at its melting point release P jouls of heat

in one second.



The power is turned off then the heat input becomes zero.

But heat output continues. It takes t seconds for the substance to solidify (given). Therefore total heat released

in

$$t \sec onds = P \times t$$
$$= mL_{fusion}$$

$$L_{fusion} = \frac{P \times t}{m}$$

Watch Video Solution On Doubtnut App

Q-12 - 18254180

The specific heat of a substance at temperature at tc is $s = at^2 + bt + c$. Calculate the amount of heat required to raise the temperature of m g of the substance from 0C to t_0C

(A) $\frac{mt_0^3 a}{3} + \frac{bt_0^2}{2} + ct_0$

(B) $\frac{mt_0^3 a}{3} + \frac{mbt_0^2}{2} + mct_0$

(C) $\frac{mt_0^3 a}{3} + \frac{mbt_0^2}{2}$

(D) None of these

SOLUTION:

$$\Delta H = \int msdt$$

$$= (m)\int_0^{t_0} (at^2 + bt$$

$$+ c)dt = m\left[\frac{at_0^3}{3}\right.$$

$$\left. + \frac{bt_0^2}{2} + ct_0\right]$$

Q-13 - 13074542

1 kg of ice at 0^C is mixed with 1 kg of steam at 100^C

(i) The equilibrium temperature is 100^C

(ii) The equilibrium temperature is 0^C

(iii) The contents of mixture are : 665 g steam, 1335 g water

(iv) The contents of mixture are 800 g steam, 1200 g water

(A) (i),(iii)

(B) (ii),(iii)

(C) (i),(iv)

(D) (ii),(iv)

CORRECT ANSWER: A

Q-14 - 11749546

A piece of ice of mass $50g$ exists at a temperature of $-20C$. Determine the total heart required to covert it completely to steam at $100C$. (Specific heat capacity of ice $= 0.5cal/g-C$, specific latent heat of fusion for ice $= 80cal/g$ and specific latent heat of vaporisation for water $= 540cal/g$).

(A) $26500cal$

(B) $12400 cal$

(C) $36500 cal$

(D) $46500 cal$

CORRECT ANSWER: C

SOLUTION:

For changing ice at $-20C$ to steam at $100C$ the complete process is achived in four different stages :

(i) The rise in temperature of ice from $-20C$ to $0C$ (i.e., melting point of ice).

Heat required for this process

$$\Delta Q_1 = (50g)(0.5cal/g - C)(0+20)C = 500cal$$

(ii) The melting of ice at 0

Heat required for this process

$\Delta Q_2 = (50g)(80cal$
$/g) = 4000cal$

(iii) The rise in temperature of melted ice (i.e. water) from

0 to $1000C$ (i.e., B.P of water)

Heat required for this process
$\Delta Q_3 = (50g)(1cal/$
$-C)(100C)$
$= 5000cal$

(iv) The vaporisation of water at $100C$

Heat required for this process
$\Delta Q_4 = (50g)(540cal$
$/g) = 27000cal$

$\therefore$ Total heat required
$\Delta Q = \Delta Q_1 + \Delta Q_2 +$
$\Delta Q_3 + \Delta Q_4$

$= 36500cal.$

Q-15 - 11749502

A small quantity mass m, of water at a temperature $\theta(\text{in}\quad C)$ is poured on to a larger mass M of ice which is at its melting point. If c is the specific heat capacity of water and L the specific heat capacity of water and L the specific latent heat of fusion of ice, then the mass of ice melted is give by

(A) $\frac{ML}{mc\theta}$

(B) $\frac{Mc\theta}{L}$

(C) $\frac{mc\theta}{ML}$

(D) $\frac{mc\theta}{L}$

CORRECT ANSWER: D

SOLUTION:

By the principal of mixture, heat given out by water =

heat absorbed by the melted ice

$$\Rightarrow mc(\theta - 0) = ML$$

$$\Rightarrow M = \frac{mc\theta}{L}$$

.

Watch Video Solution On Doubtnut App

Q-16 - 15085697

A refrigerator converts 1.3 kg of water at $20C$ into ice at $-15C$ in 1 hour. Calculate the effective power of the refrigerator. Specific latent heat of fusion of ice $= 3.4 \times 10^5 Jkg^{-1}$ Specific heat capacity of water $= 4.2 \times 10^3 Jkg^{-1}K^{-1}$ Specific heat capacity of ice $= 2.1 \times 10^3 Jkg^{-1}K^{-1}$

CORRECT ANSWER: $164.5W$

Watch Video Solution On Doubtnut App

Q-17 - 13078255

The densities of two substances are in the ratio $5:6$ and the specific heats are in the ratio $3:5$ respectively. The ratio of their thermal capacities per unit volume is

(A) $2:1$

(B) $1:2$

(C) $4:1$

(D) $1:4$

CORRECT ANSWER: B

SOLUTION:

$$H = mS = \rho VS$$

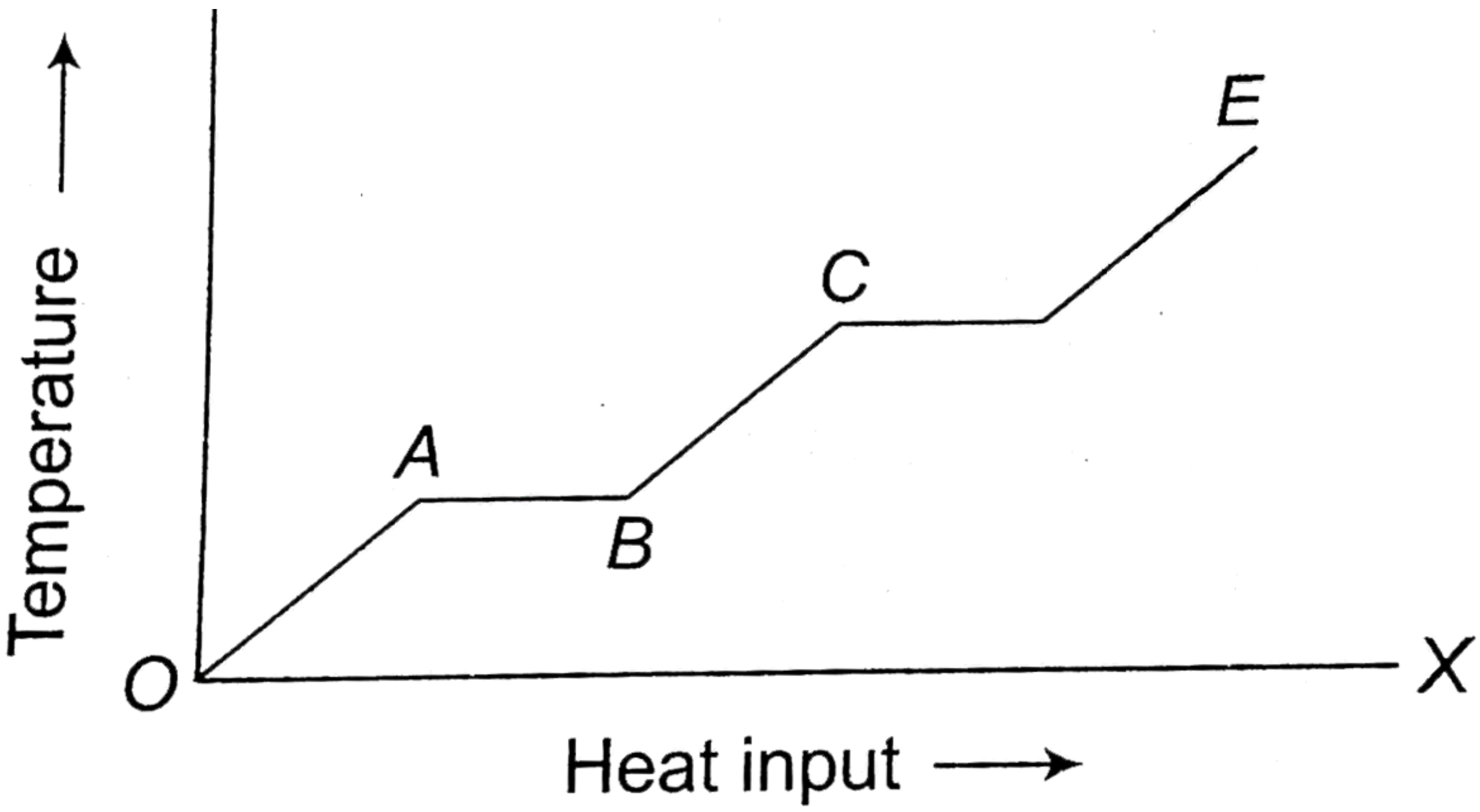
$$\Rightarrow \frac{H_1}{H_2}$$

$$= \left(\frac{\rho_1}{\rho_2}\right)\left(\frac{S_1}{S_2}\right)$$

.

Watch Video Solution On Doubtnut App

Q-18 - 13074529



A solid material is supplied with heat at a constant rate. The temperature of the material is changing with heat input as shown

(i) AB: change of state from solid to liquid.

CD: change of state from liquid to vapour

(ii) When $CD = 2AB$, i.e., latent heat of vapourization is twice the latent heat of fusion of the substance.

(iii) The reciprocal of slope of DE represents the heat capacity of vapour state of substance .

(iv) If slope of $OA >$ slope of BC, i.e., specific heat of liquid state is greater than specific heat that of solid state.

(A) (i),(iii)

(B) (ii),(iii)

(C) (iii),(iv)

(D) (i),(iv)

CORRECT ANSWER: D

Q-19 - 14796934

Two thermometers A and B are exposed in sunlight. The bulb of A is painted black, But that of B is not painted. The correct statement regarding this case is

(A) Temperature of A will rise faster than B but the final temperature will be the same in both

(B) Both A and B show equal rise in beginning

(C) Temperature of A will remain more than B

(D) Temperature of B will rise faster

Q-20 - 15511754

Two identical objects A and B are at temperature T_A and T_B respectively. Both objects are placed in a room with perfectly absorbing walls maintained at temperature $T(T_A > T > T_B)$

Statement-1: The objects A and B attain the temperature T eventually.

Statement-2: A only emits radiation while B only absorbs until radiation both attain the temperature T

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement -1 is false, statement -2 is true.

CORRECT ANSWER: C

Q-21 - 15968516

A body cools from $60C$ to $50C$ in 10 minutes . If the room temperature is $25C$ and assuming Newton's law of cooling to hold good, the temperature of the body at the end of the next 10 minutes will be

(A) $38.5^\circ C$

(B) $40^\circ C$

(C) $42.85^\circ C$

(D) $45^\circ C$

CORRECT ANSWER: C

Q-22 - 13163149

The ratio of coefficients of apparent expansions of the same liquid in two different vessels is $1:2$. If α_1 and α_2 are the coefficient of linear expansions then coefficient of real expansion of the liquid is

(A) $2\alpha_1 - \alpha_2$

(B) $3\alpha_1 - 4\alpha_2$

(C) $\alpha_1 - 2\alpha_1$

(D) $6\alpha_1 - 3\alpha_2$

CORRECT ANSWER: D

SOLUTION:

$$\frac{(\gamma_A)_1}{(\gamma_A)_2} = \frac{1}{2}, \frac{1}{2}$$

$$= \frac{\gamma_R - 3\alpha_1}{\gamma_R - 3\alpha_2}$$

Watch Video Solution On Doubtnut App

Q-23 - 14798290

5A 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 $25C$, melting point $475C$ and the latent heat L. Then v is given by

(A) mL=mS(475-25)+(1)/(2) (mv^(2))/(J)`

(B)
$$mS(475-25)+mL = \frac{1}{2}\frac{mv^2}{2J}$$

(C)
$$mS(475-25)+mL = \frac{1}{2}\frac{mv^2}{J}$$

(D)
$$mS(475-25)+mL = \frac{1}{2}\frac{mv^2}{2J}$$

Q-24 - 11749500

A uniform pressure P is exerted by an external agent on all sides of a solid cube at temperature tC. By what amount should the temperature of the cube be raised in order to bring its volume back to its original volume before the pressure was applied if the bulk modulus is B and co-efficient of volumetric expansion is γ?

(A) $\frac{P\gamma}{B}$

(B) $\frac{P}{B\gamma}$

(C) $\frac{B}{P\gamma}$

(D) $\frac{1}{BP\gamma}$

CORRECT ANSWER: B

SOLUTION:

$$B = -\frac{P}{\left(\frac{dV}{v}\right)}$$

$$dV = -\frac{pv}{B} \Rightarrow V\gamma$$

$$\Delta T = \frac{pV}{B} \Rightarrow \Delta T$$

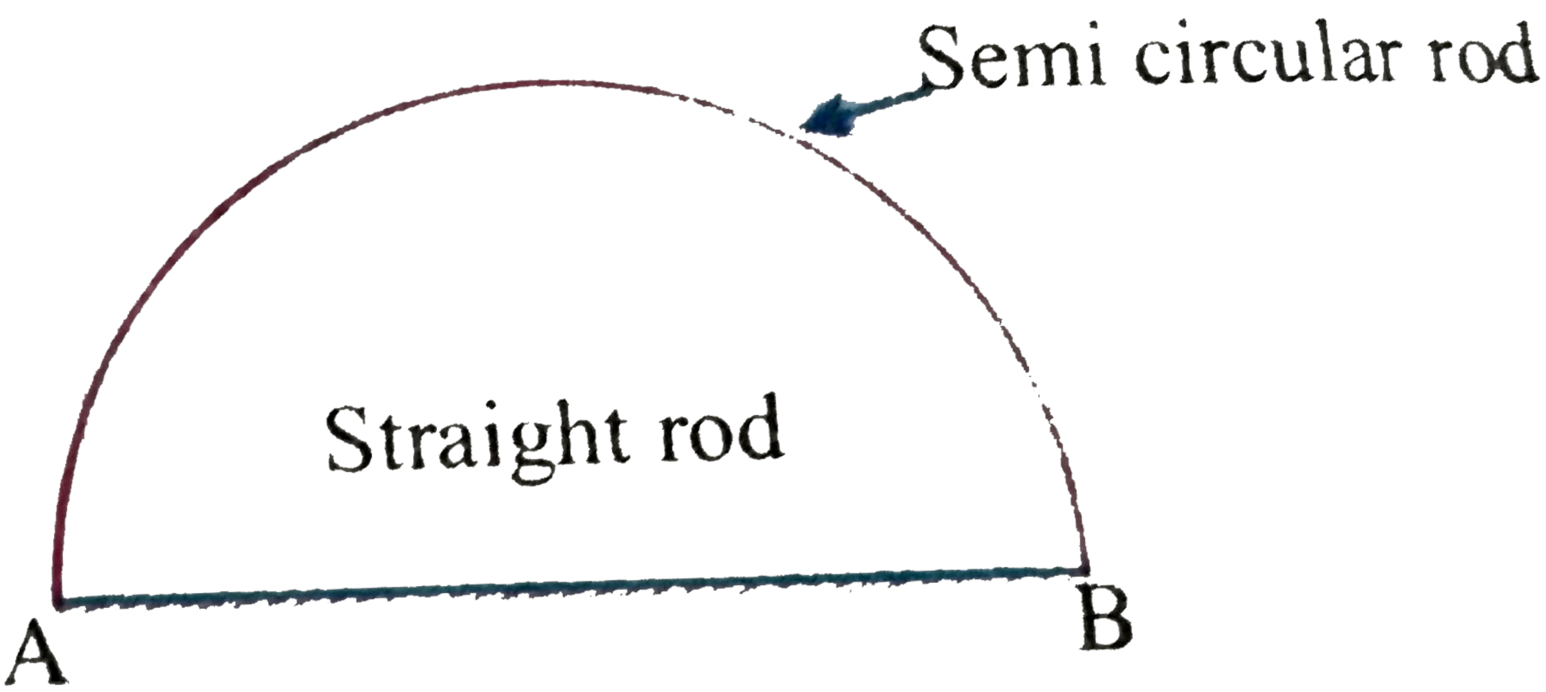
$$= \frac{p}{\gamma B}$$

.

Watch Video Solution On Doubtnut App

Q-25 - 13078145

Two rods one is semi circular of thermal conductivity K_1 and otheir is straight of thermal conductivity K_2 and of same cross sectional area are joined as shown in the The points A and B are maintained at same temperature difference. If rate of flow of heat is same in two rods then K_1 / K_2 is



(A) $2 : \pi$

(B) $1 : 2$

(C) $\pi : 2$

(D) $3 : 2$

CORRECT ANSWER: C

SOLUTION:

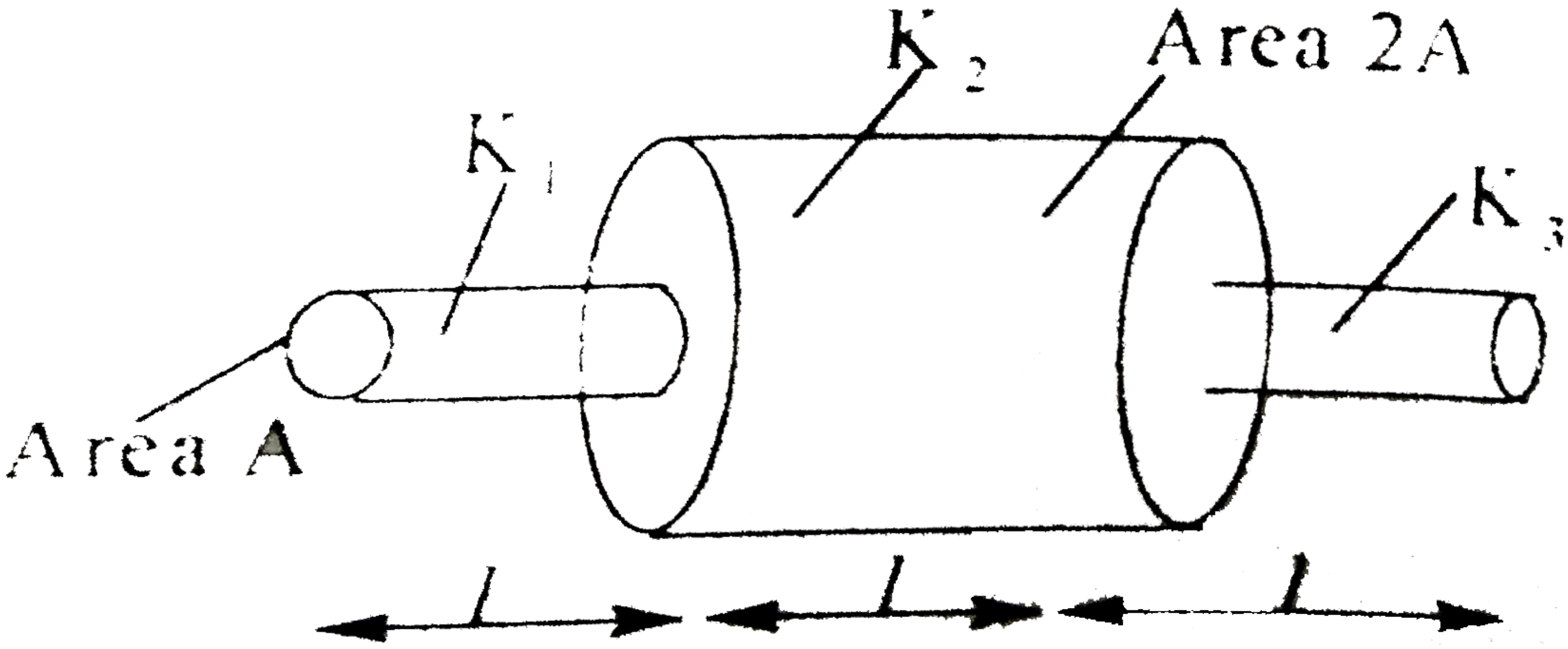
$$\left(\frac{Q}{t}\right)_{\text{semicircularrod}} = \left(\frac{Q}{t}\right)_{\text{straightrod}}$$

$$\frac{K_1 A(\Delta\theta)}{\pi r} = \frac{K_2 A(\Delta\theta)}{2r}$$

r =` radius of semi circle .

Watch Video Solution On Doubtnut App

Q-26 - 14160437



Equivalent thermal conductivity of figure given below will be given that length of eachh cylinder is l and area of cylinder having thermal conductivity K_1 & K_3 is A while middle cylinder is having K_2.

(A) $\dfrac{5}{2\left[\frac{1}{K_1}+\frac{1}{2K_2}+\frac{1}{K_3}\right]}$

(B) $\dfrac{1}{\left(\frac{1}{K_1}+\frac{1}{2K_2}+\frac{1}{K_3}\right)}$

(C) $\dfrac{2}{5\left[\frac{1}{K_1}\frac{1}{2K_2}+\frac{1}{K_3}\right]}$

(D) none of these

CORRECT ANSWER: A

SOLUTION:

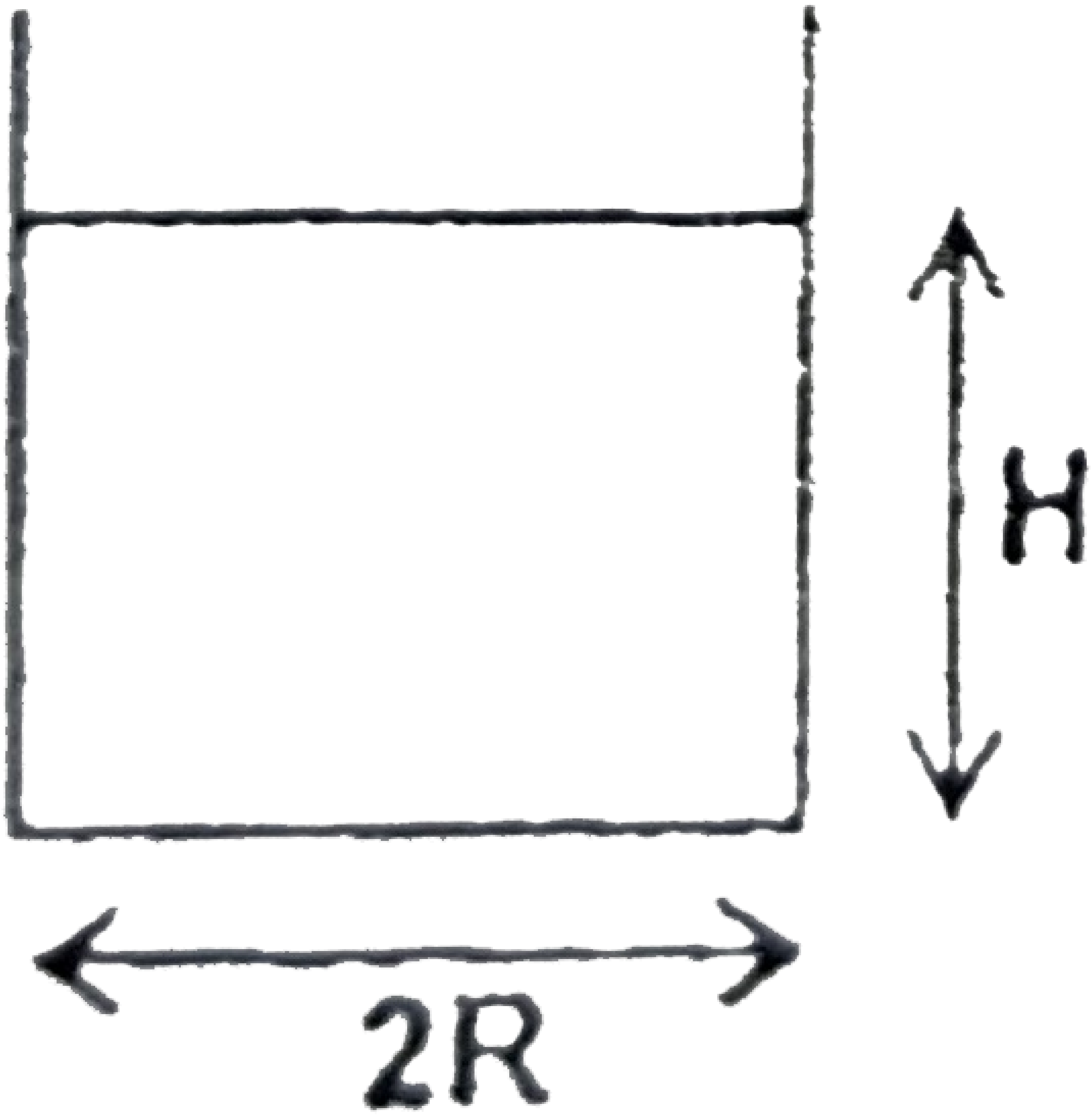
$$\frac{l}{K_1A}+\frac{l}{2K_2A}+\frac{l}{K_3A}=\frac{l}{KA}+\frac{l}{2K_A}+\frac{l}{KA}$$

$$\frac{5}{2K}=\left(\frac{1}{K_1}+\frac{1}{2K_2}+\frac{1}{K_3}\right)$$

$$K_{eq}=\frac{5}{2\left(\frac{1}{K_1}+\frac{1}{2K_2}+\frac{1}{K_3}\right)}$$

Q-27 - 15517837

On a cold winter dry, the temperature of atmosphere is $-TC$. The cylindrical dram shown is made of insultating material and it contains water at $0C$. If L is latent heat of fusion of ice, ρ is density of ice and K_R is thermal conductivity of ice, the time taken for total mass of water to freeze is



(A) $\frac{\rho L}{H^2 KT}$

(B) $\frac{\rho L H^2}{2KT}$

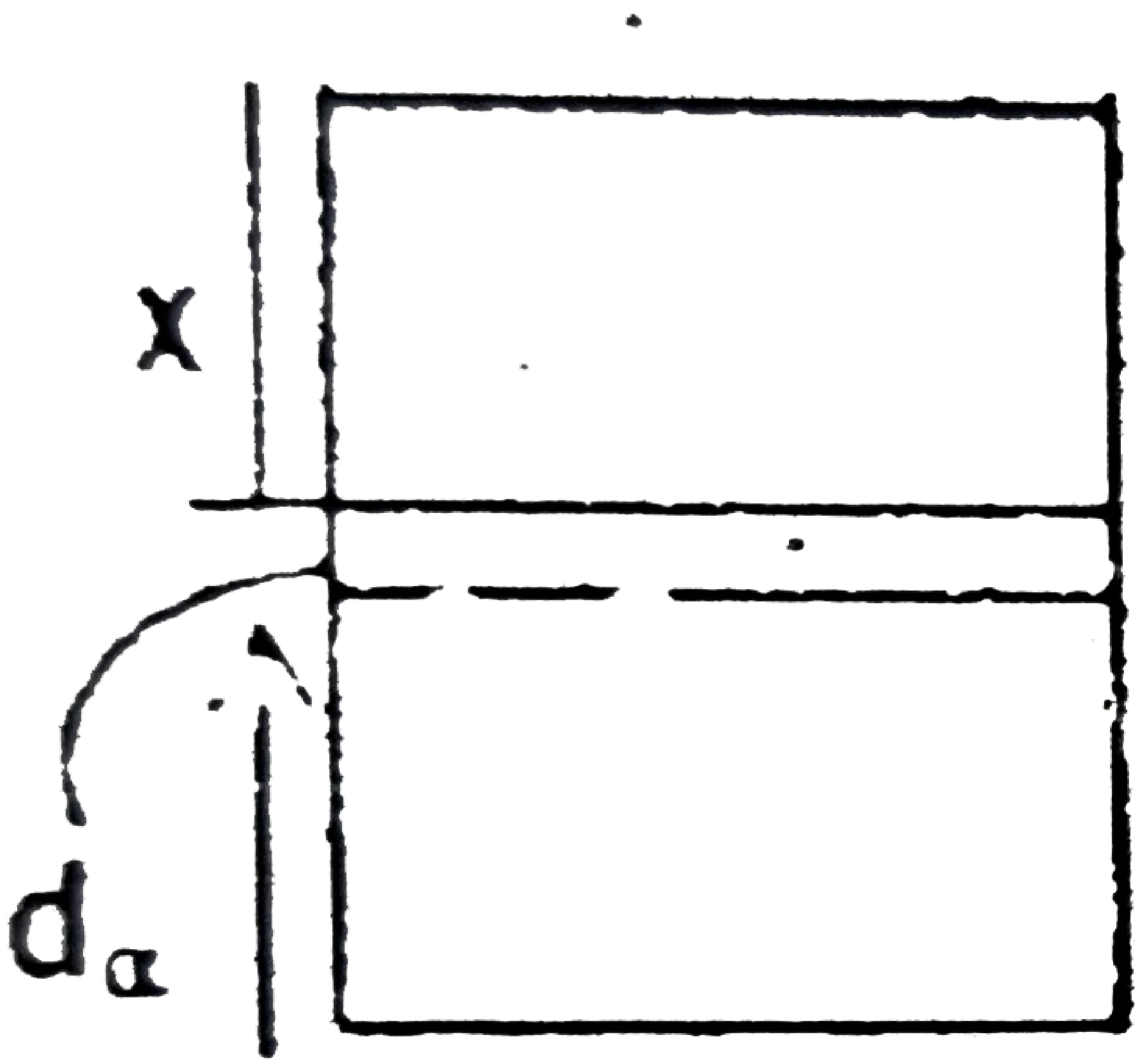
(C) $\frac{\rho L H^2}{KT}$

(D) $\frac{H^2}{\rho L K T}$

SOLUTION:

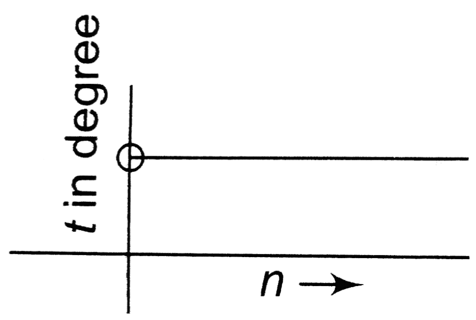
$$\frac{\rho L}{KT}\int_0^4 x\,dx = \int_0^T dt$$

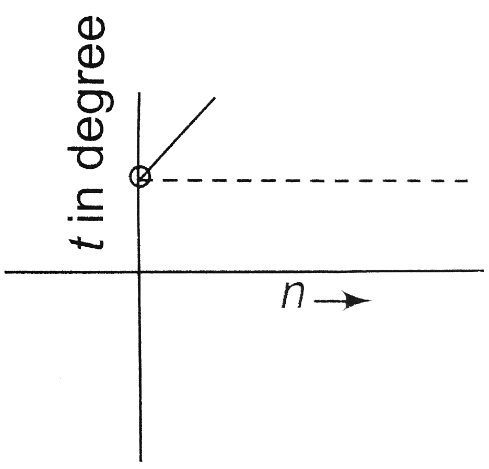
$$\Rightarrow T = \frac{\rho L H^2}{2KT}$$

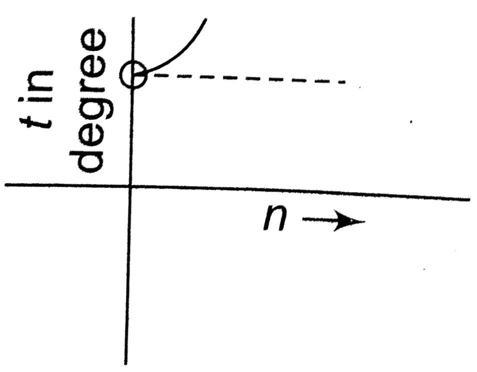


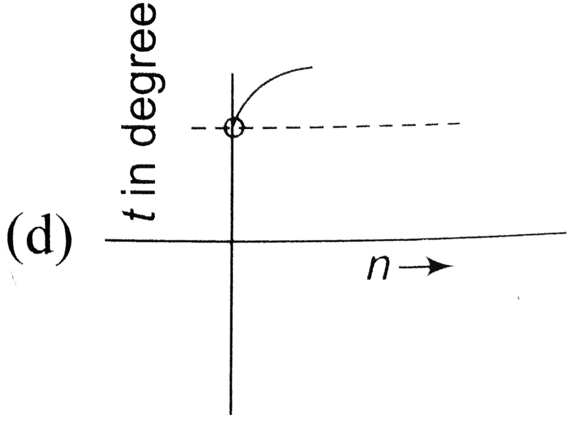
Q-28 - 11749578

A slab X of thickness $'t'$, thermal conductivity $'K'$ and area of cross-section $'A'$ is placed in thermal contact with another slab Y which is $2n^2$ times thicker, $4n$ times conductive and having n times larger cross-section area. If the outside face of X is maintained at $100C$, the outside face of Y at $0C$, then the temperature of the junction is represented by the graph $(n > 0)$

(A) (a) 

(B) (b) 

(C) (c) 



(D)

CORRECT ANSWER: A

SOLUTION:

At equilibrium :$\dot{Q}_1 = \dot{Q}_2$

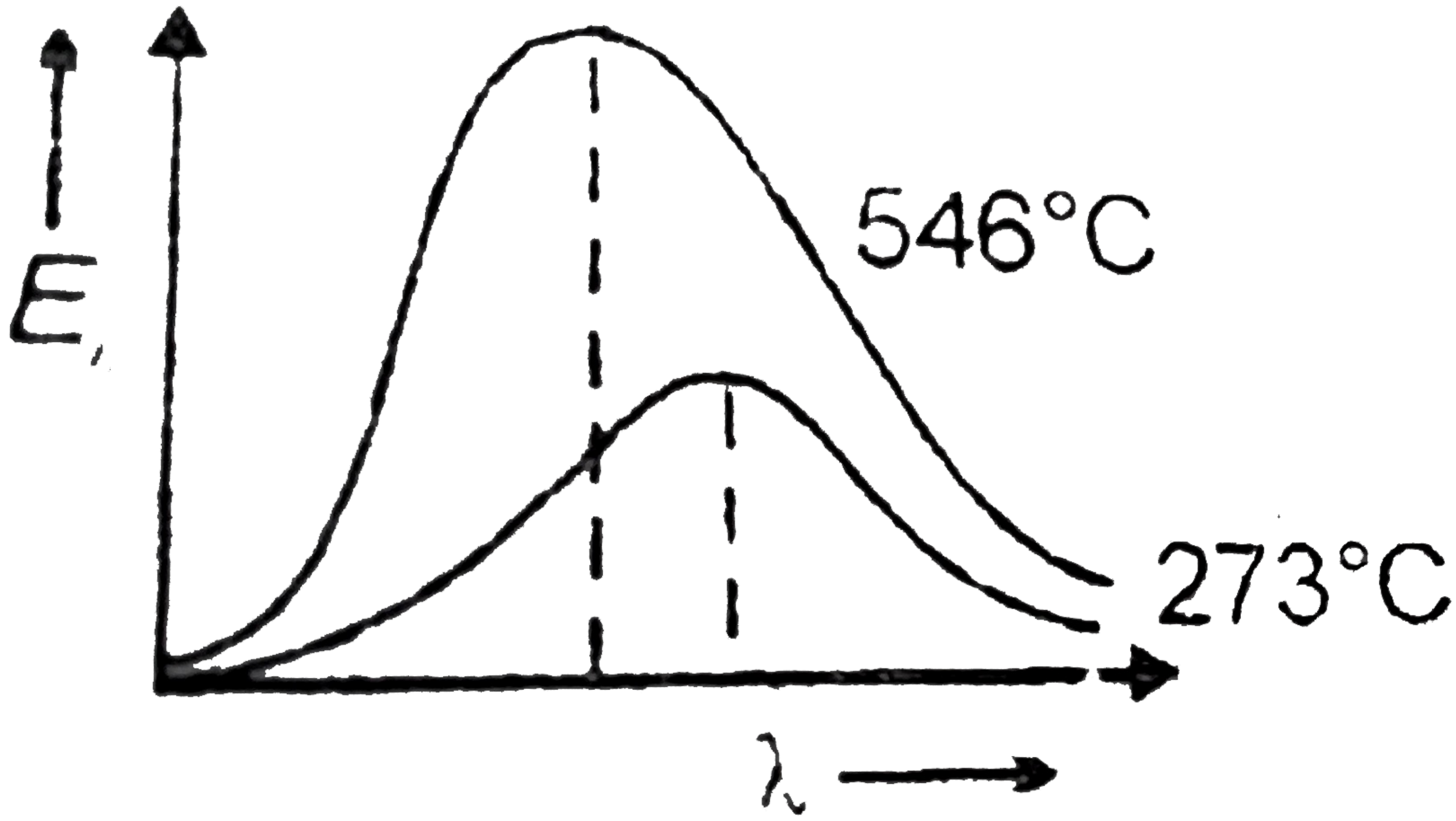
$$\Rightarrow \frac{KA(t-0)}{l} = \frac{4nkAn(100-t)}{2n^2 l}$$
$$\Rightarrow t = 200/3$$

.

Watch Video Solution On Doubtnut App

Q-29 - 14279831

The spectra of a black body at temperatures $273C$ and $546C$ are shown in the figure. If A_1 and A_2 be area under the two curves respectively, the value of $\frac{A_2}{A_1}$ is



(A) $\frac{81}{16}$

(B) $\frac{16}{1}$

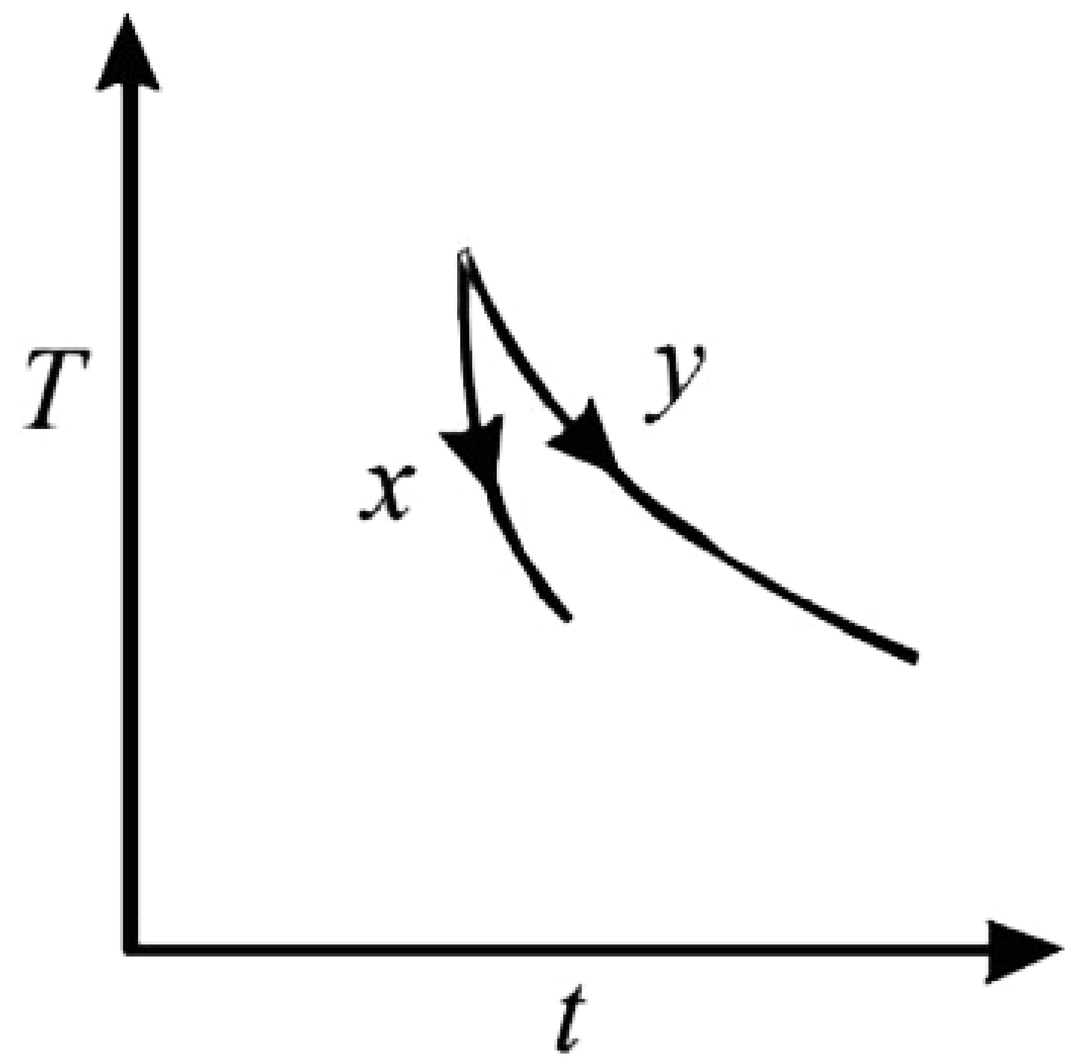
(C) $\frac{27}{8}$

(D) $\frac{16}{81}$

CORRECT ANSWER: A

Q-30 - 10059020

The graph, shown in the adjacent diagram, represents the variation of temperature (T) of two bodies, x and y having same surface area, with time (t) due to the emission of radiation. Find the correct relation between the emissivity and absorptivity power of the two bodies



(A) $E_x > E_y \& a_x < a_y$

(B) $E_x < E_y \& a_x > a_y$

(C) $E_x > E_y \& a_x > a_y$

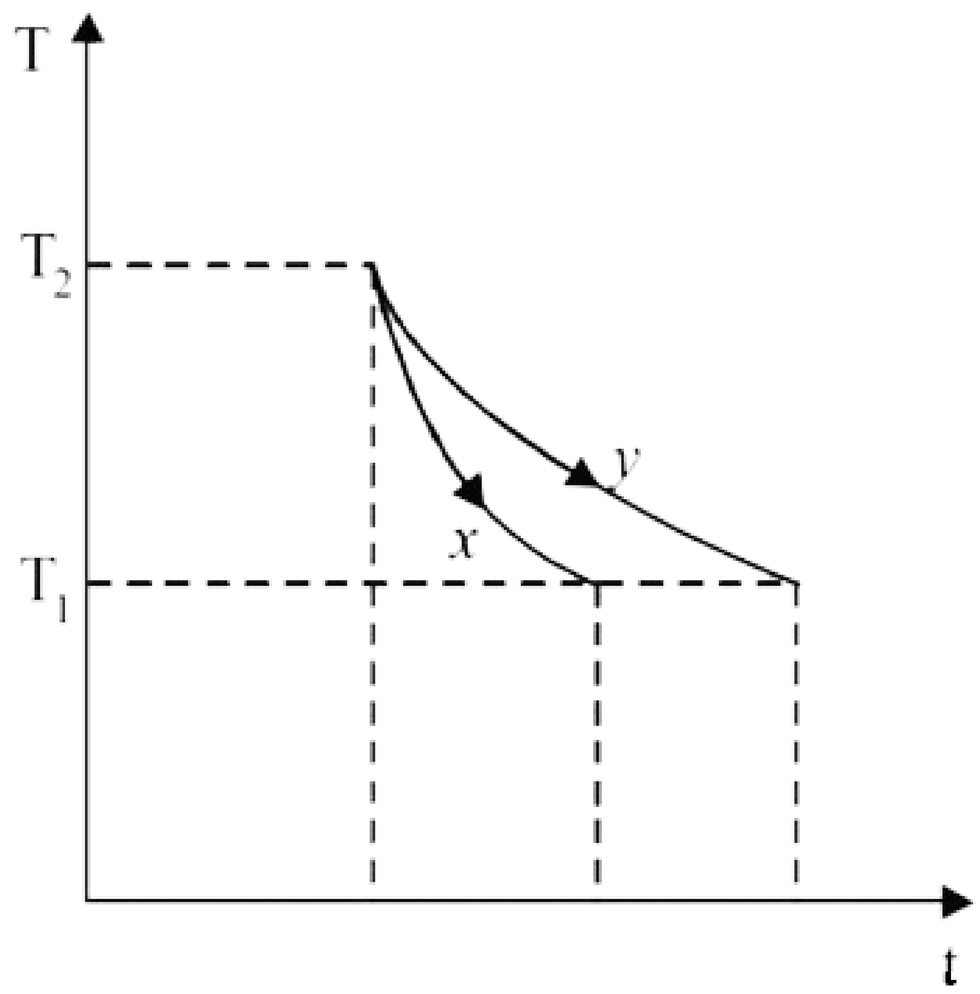
(D) $E_x < E_y \& a_x < a_y$

CORRECT ANSWER: C

SOLUTION:

(c) The graph shows that for the same temperature difference $(T_2 - T_1)$, less time is taken for x. This means

the emissivity is more for x. According to Krichoff's law, a good emitter is a good absorber as well.



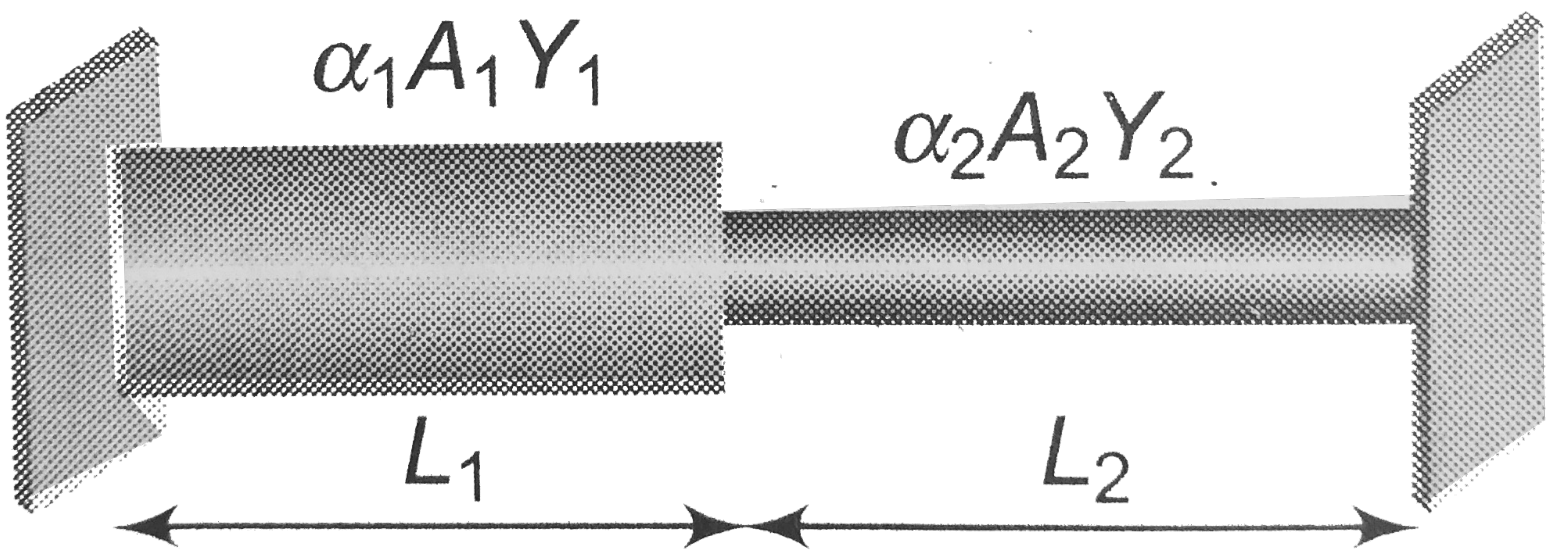
Q-31 - 11749616

Two rods are joined between fixed supports as shown in the figure. Condition for no change in the length of individual rods with the increase of temperature will be

$(\alpha_1, \alpha_2 =$ linear expansion coefficient

$A_1, A_2 =$ Area of rods

$Y_1, Y_2 =$ Young modulus $)$



(A) $\frac{A_1}{A_2} = \frac{\alpha_1 Y_1}{\alpha_2 Y_2}$

(B) $\frac{A_1}{A_2} = \frac{L_1 \alpha_1 Y_1}{L_2 \alpha_2 Y_2}$

(C) $\frac{A_1}{A_2} = \frac{L_2 \alpha_2 Y_2}{L_1 \alpha_1 Y_1}$

(D) $\frac{A_1}{A_2} = \frac{\alpha_2 Y_2}{\alpha_1 Y_1}$

CORRECT ANSWER: D

SOLUTION:

$$Y = \frac{\text{Stress}}{\text{strain}} = \frac{T/A}{\Delta l/l}$$
$$T = \frac{Y \cdot \Delta l}{l} A = Y \cdot A\alpha\Delta T$$

In both the rods tension will be same so

$T_1 = T_2$, Hence,

$$Y_1 A_1 \alpha_1 \Delta T = Y_2 A_2 \alpha_2 \Delta T$$

$$\frac{A_1}{A_2} = \frac{Y_2 \alpha_2}{Y_1 \alpha_1}.$$

Q-32 - 13162818

If L_1 and L_2 are the lengths of two rods of coefficients of linear expansion α_1 and α_2 respectively the condition for the difference in lengths to be constant at all temperatures is

(A) $L_1\alpha_1 = L_2\alpha_2$

(B) $L_1\alpha_2 = L_2\alpha_1$

(C) $L_1\alpha_1 = L_2\alpha_2$

(D) $L_1\alpha_2 = L_2\alpha_1$

CORRECT ANSWER: A

Watch Video Solution On Doubtnut App

Q-33 - 11749623

A solid cube and a solid sphere of the same material have equal surface area. Both are at the same temperature $120C$, 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 mor mass will cool down faster

CORRECT ANSWER: B

SOLUTION:

Rate of cooling of a body

$$R=\frac{\Delta\theta}{t}$$

$$=\frac{A\varepsilon\sigma\left(T^4-T_0^4\right)}{mc}$$

$$\Rightarrow R\propto\frac{A}{m}$$

$$\propto\frac{\text{Area}}{\text{Volume}}$$

$\Rightarrow$ For the same surface area, $R\propto\frac{1}{\text{Volume}}$

$\therefore$ Volume of cube $<$ Volume of sphere

$\Rightarrow R_{\text{cube}} > R_{\text{shpere}}$ ie., cube, down with faster rate.

Watch Video Solution On Doubtnut App

Q-34 - 10966221

Two spheres, one solid and other hollow are kept in atmosphere at same temperature. They are made of same material and their radii are also same. Which sphere will cool at a faster rate initially?

CORRECT ANSWER: A

SOLUTION:

In the equations,

$$-\frac{dT}{dt} = \frac{eA\sigma}{mc}(T^4 - T_0^4)$$

Only mass is different. Therefore,

$$-\frac{dT}{dt} \propto \frac{1}{m}$$

Mass of hollow sphere is less. So, hollow sphere will cool at a faster rate initially.

Watch Video Solution On Doubtnut App

Q-35 - 13078097

An object is being heated by a heater supplying $60W$ of heat. Temperature of surrounding is $20C$ and the temperature of object becomes constant at $50C$ Now the heater is switched off What is the rate at which the object will lose heat when its temperature has dropped to $30C$.

(A) $20W$

(B) $30W$

(C) $40W$

(D) $60W$

CORRECT ANSWER: A

Watch Video Solution On Doubtnut App

Q-36 - 13152184

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) $\frac{9}{4}\lambda_m$

CORRECT ANSWER: B

SOLUTION:

(2) $\lambda_m T_1 = \lambda'_m T_2$

$$510T_1 = 350T_2$$

$$\frac{T_1}{T_2} = \frac{350}{510} = 0.69$$

Watch Video Solution On Doubtnut App

Q-37 - 11749686

The two ends of a rod of length L and a uniform cross-sectional area A are kept at two temperature T_1 and T_2 $(T_1 > T_2)$. The rate of heat transfer. $\frac{dQ}{dt}$, through the rod in a steady state is given by

(A) $\frac{dQ}{dt} = \frac{KL(T_1 - T_2)}{A}$

(B) $\frac{dQ}{dt} = \frac{KL(T_1 - T_2)}{LA}$

(C) $\frac{dQ}{dt} = KLA(T_1 - T_2)$

(D) $\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{L}$

CORRECT ANSWER: D

SOLUTION:

For a rod of length L and area of cross-section A whose faces are maintained at temperature T_1 and T_2 respectively.

Then in steady state the rate of heat flowing form one face to the other face in time t is given by $\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{L}$.

Q-38 - 11749691

If the radius of a star is R and it acts as a black body, what would b the temperature of the star, in which the rate of energy production is Q?

(A) $\left(\frac{Q}{4\pi R^2 \sigma}\right)^{1/4}$

(B) $\frac{Q}{4\pi R^2 \sigma}$

(C) $\left(\frac{Q}{4\pi R^2 \sigma}\right)$

(D) $\left(4\pi R^2 Q / \sigma\right)^{1/4}$

CORRECT ANSWER: A

SOLUTION:

If r is the radius of the star and T its temperature, then the energy emitted by the star per second through radiation in accordance with Stefan's law will be given by

$$A\sigma T^4 = 4\pi r^2 \sigma T^4$$

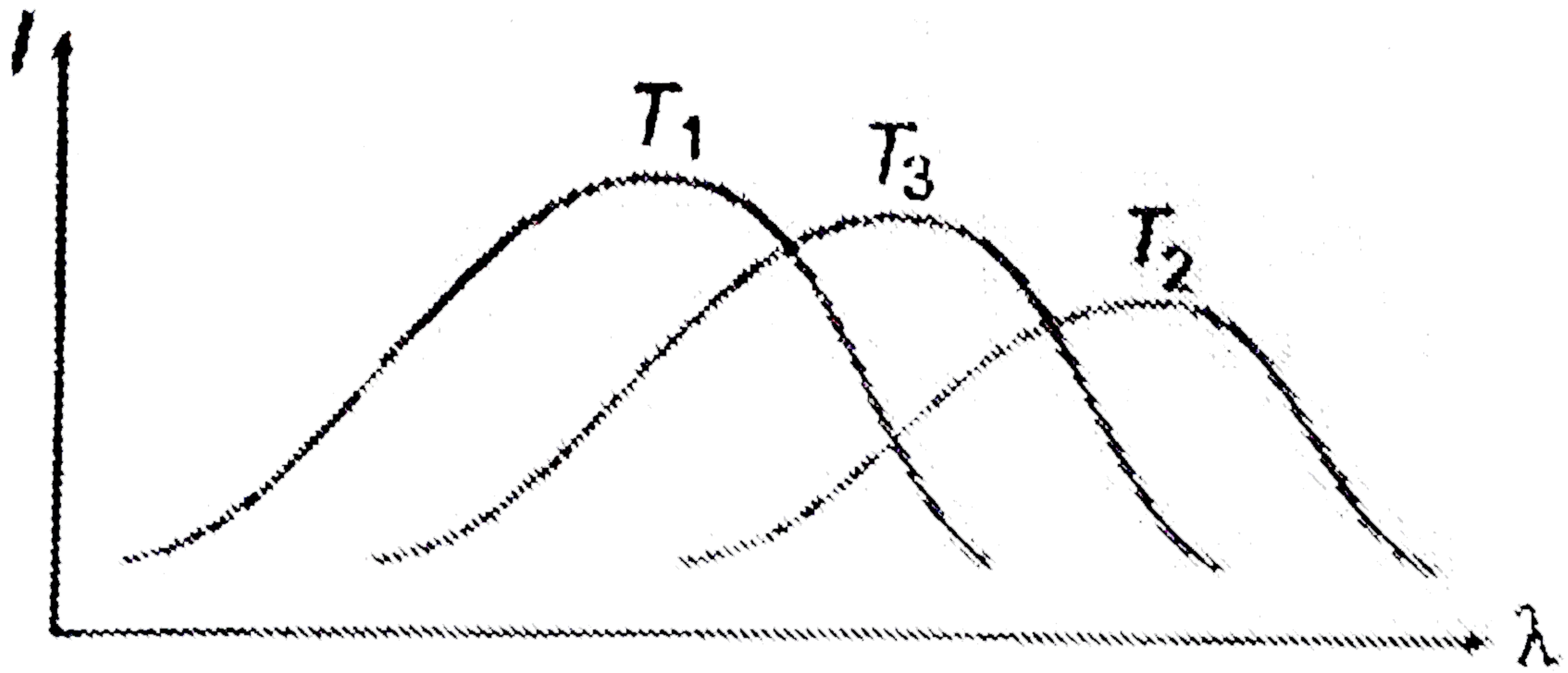
$$Q = 4\pi R^2 \sigma T^4 \Rightarrow T$$

$$= \left(\frac{Q}{4\pi R^2 \sigma}\right)^{1/4}$$

.

Q-39 - 18254280

The plots of intensity of radiation versus wavelength of 3 black bodies of temperatures T_1, T_2 and T_3 as shown in the figure, then



(A) $T_1 > T_2 > T_3$

(B) $T_3 > T_2 > T_1$

(C) $T_1 > T_3 > T_2$

(D) $T_1 < T_3 < T_2$

SOLUTION:

(c)

Watch Video Solution On Doubtnut App

Q-40 - 15717274

A metal rod of silver at $0C$ is heated to $100C$. It's length is increased by $0.19cm$. Coefficient of cubical expansion of the silver rod is

(A) $5.7 \times 10^{-5} / {}^\circ C$

(B) $0.63 \times 10^{-5} / {}^\circ C$

(C) $1.9 \times 10^{-5} / C$

(D) $16.1 \times 10^{-5} / {}^\circ C$

CORRECT ANSWER: A

Watch Video Solution On Doubtnut App

Q-41 - 10965948

A steel rod of length $1m$ is heated from $25^{\text{to}}75^{C}$ keeping its length constant. The longitudinal strain developed in the rod is (Given, coefficient of linear expansion of steel = $12 \times 10^{-6} / ^{C}$).

(A) 6×10^{-4}

(B) -6×10^{-5}

(C) -6×10^{-4}

(D) zero

CORRECT ANSWER: C

SOLUTION:

It means rod is compressed from its natural length by Δl

.

$\therefore$ Strain

$$= -\frac{\Delta l}{l} = -\frac{l\Delta\alpha\Delta\theta}{l}$$

$$= (-\alpha d\theta) = -(12 \times 10^{-6})(50)$$

$= -6 \times 10^{-4}.$

Watch Video Solution On Doubtnut App

Q-42 - 17817929

An aluminium measuring rod, which is correct at 5^C measures the length of a line as 80 cm at 45^C If thermal coefficient of linear expansion of aluminium is $2.50 \times 10^{-4} / ^C$, the correct length of the line is:

(A) $80.05cm$

(B) $79.92cm$

(C) $81.12cm$

(D) $79.62cm$

CORRECT ANSWER: A

Watch Video Solution On Doubtnut App

Q-43 - 15217369

A block of ice at $-20C$ having a mass of 2kg is added to a 3kg water at $15C$. Neglecting heat losses and the heat capacity of the container

(A) The final temperature will be less than $0^\circ C$

(B) Ice will completely melt

(C) Water will partially freeze

(D) Final temperature will be more than $0^\circ C$

CORRECT ANSWER: 3

SOLUTION:

$$Q_{reqd} = 2000 \times \frac{1}{2} \times (0 - 20) = 20000 cal$$

$$Q_{av} = 3000 \times 1 \times (15 - 0) = 45000 cal$$

$$Q_{\text{reqd to melt}} = 2000 \times 80 = 160000$$

$\rightarrow$ not sufficient

Watch Video Solution On Doubtnut App

Q-44 - 18254180

The specific heat of a substance at temperature at tc is

$s = at^2 + bt + c$. Calculate the amount of heat required to raise the temperature of m g of the substance from 0C to t_0C

(A) $\frac{mt_0^3 a}{3} + \frac{bt_0^2}{2} + ct_0$

(B) $\frac{mt_0^3 a}{3} + \frac{mbt_0^2}{2} + mct_0$

(C) $\frac{mt_0^3 a}{3} + \frac{mbt_0^2}{2}$

(D) None of these

SOLUTION:

$$\Delta H = \int msdt$$

$$= (m)\int_0^{t_0} (at^2 + bt + c)dt = m\left[\frac{at_0^3}{3} + \frac{bt_0^2}{2} + ct_0\right]$$

Q-45 - 14163192

The temperature of a hot liquid in a container of negligible heat capacity falls at the rate of $3K/\min$ due to heat emission to the surroundings, just before it begins to solidify. The temperature then remains constant for $30\min$, by the time the liquid has all solidfied. Find the ratio of specific heat capacity of liquid to specific latent heat of fusion.

CORRECT ANSWER: $\frac{1}{90}$

Watch Video Solution On Doubtnut App

Q-46 - 13074502

Steam at 100^{C} is allowed to pass into a vessel containing $10g$ of ice and 100 g of water at 0^{C} until all the ice is melted and the temperature is raised to 50^{C}. Neglecting water equivalent of the vessel and the loss due to radiation etc. Calculate how much steam is condensed.

SOLUTION:

If m mass of steam,

$$10 \times 80 + (10 + 100) \times 1 \times (5 - 0) = m \times 540 + m \times 1 \times (100 - 5)$$

$$1350 = 635m$$

$$m = \frac{1350}{635} = 2.12g$$

Watch Video Solution On Doubtnut App

Q-47 - 15085695

A vessel containing 100 g ice at $0C$ is suspended in a room where temperature is $35C$. It was found that the entire ice melted in 10 hour. Now the same vessel containing 100 g of water at $0C$ is suspended in the same room. How much time will it take for the temperature of water to rise to $0.5C$. Neglect the heat capacity of the vessel. Specific heat of water and specific latent heat of fusion of ice are $1calg^{-1}.C^{-1}$ and $80calg^{-1}$ respectively.

CORRECT ANSWER: 3.75 MIN.

Watch Video Solution On Doubtnut App

Q-48 - 11749528

$20gm$ ice at $-10C$ is mixed with mgm steam at $100C$. The minimum value of m so that finally all ice and steam converts into water is:

(Use $s_{\text{ice}} = 0.5\text{cal gm}C$,
$S_{\text{water}} = 1cal/gmC, L$
) (melting) $= 80cal/gm$ and
$L(\text{vaporization}) = 540cal$
$/gm$

)

(A) $\frac{185}{27} gm$

(B) $\frac{135}{17} gm$

(C) $\frac{85}{32} gm$

(D) $\frac{113}{17} gm$

CORRECT ANSWER: C

SOLUTION:

For minimum value of m, the final temperature of the mixture must be $0C$

$$\therefore 20 \times \frac{1}{2} \times 10 + 20$$
$$\times 80 = m540 + m \cdot 1$$
$$\cdot 100$$

$$\therefore M = \frac{1700}{640}$$

$$= \frac{85}{32} gm$$

.

Watch Video Solution On Doubtnut App

Q-49 - 11445993

Water at 0^C was heated until it started to boil and then until it all changed to steam. The time required to heat water from 0^C to 100^C is 5 min and the time to change boiling water to steam is 28 minutes. If the flame supplied heat at a constant rate, the specific latent heat of vaporisation of water (neglecting heat losses, container etc. is (in J/g). (specific heat of water s $= 4.2J/g$)

(A) 540

(B) 2268

(C) 2352

(D) 2356

CORRECT ANSWER: C

SOLUTION:

Let heat is supplied at constant rate P,

For 0^C to 100^C

$P \times (5 \times 60) = m$

$\times 4.2 \times (100 - 0)$

.(i)

For boiling: $P \times (28 \times 60) = mL$ ..(ii)

From (i) and (ii)

$L = (4.2 \times 100) \times \frac{28}{5}$

$= 2352 J / g$

Watch Video Solution On Doubtnut App

Q-50 - 13074527

The temperature of equal masses of three different liquids A, B and

C are 30^C, 60^C and 75^C respectively. The temperature when A and B are mixed is 50^C and when B and C are mixed, it is 70^C. The equilibrium temepratur when A and C are mixed will be

(A) $56^\circ C$

(B) $66^\circ C$

(C) $50^\circ C$

(D) $60^\circ C$

CORRECT ANSWER: B

SOLUTION:

$$(A+B)$$
$$: ms_B(60-50)$$
$$= ms_A(50-30)$$

$$10s_B = 20s_A \Rightarrow S_A$$
$$= \frac{s_B}{2}$$

$$(B+C)$$
$$: ms_C(75-70)$$
$$= ms_B(70-60)$$

$$5S_C = 10S_B \Rightarrow S_C$$
$$= 2s_B$$

$$(A+C) : ms_C(75-\theta)$$
$$= ms_A(\theta-30)$$

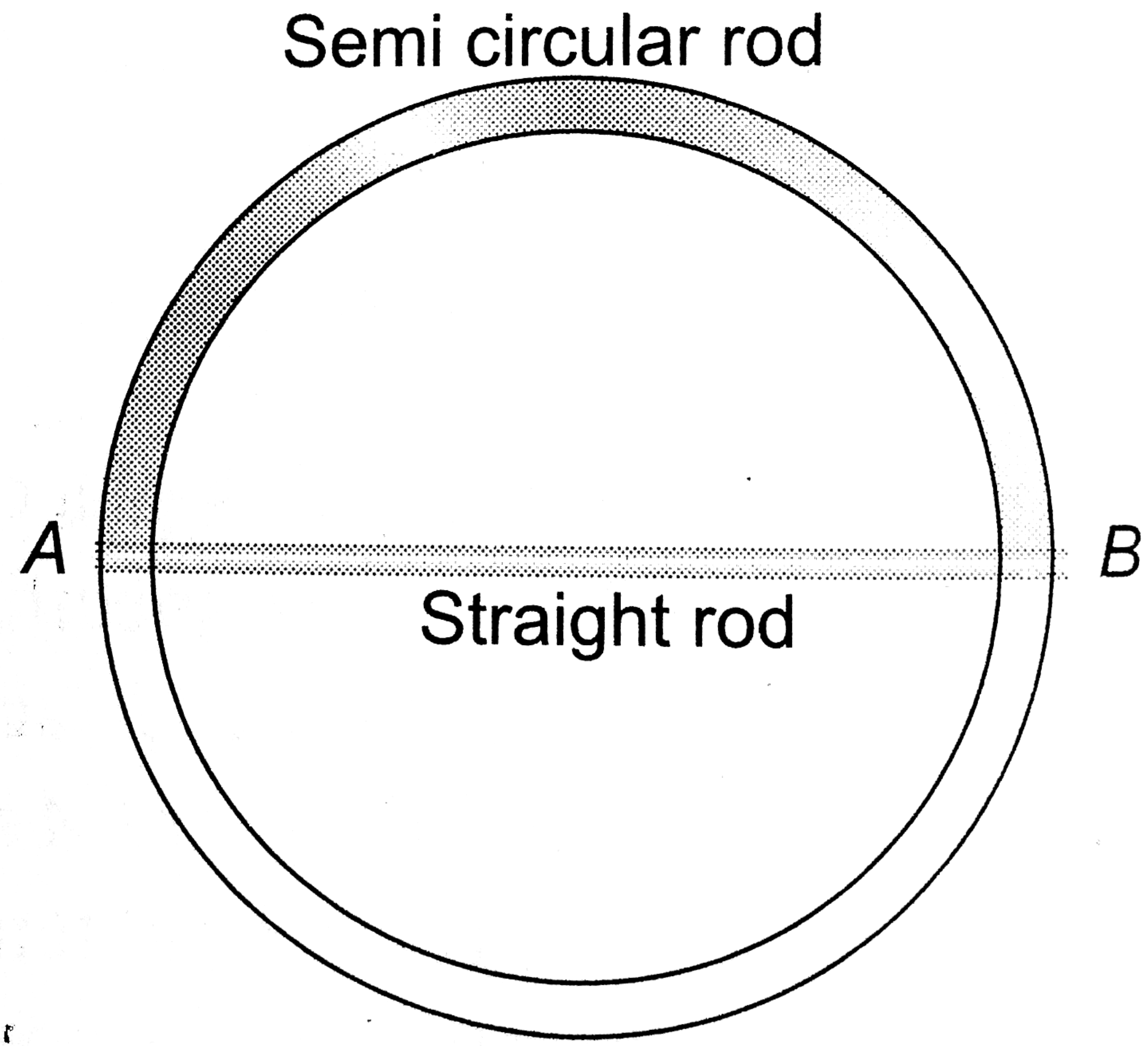
$$2S_B(75-\theta)$$
$$= \frac{S_B}{2}(\theta-30)$$

$$4(75-\theta) = \theta-30$$
$$\theta = \frac{330}{s} = 66^C$$

Watch Video Solution On Doubtnut App

Q-51 - 11749561

Two rods (one semi-circular and other straight) of same material and of same cross-sectional area are joined as shown in the figure. The point A and B are maintained at different temperature. Find the ratio of the heat transferred through a cross-section of a semi-circular rod to the heat transferred through a cross section of the straight rod in a given time.



(A) $\frac{2}{\pi}$

(B) $\frac{1}{\pi}$

(C) π

(D) $\frac{\pi}{2}$

CORRECT ANSWER: A

SOLUTION:

$\frac{dQ}{dt} = \frac{KA\Delta\theta}{l}$, for both rods K, A and $\Delta\theta$ are same

$\Rightarrow \frac{dQ}{dt} \propto \frac{1}{l}$ so $\frac{(dQ/dt)_{\text{semicircular}}}{(dQ/dt)_{\text{straight}}}$

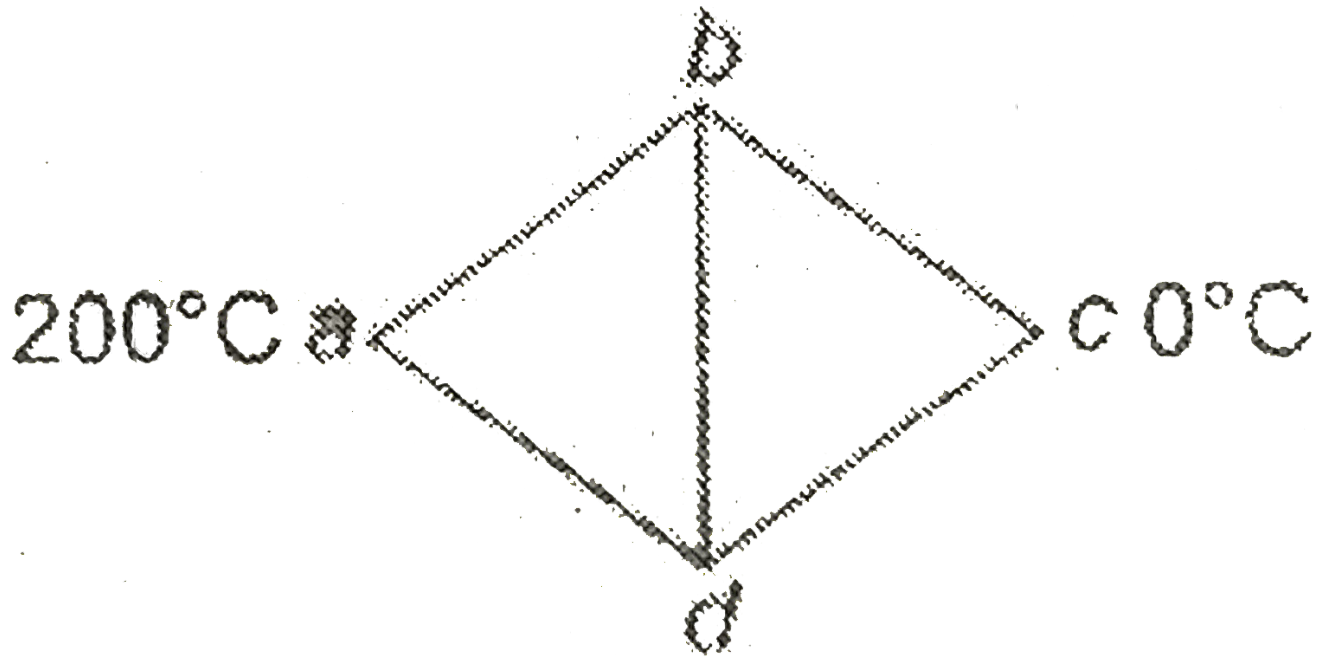
$= \frac{l_{\text{straight}}}{l_{\text{semicircular}}} = \frac{2r}{\pi r}$

$= \frac{2}{\pi}$

.

Watch Video Solution On Doubtnut App

Five rods of same material and same cross-section are joined as shown. Lengths of rods ab, ad and bc are l, 2l and 3l respectively. Ends a and c are maintained at temperatures $200C$ and $0C$ respectivelly.



For what length x of rod dc there will be no heat flow through rod bd ?

(A) 4l

(B) 2l

(C) 6l

(D) 9l

CORRECT ANSWER: C

Watch Video Solution On Doubtnut App

Q-53 - 13077941

Two rods A and B of same metal and of same cross-section have length in the ratio $1:2$ One end of each rod is at OC and temperature of other ends are $30C$ and $40C$ respectively Which of the rod will have higher flow of heat ? .

(A) Rod A

(B) Rod B

(C) Both will have same

(D) Depends upon the shape

CORRECT ANSWER: A

Watch Video Solution On Doubtnut App

Q-54 - 13152148

Two spherical black bodies of radii R_1 and R_2 and with surface temperature T_1 and T_2 respectively radiate the same power. R_1 / R_2 must be equal to

(A) $\left(\frac{T_1}{T_2}\right)^2$

(B) $\left(\frac{T_2}{T_1}\right)^2$

(C) $\left(\frac{T_1}{T_2}\right)^4$

(D) $\left(\frac{T_2}{T_1}\right)^4$

CORRECT ANSWER: B

SOLUTION:

(2) $u = e\sigma 4\pi r^2 T^4$

$R_1^2 T_1^4 = R_2^2 T_2^4$

$$\frac{R_1}{R_2} = \left(\frac{T_2}{T_1}\right)^2$$

Q-55 - 14796934

Two thermometers A and B are exposed in sunlight. The bulb of A is painted black, But that of B is not painted. The correct statement regarding this case is

(A) Temperature of A will rise faster than B but the final temperature will be the same in both

(B) Both A and B show equal rise in beginning

(C) Temperature of A will remain more than B

(D) Temperature of B will rise faster

Q-56 - 11445881

There are two thin spheres A and B of the same material and same thickness. They behave like black bodies, Radius of A is double that of B and Both have same temperature T. When A and B are kept in a room of temperature $T_0(< T)$, the ratio of their rates of cooling is (assume negligible heat exchange between A and B).

(A) $2:1$

(B) $1:1$

(C) $4:1$

(D) $8:1$

CORRECT ANSWER: B

SOLUTION:

The rate of heat loss by a thin hollow sphere of thickness

Δx, mean radius r and made of density ρ is given by

$$mS = \frac{dT}{dt} = \varepsilon\sigma A\left(T^4 - T_0^4\right)$$

$$\left(\rho 4\pi r^2 \Delta x\right) S \frac{dT}{dt} = -\varepsilon\sigma 4\pi r^2 \left(T^4 - T_0^4\right)$$

$\frac{dT}{dt} = \frac{\varepsilon\sigma\left(T^4 - T_0^4\right)}{S\Delta x}$ is independent of radius Hence the rate of cooling is same for both spheres.

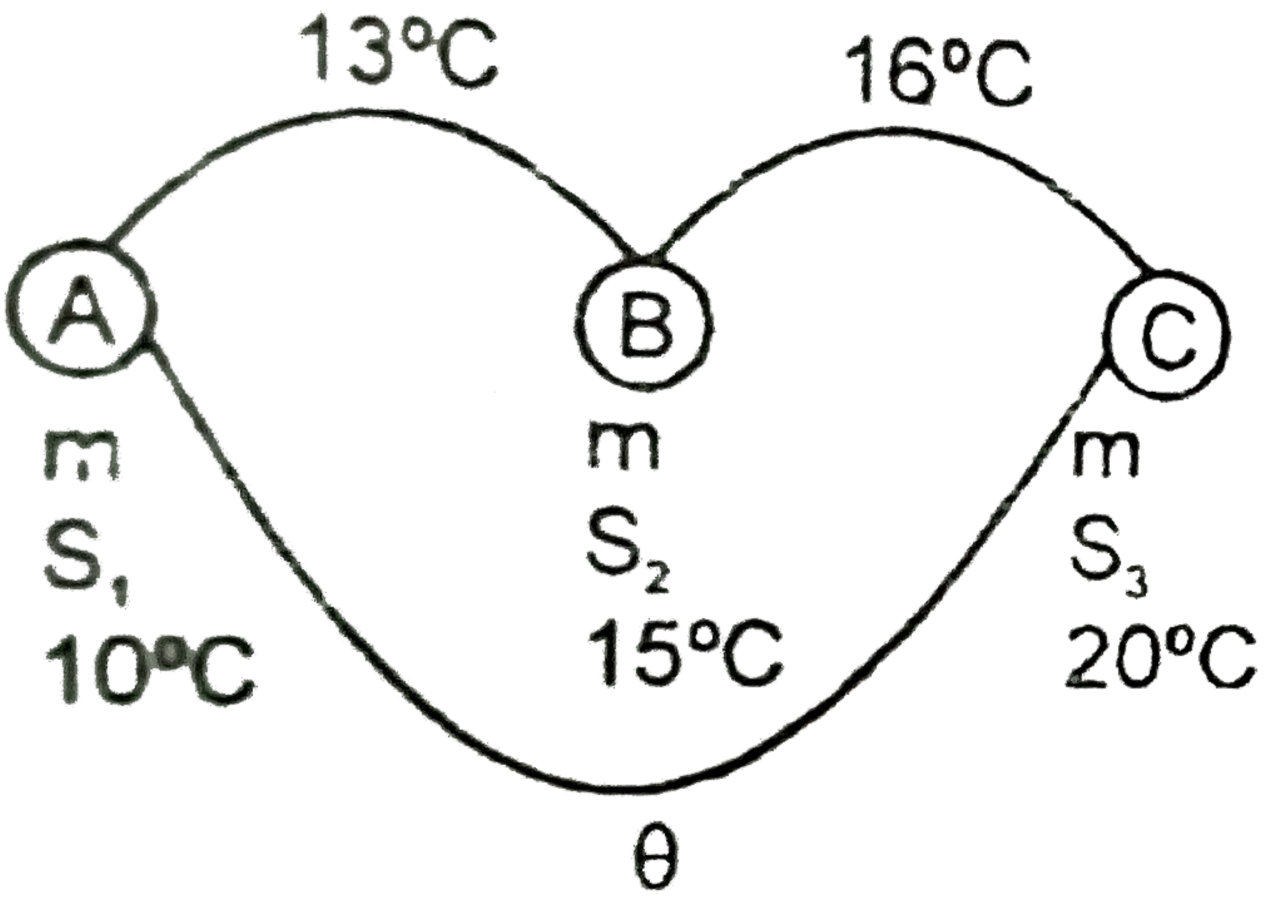
Watch Video Solution On Doubtnut App

Q-57 - 14162997

The temperature of equal masses of three different liquids A, B, and C are $10C15C$ and $20C$ respectively. The temperature when A and B are mixed is $13C$ and when B and C are mixed. It is $16C$.

What will be the temperature when A and c are mixed?

SOLUTION:



when A and B are mixed

$mS_1 \times (13 - 10) = m$
$\times S_2 \times (15 - 13)$

$3S_1 = 2S_2$. (1)

when B and C are mixed

$S_2 \times 1 = S_3 \times 4$. (2)

when C and A are mixed

$S_1(\theta - 10) = S_3$
$\times (20 - \theta) .... (3)$

by using equation (1),(2) and (3)

we get $\theta = \frac{140}{11} . C$

Watch Video Solution On Doubtnut App

Q-58 - 13078266

Two liquids at temperature 60^{C} and 20^{C} respectively have masses in the ratio $3:4$ their specific heat in the ratio $4:5$. If the two liquids are mixed, the resulatant temperature is.

(A) $70^{\circ} C$

(B) $50^{\circ} C$

(C) $40^{\circ} C$

(D) $35^{\circ} C$

CORRECT ANSWER: D

SOLUTION:

Heat lost = Heat gained

$$\theta = \frac{m_1 S_1 \theta_1 + m_1 S_2 \theta_2}{m_1 S_1 + m_2 S_2}$$

.

Watch Video Solution On Doubtnut App

Q-59 - 15968503

Equal masses of two liquids are filled in two similar calorimeters. The rate of cooling will

(A) Depend on the nature of the liquids

(B) Depend on the specific heats of liquids

(C) Be same for both the liquids

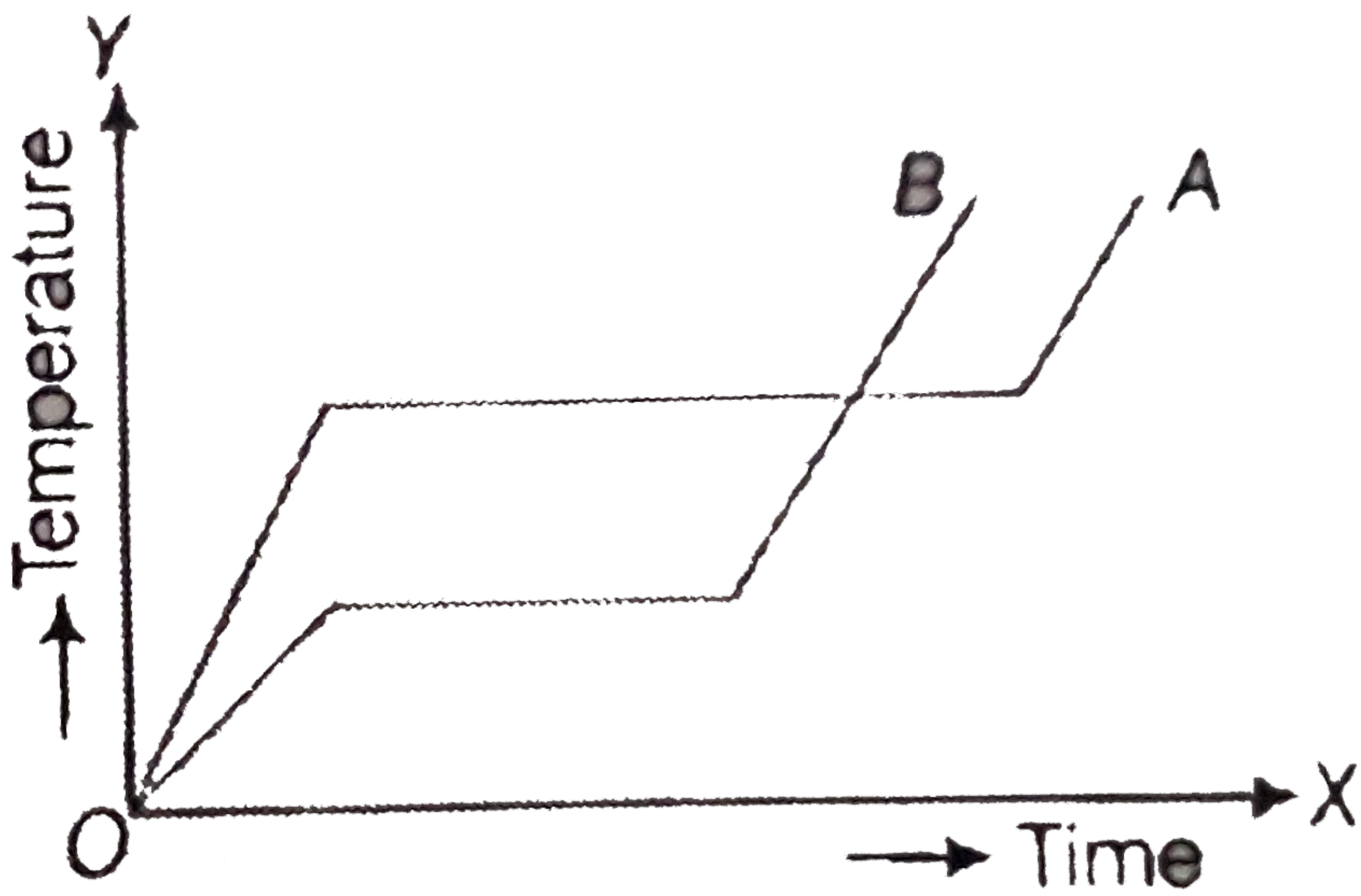
(D) Depend on the mass of the liquids

CORRECT ANSWER: B

Watch Video Solution On Doubtnut App

Q-60 - 18254179

Equal masses of two liquids A and B contained in vessels of negligible heat capacity are supplied heat at the same rate. The temperature-time graphs for the liquids are shown in the figure. If S represents specific heat and L represents latent heat of liquid, then



(A) $S_A > S_B, L_A < L_B$

(B) $S_A > S_B, L_A > L_B$

(C) $S_A < S_B, L_A < L_B$

(D) $S_A < S_B, L_A > L_B$

SOLUTION:

d


Apne doubts ka Instant video solution paayein
Abhi Doubtnut try karein!
GET IT ON
Google Play
Whatsapp your doubts on
8400400400
Crop only one question at a time
Illustration 4.32 If $\sqrt{x}+\sqrt{y}=4$, then find $\frac{dx}{dy}$ at $y=1$.
Sol. Differentiating both sides of the given equation w.r.t. we get
Forum
Profile
doubtnut