PHYSICS

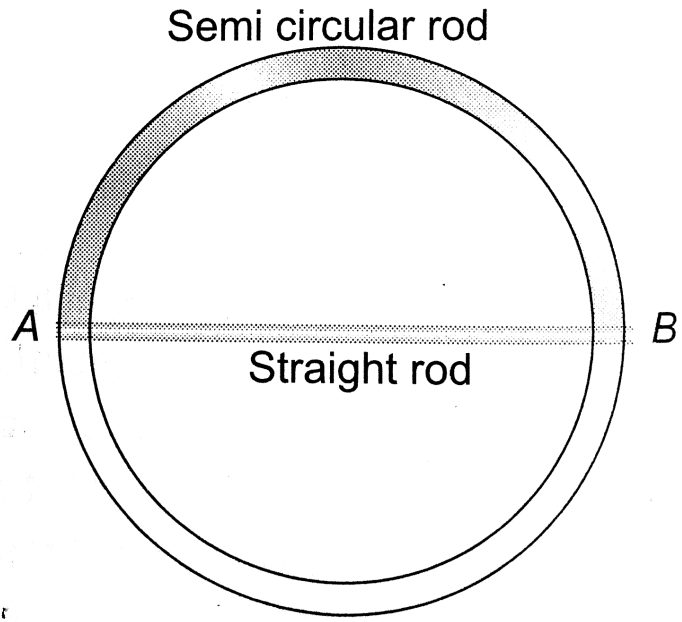
BOOKS - DISHA PHYSICS (HINGLISH)

HEAT TRANSFER AND NEWTONS LAW OF COOLING

Physics

1. 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. $2:\pi$

B. $1:2$

C. $\pi:2$

D. $3:2$

Answer:

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2. A wall has two layers A and B each made of different materials. Both the layers have the same thickness. The thermal conductivity of materials A is twice of B. Under thermal equilibrium temperature difference across the layer B is $36^{\circ}C$. The temperature difference across layer A is

A. $6^{\circ}\mathrm{C}$

B. $12^{\circ}\mathrm{C}$

C. $18^\circ C$

D. $24^\circ C$

Answer:

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3. A room at $20^\circ C$ is heated by a heater of resistence 20 ohm connected to 200 VV mains. The temperature is uniform throughout the room and the heati s transmitted through a glass window of area $1m^2$ and thickness 0.2 cm. Calculate the temperature outside. Thermal conductivity of glass is $0.2cal/mC^\circ$ s and mechanical equivalent of heat is $4.2J/cal$.

A. $15.24^\circ C$

B. $15.00^\circ C$

C. $24.15^\circ C$

D. none of these

Answer:

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4. A composite metal bar of uniform section is made up of length 25 cm of copper, 10 cm of nickel and 15 cm of aluminium. Each part being in perfect thermal contact with the adjoining part. The copper end of the composite rod is maintained at $100^\circ C$ and the aluminium end at

$0^\circ C$. The whole rod is covered with belt so that there is no heat loss occurs at the sides. If $K_{Cu} = 2K_{Al}$ and $K_{Al} = 3K_{Ni}$, then what will be the temperatures of $Cu - Ni$ and $Ni - Al$ junctions respectively

A. $23.33^\circ C$ and $78.86^\circ C$

B. $83.33^\circ C$ and $20^\circ C$

C. $50^\circ C$ and $30^\circ C$

D. $30^\circ C$ and $50^\circ C$

Answer:

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5. Three rods of the same dimension have thermal conductivities 3K, 2K and K. They are arranged as shown in fig. with their ends at $100^\circ C, 50^\circ C$ and $20^\circ C$. The temperature of their junction is

- $60^\circ C$
- $70^\circ C$
- $50^\circ C$
- $35^\circ C$

Answer:

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6. A black body is at a temperature of 2880 K. The energy of radiation emitted by this object with wavelength

between 499 nm and 500 nm isU_1, between 999 nm and 1000 nm is U_2 and between 1499 nm and 1500 nm is U_3. The Wein's constant $b = 2.88 \times 10^6 \text{nm K}$. Then

A. $U_1 = 0$

B. $U_3 = 0$

C. $U_1 > U_2$

D. $U_2 > U_2$

Answer:

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7. A body initially at $80^\circ C$ cools to $64^\circ C$ in 5 minutes and to $52^\circ C$ in 10 minutes. What will be its temperature

in 15 minutes and what is the temperature of its surroundings?

A. $42.7^\circ \mathrm{C}$

B. $35^\circ \mathrm{C}$

C. $47^\circ \mathrm{C}$

D. $40^\circ \mathrm{C}$

Answer:

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8. A $5cm$ thick ice block is there on the surface of water in a lake. The tmeperature of air $-10^\circ C$, how muct time it

will take to double the thickness of the block?

$\left(L = 80cal/g, K_{ice} = 0.004cal/s - K, d_{ice} = 0.92gcm^{-3}\right)$

A. 1 hour

B. 191 hours

C. 19.1 hours

D. 1.91 hours

Answer:

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9. A cylindrical rod with one end in a steam chamber and the other end in ice results in melting of 0.1 g of ice per second. If the rod is replaced by another with half the

length and double the radius of the first and if the thermal conductivity of material of second rod is 1/4 that of first, the rate at which ice melts in g/s will be

A. 3.2

B. 1.6

C. 0.2

D. 0.1

Answer:

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10. An ice box used for keeping eatables cool has a total wall area of $1m^2$ and a wall thichness of 5.0 cm. The

thermal cunductivity of the ice box is $K = 0.01 J/m^{\circ} C$. It is filled with large amount of ice at $0^{\circ} C$ along with eatables on a dfay when the temperature is $30^{\circ} C$ The latent heat of fusion of ice is $334 \times 10^3 J/kg$. The amount of ice melted in one day is (1 day $= 86,000 s$)

A. 776 gm

B. 7760 gm

C. 11520 gm

D. 1552gm

Answer:

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11. A solid copper sphere (density rho and specific heat c) of radius r at an initial temperature $200K$ is suspended inside a chamber whose walls are at almost $0K$. The time required for the temperature of the sphere to drop to 100K is .....

A. $\frac{72}{7}\frac{r\rho c}{\sigma}$

B. $\frac{7}{72}\frac{r\rho c}{\sigma}$

C. $\frac{27}{7}\frac{r\rho c}{\sigma}$

D. $\frac{7}{27}\frac{r\rho c}{\sigma}$

Answer:

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12. Four rods of identical cross-sectional area and made from the same metal form the sides of square. The temperature of two diagonally opposite points are T and $\sqrt{2}T$ respectively in the steady state. Assuming that only heat conduction takes place, what will be the temperature difference between other two points

A. $\frac{\sqrt{2}+1}{2}T$

B. $\frac{2}{\sqrt{2}+1}T$

C. 0

D. none of these

Answer:

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13. Consider two hot bodies B_1 and B_2 which have temperature $100^\circ \mathrm{C}$ and $80^\circ \mathrm{C}$ respectively at t = 0. The temperature of surroundings is $40^\circ \ \mathrm{C}$. The ratio of the respective rates of cooling R_1 and R_2 of these two bodies at$t = 0$ will be

A. $R_1 : R_2 = 3:2$

B. $R_1 : R_2 = 5:4$

C. $R_1 : R_2 = 2:3$

D. $R_1 : R_2 = 4:5$

Answer:

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14. A body cools from 60°C to 50°C in 10 min. Find its temperature at the end of next 10 min if the room temperature is $25^\circ C$. Assume Newton's law of cooling holds.

A. 38.5°C

B. 40°C

C. 42.85°C

D. 45°C

Answer:

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15. The rates of cooling of two different liquids put in exactly similar calorimeters and kept in identical surroundings are the same if

A. The masses of the liquids are equal

B. Equal masses of the liquids at the same temperature are taken

C. Different volumes of the liquids at the same temperature are taken

D. Equal volumes of the liquids at the same temperature are taken

Answer:

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16. For cooking the food, which of the following type of utensil is most suitable

A. High specific heat and low conductivity

B. High specific heat and high conductivity

C. Low specific heat and low conductivity

D. Low specific heat and high conductivity

Answer:

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17. Two rods A and B are of equal lengths. Their ends of kept between the same temperature and their area of cross-section are A_1 and A_2 and thermal conductivities K_1 and K_2. The rate of heat transmission in the two rods will be equal, if

A. $K_1A_2 = K_2A_1$

B. $K_1A_1 = K_2A_2$

C. $K_1 = K_2$

D. $K_1A_1^2 = K_2A_2^2$

Answer:

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18. While measuring the thermal conductivity of liquids the upper part is kept hot and lower cooled so that .

A. Convection may be stopped

B. Radiation may be stopped

C. Heat conduction is easier downwards

D. It is easier and more convenient to do so

Answer:

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19. When fluids are heated from the bottom, convection currents are produced because

A. Molecular motion of fluid becomes aligned

B. Molecular collisions take place within the fluid

C. Heated fluid becomes more dense than the cold fluid above it

D. Heated fluid becomes less dense than the cold fluid above it

Answer:

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20. If between wavelength λ and$\lambda + d\lambda$, e_λ and a_λ be the emissive and absorptive powers of a body and E_λ be the

emissive power of a perfectly black body, then according to Kirchoff's law, which is true

A. $e_\lambda = a_\lambda = E_\lambda$

B. $e_\lambda E_\lambda = a_\lambda$

C. $e_\lambda = a_\lambda E_\lambda$

D. $e_\lambda a_\lambda E_\lambda = \text{constant}$

Answer:

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21. 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

Answer:

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22. Two bodies A and B have thermal emissivities of 0.01 and 0.81 respectively. The outer surface areas of the two bodies are same. The two bodies emit total radiant power at the same rate. The wavelength λ_B

corresponding to maximum spectral radiancy from B is shifted from the wavelength corresponding to maximum spectral radiancy in the radiation from A by 1.0 μm. If the temperature of A is 5802 K, calculate (a) the temperature of B, (b) wavelength λ_B.

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

Answer:

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23. A cane is taken out from a refrigerator at $0^\circ \mathrm{C}$. The atmospheric temperature is $25^\circ \mathrm{C}$. If t1 is the time taken to heat from $0^\circ \mathrm{C}$ to $5^\circ \mathrm{C}$ and t_2 is the time taken from $10^\circ \mathrm{C}$ to $15^\circ \mathrm{C}$, then the wrong statements are

(1) $t_1 > t_2$

(2)$t_1 = t_2$

(3) There is no relation

(4)$t_1 < t_2$

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

Answer:

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24. The rate of loss of heat from a body cooling under conditions of forced convection is proportional to its

(1) surface area

(2) excess of temperature over that of surrounding

(3) heat capacity

(4) absolute temperature

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

Answer:

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25. A brass ball of mass 100g is heated to $100^\circ \mathrm{C}$ and then dropped into 200g of turpentine in a calorimeter at $15^\circ \mathrm{C}$. The final temperature is found to be $23^\circ \mathrm{C}$. Take specific heat of brass as $0.092 \mathrm{cal}/\mathrm{g}^\circ \mathrm{C}$ and water equivalent of calorimeter as 4g.

The specific heat of turpentine is

A. $0.42 \mathrm{cal}/\mathrm{g}^\circ \mathrm{C}$

B. $0.96 \mathrm{cal}/\mathrm{g}^\circ \mathrm{C}$

C. $0.72 \mathrm{cal} / \mathrm{g}^{\circ} \mathrm{C}$

D. $0.12 \mathrm{cal} / \mathrm{g}^{\circ} \mathrm{C}$

Answer:

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26. A brass ball of mass 100g is heated to $100^{\circ} \mathrm{C}$ and then dropped into 200g of turpentine in a calorimeter at $15^{\circ} \mathrm{C}$. The final temperature is found to be $23^{\circ} \mathrm{C}$. Take specific heat of brass as $0.092 \mathrm{cal} / \mathrm{g}^{\circ} \mathrm{C}$ and water equivalent of calorimeter as 4g.

Heat lost by the ball is approximately

A. 810 cal

B. 610 cal

C. 710 cal

D. 510 cal

Answer:

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27. A brass ball of mass 100g is heated to $100^\circ \mathrm{C}$ and then dropped into 200g of turpentine in a calorimeter at $15^\circ \mathrm{C}$. The final temperature is found to be $23^\circ \mathrm{C}$. Take specific heat of brass as $0.092 \mathrm{cal}/\mathrm{g}^\circ \mathrm{C}$ and water equivalent of calorimeter as 4g.

Heat gained by turpentine and calorimeter is approximately

A. 810 cal

B. 610 cal

C. 710 cal

D. 510 cal

Answer:

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28. Assertion : The equivalent thermal conductivity of two plates of same thickness in contact (series) is less than the smaller value of thermal conductivity.

Reason : For two plates of equal thickness in contact (series) the equivalent thermal conductivity is given by

$$\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2}$$

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.

Answer:

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29. Assertion : Coefficient of absorption of radiation of an ideal black body is 1.

Reason : An ideal black body emits radiation of all wavelengths.

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.

Answer:

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30. Statement-1 : As temperature of a black body is raised, wavelenght corresponding to which energy emitted is maximum, reduces.

Statement-2 : Higher temperature would mean higher energy and hence higher wavelength.

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.

Answer: