PHYSICS

AIMED AT STUDENTS PREPARING FOR IIT JEE EXAMS

TRANSMISSION OF HEAT

Solved Example

1. The temperature of the two ends A and B of a rod of length $25cm$ and circular cross section are $100^\circ C$ and $0^\circ C$ respectively In the steady state, find the temperature at a point $10cm$ from the end B (ifnore loss of heat from curved surface of the body) ?

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2. Two walls of thicknes l_1 and l_2 and ther-mal condctivities K_1 and K_2 are in contact In the steady state, if the temperature at the outer faces are T_1 and T_2 find the temperature at the common wall .

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3. A rod of length L with sides fully insulated is made of a material whose thermal conductivity K varies with temperature as $K = \frac{\alpha}{T}$ where α is constant. The ends of rod are at temperature T_1 and $T_2(T_2 > T_1)$ Find the rate of heat flow per unit area of rod .

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4. A cubical thermocol ice box of side length $30cm$ has thichess of $5.0cm$ If $4.0kg$ of ice is put in the box estimate the amount of ice remaining after $6hr$ The utside temperature is $45^\circ C$ and co-efficinet of the thermal conductivity of the thermocol is $0.01Js^{-1}m^{-1}K^1$ (Latent Heat of fusion of water $= 335 \times 10^3 Jkg^{-1}$) .

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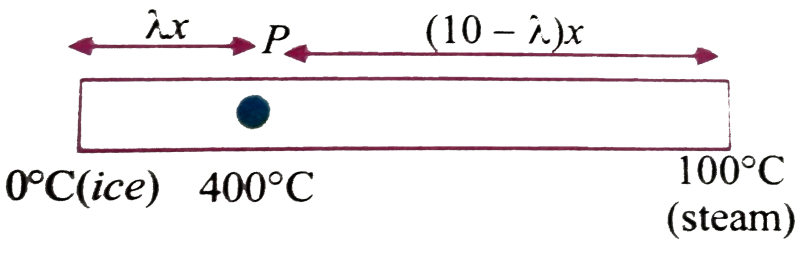
5. A metal rod AB of length $10x$ has it one end in ice at $0^\circ C$ and the other end B in water at $100^\circ C$ If a point P on the rod is maintained at $400^\circ C$ then it is found that equal amounts of water and ice evaporate and melt per unit time. The latent heat of melting of ice is $80cal/g$ If the point P is at a distance of λx from the ice end A find the value of λ [neglect any heat loss to the surrounding] .



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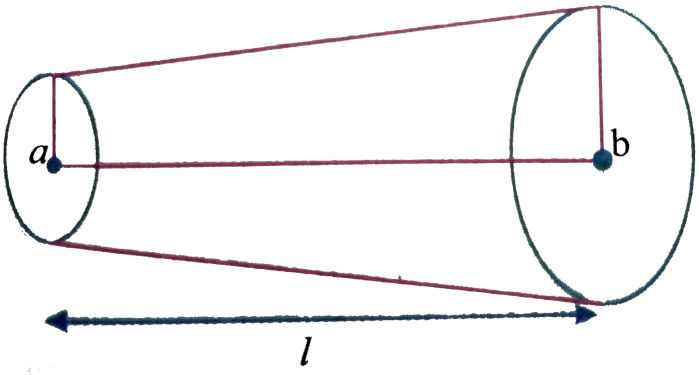
6. Find the value of the thermal resistance of the non-uniform cylindrical rod of thermal conductivity K and length I as shown in



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7. A room has a window fixed with a pane of area $1.2m^s$ The glass has thickness $2.2mm$ If the temperature outside the room is $36^\circ C$ and the temperature inside is $26^\circ C$

(a) calculate the heat flowing into the room every hour

(b) If the same single pane window is replaced by double paned window with an air gap of $0.50cm$ between the two panes calculate the heat flowing into the room every hour

$K_g = 0.80Wm^{-1}K^{-1}$, $K_{air} = 0.0234Wm^{-1}K^{-1}$.

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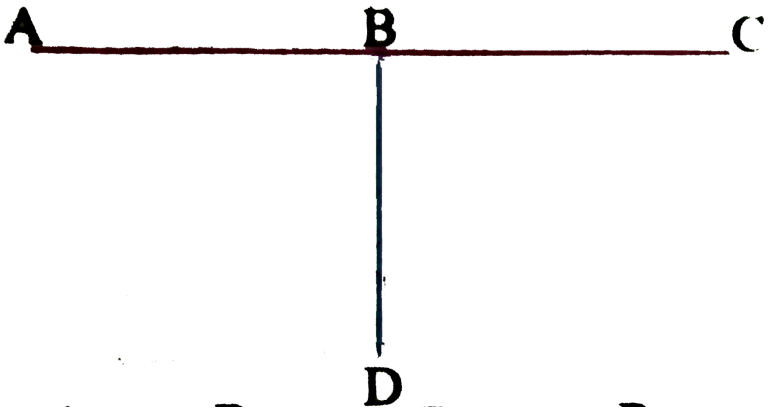
8. Three rods AB, BC and BD made of the same materical and having the same area of cross section have been joined as shown is the The ends A, C and D are held at temperatures $20^\circ C$ Cand $80^\circ C$ respectively If each rod is of same length then find the temperature at the junction B of the three rods



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9. Three rods of Copper Branss and Steel are welded together to form a Y-shaped structure Area of cross -section of each rod is $4cm^{-2}$ End of copper rod is maintained at $100^\circ C$, where as ends of brass, steel are kept at $0^\circ C$ Lenths of the copper brass and steel rods are 46, 13 andd $12cms$ respectively The rods are thermally insulated from surroundings except

at ends Thermal conductivities of copper, brass and steel are $0.92, 0.26$ and $0.12 CGS$ units respectively Rate of heat flow through coper rod is .

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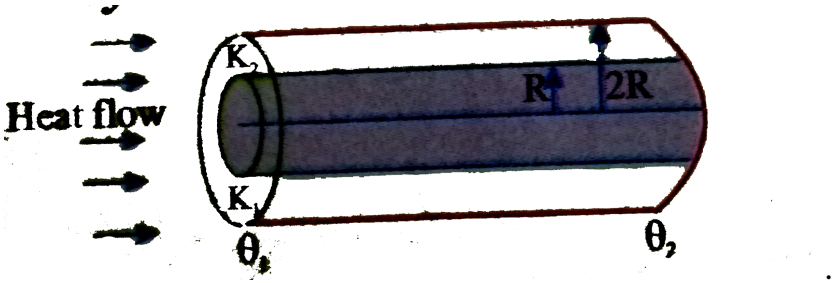
10. A cylinder of radius R made of a material of thermal conductivity K_1 is surrounded by cylindrical shell of inner radius R and outer radius $2R$ made of a material of thermal con-ductivity K_2 The two ends of the combined system are maintained at two differnet tem-peratures There is no loss of heat across the cylindrical surface and system is in steady state What is the effective thermal conductivity of the system



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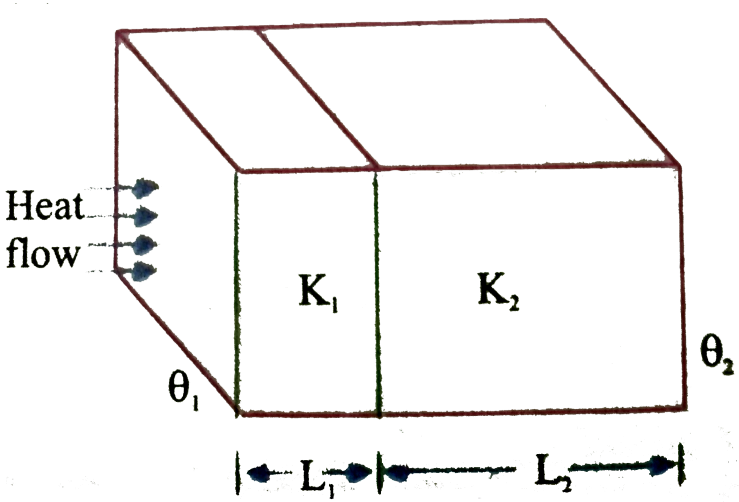
11. Two plates each of area A thickness L_1 and L_2 thermal conductivities K_1 and K_2 respectively are joined to from a single plate of thickness $(L_1 + L_2)$ If the temperatures of the free surfaces are θ_1 and θ_2 Calculate

(a) Rate of flow of heat

(b) Temperature of interface



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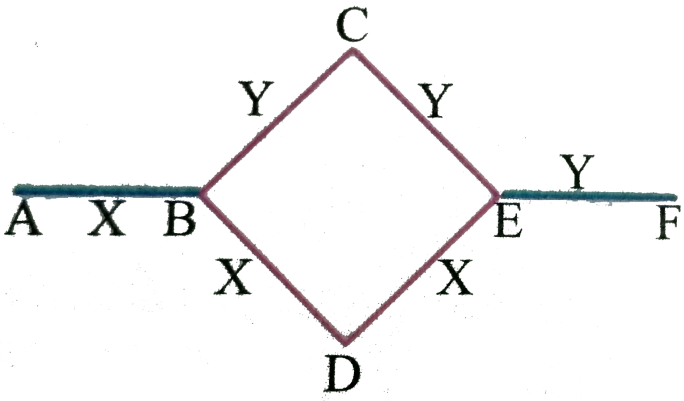
12. Rods X and Y of identical dimensions but of different materials are joined as shown in The length of each part is the same It the temperature of end A and F be main tained at $100^\circ C$ and $20^\circ C$ respectively then

find the temperatures of the junctions B and E (Thermal conductivity of X is double that of Y) .



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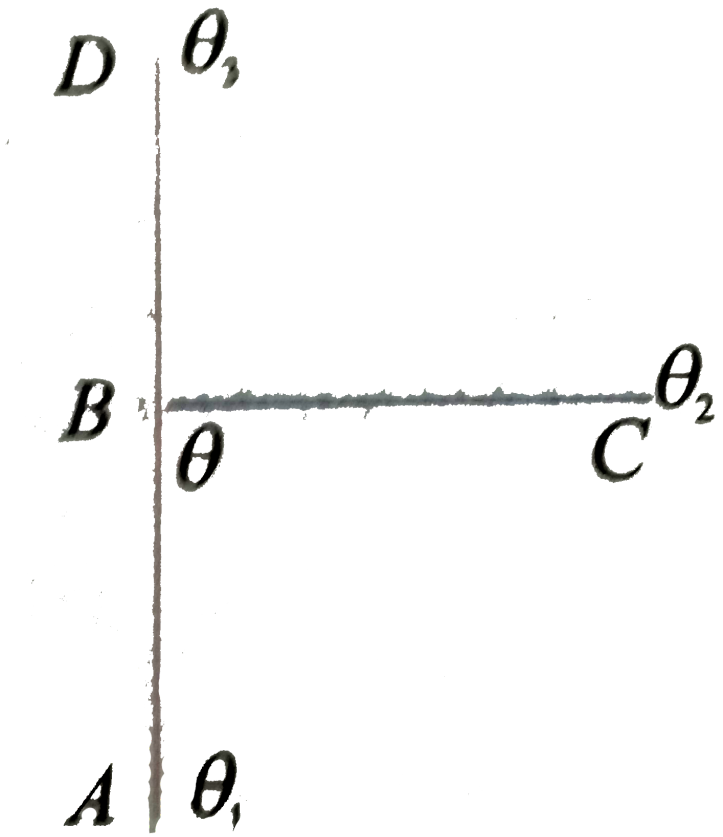
13. Three rods AB, $BC$and BD having thremal conductivities in the ratio $1:2:3$ and lengths in the ratio $2:1:1$ are joined as shown in The ends A, C and D are at temperature θ_1, θ_2 and θ_3 respectively Find the temperature of the junction B

(Assume steady state and $\theta_1 > \theta > \theta_2 > \theta_3$)



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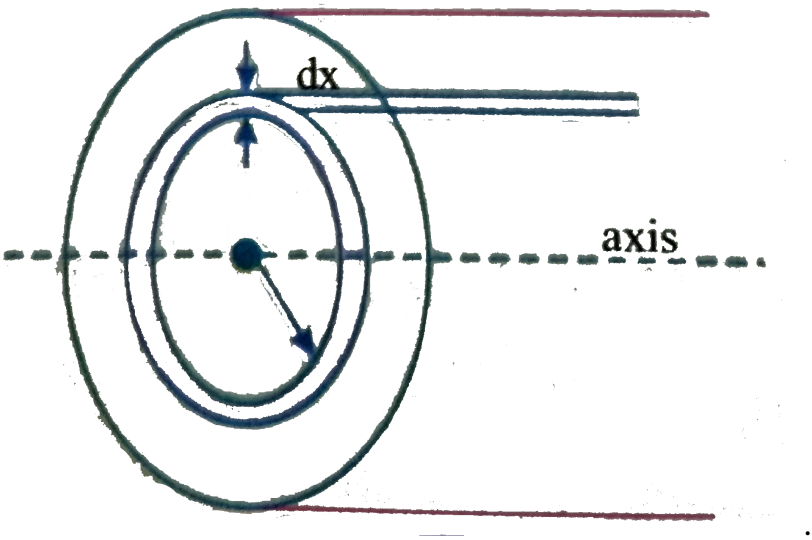
14. A cylinder of radius R and length l is made uo of a substnace whose thermal conductivity K varies with the distance x from the axis as $K = K_1 x + K_2$ Detemine the effective thermal conductivity between the

flat faces of the cylinder



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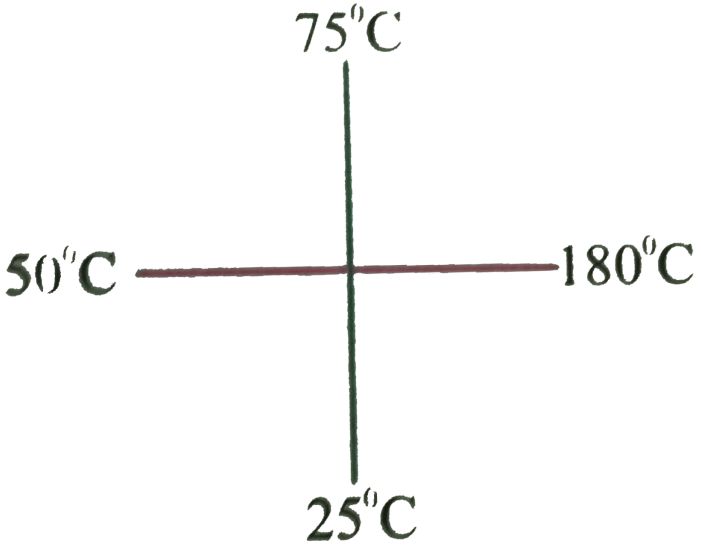
15. Two identical rods are joined at their middle points The ends are maintained at constant temperatures as indicated Find the temperature

of the junction



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16. The thickness of ice in a lake is $5cm$ and the atmospheric temperature is $10^{\circ}C$ Calculate the time rquired for the thickness of ice to grow to $7cm$ Therml conductivity for ice $= 4 \times 10^{-3} calcm^{-1}s^{-1}c^{-10}$ density of ice $= 0.92g/cm^3$ and latent heat of fusion of ice $= 80cal/g$.

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17. A hollow sphere of glass whose external and internal radii are $11cm$ and $9cm$ respec-tively is completely filled with ice at $0^\circ C$ and placed in a both of boiling water How long will it take for the ice to melt completely ? Givne that density of ice $= 0.9g/cm^3$ latent heat of fusion of ice $= 80cal/g$ and thermal conductivity of glass $= 0.002cal/cm - s^\circ C$.

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18. In the Ingen hausz method to compare the thermal conductivities of differnet substances the length upto which wax melted in copper and zinc rods are $9.3cm$ and $5cm$ respectively Compare their thermal conductivities .

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19. A stema pipe with a radius R_1 is surrounded by an insulating jacket with an outer radius of R_0 If the temperature of the inner (θ_1) and outer (θ_0) surface are fixed $(\theta_1 > \theta_0)$ find the heat flow through the jacket.

(Apply the heat conduction euation to steady state radial heat flow corresponding to cylindrical symmetry) .

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20. A steam pipe of radius $5cm$ carries steam at $100^{\circ}C$ The pipe is covered by a jacket of insulating material $2cm$ thick having a ther mal conductivity $0.07Wm^{-1}k^{-1}$ if the tempera ture at the outer wall of the pipe jacket is $20^{\circ}C$ how much heat is lost through the jacket per mater lenght in an hour ? .

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21. A trunner moves along the road at $2ms^{-1}$ in still air that is at a temperature of $29^{\circ}C$ His surface area is $1.4m^2$ of which apporoximately $85\,\%$ is exposed to the air Find the rate of convective heat loss from his skin at a temperature $35^{\circ}C$ to the outside air ? Coefficient of convection for dry air and bare skin at whind speed $2ms^{-1}$ is $22W/m^2-C$.

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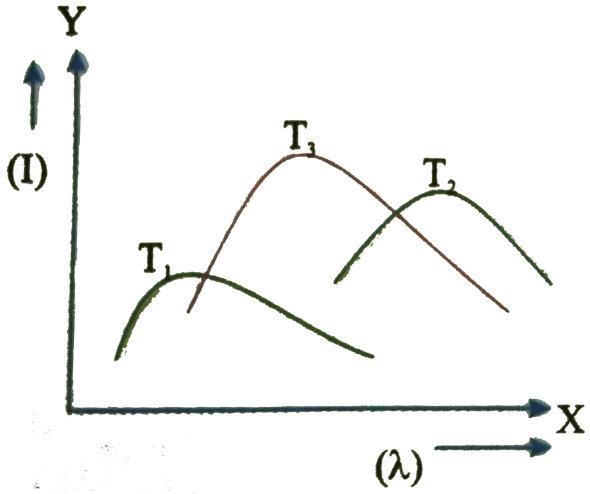
22. The plots of intensity versus wavelength for three black bodies at temperatures T_1, T_2 and T_3 respectively are shown in Their temperatures are shown in How their temperatures are related ?



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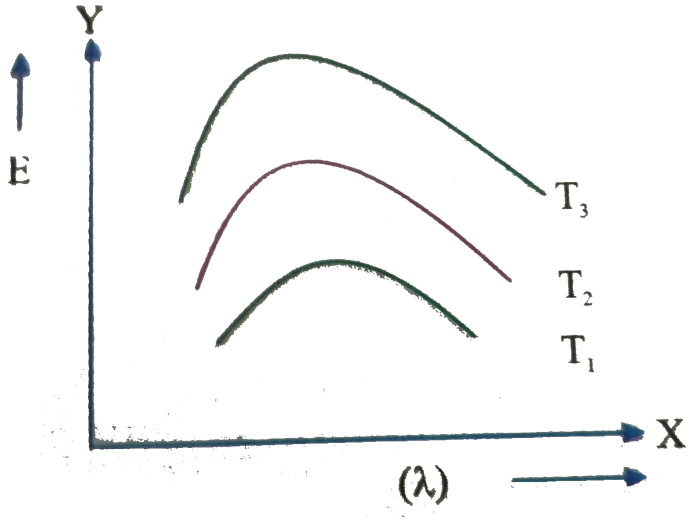
23. Variation of radiant energy emitted by Sun, filament of Tungsten Lamp and welding arc as a function of its wavelength shown in Identify the

temperatures of Sun. filament lamp and welding are



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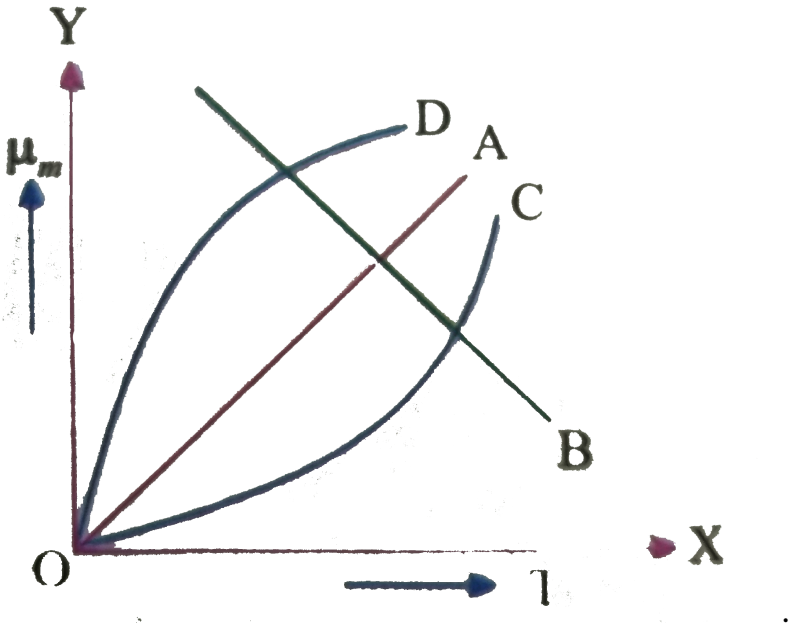
24. The frequency (v_m) corresponding to which energy emitted by a black body is maximum may vary with temperature T of the body as shown in

Which of the curves repersents correct variation ?



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25. If a black body is radiating at $T = 1650K$ at what wavelenght is the intensity maximum ? .

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26. Two spherical bodies A (radius 6cm) and B (radius 18cm) are at temperature T_1 and T_2 respectively The maximum intensity in the emission spectrum of A is at $500nm$ and in that of B is at $1500nm$ considering them to be black bodies, what will be the ratio of the rate of total energy radiated by A to that of B . ?

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27. Find the temperature of an oven if it radiates 8.28 cal per second through an opening whose area is $6.1cmcm^2$ Assume that the radiation is close to that of a black body ? .

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28. Three very large plates of same area are kept parallel and close to each other. They are considered as ideal black surface and have very high thermal conductivity The first and thired plates are maintained at

temperatures $2T$ and $3T$ respectively Find the temperature of the middle (i.e second) plate under steady state .

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29. A sphere with diameter of $80cm$ is held at a temperature of $250^{\circ}C$ and is radiating en-ergy If the intensity of the radiation detected at a distance of $2.0m$ from the sphere 's cnetre is $102W/m^2$ What is the emissivity of the shere ? .

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30. One end of a rod of length $20cm$ is inserted in a furnace at $800K$ The sides of the rod are coverd with an insulating meterial and the other end emits radiation like a black boy The temperature of this end is $750K$ in the steady state The temperature of the surrounding air is $300K$ Assuming radiation to be the only imporatant mode of energy transfer between the surrounding and the open end of the rod, find the thermal conductivity of the rod Stefan's constant $\sigma = 6.0 \times 10^8 Wm^{-2}K^{-4}$.

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31. A body cools from $80^\circ C$ to $50^\circ C$ in 5 minutes Calculate the time it takes to cool from $60^\circ C$ to $30^\circ C$ The temperature of the surroundings is $20^\circ C$.

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32. Two sheres made of same material have their radii in the ratio $1:3$ They are heated to the same temperature and kept in the same surroudings at a moderate temperature Show that the ratio of their initial rates of fall of temperature is $3:1$ if the bodies are cooled by natural convection and radiation .

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C .U .Q

1. Why metals are good conductors of heat ?

A. they contain large number of free electrons

B. their aloms are relatively apart

C. their atoms collide frequently

D. they have reflecting surface

Answer: A

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2. In steady state .

A. heat received is partly conducted and partly radiated.

B. heat is not absorbed

C. both 1 and 2

D. all the heat is conducted

Answer: C

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3. Two rods of different materials having differnet lengths and same cross sectional areas are joined end to end in a straight line. The free ends of this compound rod are maintained at different temperatures The temperature gradient in each rod will be .

A. same

B. zero

C. directly proportional to thermal conductivity of rod

D. inversely proportional to thermal conductivity of the rod .

Answer: D

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4. A piec of paper wrapped tightly on a wooden rod is found to get charged quickly when held over a flame compared to similar piece when wrapped on a brass on a brass rod This is because .

A. brass is good conductor and wood is a bad conductor of heat

B. brass is a bad conductor of heat

C. wood contains large number of free electrons

D. wood is a good conductor of heat

Answer: A

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5. When heat flows through a wire of uniform cross section under steady state, then

A. temperature gradient is same every where

B. temperature at a particular point remains same

C. rate of heat flow is same at all cross sections

D. all the above

Answer: D

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6. Temperature is analogous to

A. charge

B. potential difference

C. electric field strength

D. force

Answer: B

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7. On heating one end of a rod the temperature of the whole rod will be uniform when .

A. $k = 1$

B. $k = 0$

C. $k = 100$

D. $k = \infty$

Answer: D

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8. For an ideal conductor thermal resistance is .

A. unity

B. infinity

C. zero

D. 1000

Answer: C

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9. A metal rod of area of cross section A has length L and coefficient of thermal conductivity K the thermal resistance of the rod is .

A. $\frac{L}{KA}$

B. $\frac{KL}{L}$

C. $\frac{KA}{L}$

D. $\frac{A}{KL}$

Answer: A

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10. Thermmal conductivity of a metal rod depends on .

A. area of cross section

B. temperature gradient

C. time of flow of heat

D. all the above

Answer: D

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11. Coefficient of thermal conductivity .

A. depends upon nature of the meterial of the body

B. is independent of dimensions of the body

C. both 1 and 2

D. depends on temperature difference

Answer: C

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12. If the end of metal rod is heated then the rate of flow the heat does not depend on

A. area of end of the rod

B. mass of the rod

C. time

D. temperature gradient

Answer: B

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13. In the following solids thermal conductivity is maximum for .

A. copper

B. aluminium

C. gold

D. silver

Answer: D

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14. For a perfect insulator coefficient of thermal conductivity is .

A. zero

B. infinire

C. one

D. two

Answer: A

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15. Why is it hotter at the same distance over the top of a fire than in front of it?

A. air conducts heat upwards only

B. heat is radiated upwards only

C. convection of heat occurs upwards only

D. heat is radiated downwards only

Answer: C

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16. The process in which rate of transfer of heat maximum is .

A. convection

B. convection

C. radiation

D. in all these heat is transferred with the same speed

Answer: C

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17. By which of the following methods could a cup of hot tea loss heat when placed on metallic table in a class room .

A. a,b

B. b,c

C. a,b,c

D. a,b,c,d

Answer: D

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18. The thermal radiations are similar to .

A. X-rays

B. cathode rayes

C. alpha-rays

D. gamma -rays

Answer: A

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19. The temperature at which a black body ceases to radiate energy is .

A. $0K$

B. $273K$

C. $-273k$

D. at all temperatures

Answer: A

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20. The intensity of energy radiated by a hot body at distance r from it varies as .

A. r^2

B. $\frac{1}{r^2}$

C. $\frac{1}{r^4}$

D. $\frac{1}{r^3}$

Answer: B

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21. When a body has the same temperature as that of its surroundings

A. it does not radiate heat

B. it radiates same quantity of heat as it receives from the surroundings

C. it radiates same quantity of heat as it receives from the surroundings

D. it radiates same quantity of heat as it receives from the surroundings

Answer: B

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22. One healf of a slab of ice is covered with black cloth and the other half with white cloth This is then placed in sunlight After some time the pieces of cloth are removed Then .

A. ice has melted equally under both the pieces

B. more ice has melted under white cloth

C. more ice has melted under black cloth

D. it will depend on the medium in which ice is placed

Answer: C

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23. Compared to a person with white skin another person with dark skin will experience .

A. less heat and more cold

B. more heat and more cold

C. more heat and less cold

D. less heat and less cold

Answer: B

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24. Which of the following statements is wrong ?

A. rough surface are better radiators than smooth surface

B. highly polised mirror like surfaces are very good radiators

C. black surfaces are better absobers than white ones .

D. black surfaces are better radiators than white ones .

Answer: B

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25. The physical factor distinguishes thermal radiation from visible light is

.

A. wavelenght

B. pressure

C. temperature

D. amplitude

Answer: A

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26. If we place our hand below a lighted electric bulb We feel warmer because of .

A. convection

B. radiation

C. conduction

D. both 1 and 2

Answer: B

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27. Heating effect of the incoming solar radiation is maximum at local noon because .

A. atmospheric absorption is zero

B. sun's rays travel through minimum air thicknes

C. solar rays are vetical to the ground

D. outgoing radiation is minimum

Answer: B

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28. The absorptivity of Lamp black and platinum black is .

A. 0.91

B. 0.98

C. 1.00

D. 0.99

Answer: B

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29. Absorptive power of a white body and of a perfectly black body respectively are .

A. $1, 0$

B. 0.1

C. $-1, \ -1$

D. $\infty, 0$

Answer: B

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30. Three bodies A, B, C are at $-27^\circ C, 0^\circ C, 100^\circ C$ respectively The body which does not radiate heat is .

A. A

B. B

C. All the bodies radiate heat

D. C

Answer: C

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31. At high temperature black body spectrum is .

A. continuous absorption

B. line absorption

C. continuous emission

D. line emission

Answer: C

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32. A black body emits

A. radiations of all wave lenghts

B. no radiation

C. radiation of single wave length

D. radiation of selected wave length

Answer: A

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33. The best laboratory approximation to an ideal black body is .

A. lump of charocoal heated to high temperature

B. a glass surface coated with coal tar

C. a metal coated with black dye

D. a hollow enclosure blackened inside with lamp black and have a small hole

Answer: D

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34. A black body does not .

A. emit radiation

B. reflect radiation

C. absorb radiation

D. emit and absorb radiation

Answer: B

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35. If the amount of heat energy received per unit area from the Sun is measured on Earth Mars and Jupiter it will be .

A. the same for all

B. in decrasing order of Jupiter Mars, Earth

C. in increasing order of Jupiter Mars, Earth

D. in decrasing order of Jupiter Mars, Earth

Answer: C

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36. The colour of a star is a measure of its .

A. age

B. temperature

C. size

D. distance from the earth

Answer: B

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37. 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. heat conduction is easier downward

D. it is easier and more convenient to do so

Answer: A

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38. If 'p' calorie of heat energy is incident on a body and absorbs 'q' calories its coefficient of absorption is .

A. p/q

B. $p-q$

C. q/p

D. $q + P$

Answer: C

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39. The velocity of heat radiation in vacuum is .

A. Equal to that of light

B. Less than that of light

C. Greater than that of light

D. Equal to that of sound

Answer: A

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40. Distribution of enrgy in the spectrum of a black body can be correctly repersented by .

A. Wien's law

B. Stefan's las

C. Planck 's law

D. Kirchhoff's law

Answer: C

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41. Four pieces of iron are heated to different are respectively red, yellow orange and white respectively The one that is heated to the highest temperature will exhibit the colour .

A. `White

B. Yellow

C. Red

D. Orange

Answer: A

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42. A star which appears blue will be

A. much hotter than the sun

B. colder than the Sun

C. as hot as the Sun

D. $at - 273^{\circ} C$

Answer: A

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43. If a star is colder than the Sun it appears

A. Yellow

B. Red

C. Blue

D. Violet

Answer: B

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44. The amount of radiation emitted by a perfectly black body is proportional to .

A. temperature on ideal gas scale

B. fourth root of temperature on ideal gas scale

C. fourth power of temperature on ideal gas scale

D. source of temperature on ideal scale

Answer: C

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45. At a given temperature the ratio between emissive power and absorptive power is same for all bodies and is equal to the emissive power of black body This statemetn is called .

A. Newton's Law

B. Planck's law

C. Kirchoff's law

D. Wien ,s law

Answer: C

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46. If the sun become twice hotter it will radiate .

A. energy sixteen times larger

B. predominantly in the infrared

C. predominantly in the ultra violet

D. energy sixteen times smaller

Answer: A

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47. Three identical shperes of different meterials iron gold and silver are at the same temperature The one that radiates more energy is .

A. Gold

B. Silver

C. Iron

D. All radiate equally

Answer: D

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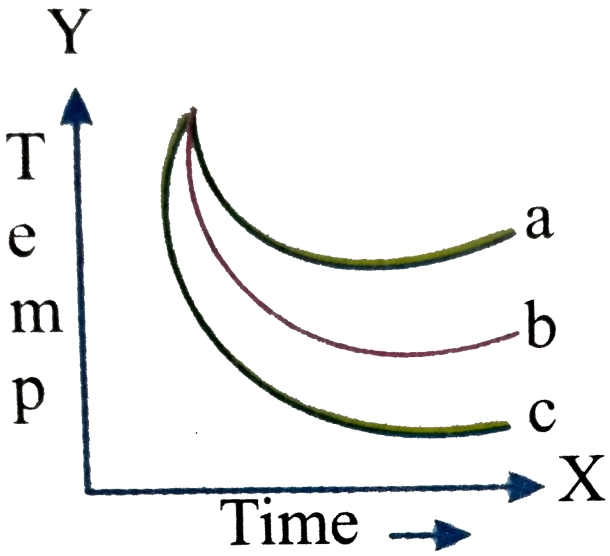
48. Cooling graphs are drawn for three liquids a,b and c The specific heat is maximum for liquid



A. a

B. b

C. c

D. for all the three a,b and c

Answer: A

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49. A black body of temperature T is inside a chamber of temperature T_0 Now the closed chamber is slightly opened to Sun that temeperature of black body (T) and chamber (T_0) remain constant .

A. Black body will absorb more radiation from the Sun .

B. Black body will absorb less radiation from the Sun .

C. Black body emits more thermal energy

D. Black body emits thermal energy equal to the thermal energy absorbed by it .

Answer: D

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50. The rate of cooling of a body is .

A. independent of the nature of the surface of the body

B. independent of the area of the body

C. dependent on the excess of temperature of the body above that of the surroundings .

D. independent of the temperature of the surroundings

Answer: C

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51. A cube a sphere and a circular plate made of same meterial and having same mass are heated to same high temperature The body that cools at the least rate when left in air at room temperature is .

A. Sphere

B. Cube

C. Circular plate

D. All at the same rate

Answer: A

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52. Newton's law of cooling is applied in laboratory for the determination of the .

A. Specific heat of gases

B. Latent heat of gases

C. Specific heat of liquids

D. Latent heat of liquids

Answer: C

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53. Newton's law of cooling is a special case of .

A. Kirchoff' s law

B. Wien' s law

C. Stefan-Bolzmann's law

D. Planck' s law

Answer: C

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54. The amount of heat energy radiated per second by a surface depends upon .

A. Depends upon nature of the meterial of the body

B. Difference of temperature between the surface and its surroundings

C. Nature of the surface

D. All the above

Answer: D

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55. Four identical copper cylinders are painted If they are all heated to the same temperature and left in vacuum which will cool most rapidly .

A. Painted shiny white

B. Painted rough black

C. Painted shiny black

D. Painted rough white

Answer: B

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56. If T_B and T_s are the temperatures of the body and the surroundings and $T_B - T_s$ is of very high value, then the rate of cooling in natural convection is proportional to .

A. T_B^4

B. T_S^4

C. $(T_B - T_S)^{\frac{5}{4}}$

D. $\left(T_B^{\frac{5}{4}} - T_S^{\frac{5}{4}}\right)$

Answer: A

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57. Newton's law of cooling is a law connected with .

A. Conduction

B. Convection

C. Radiation

D. Convection and Radiation

Answer: D

Watch Video Solution

58. Newton's law of cooling holds good provided the temperature difference between the body and the surroundings is .

A. large

B. small

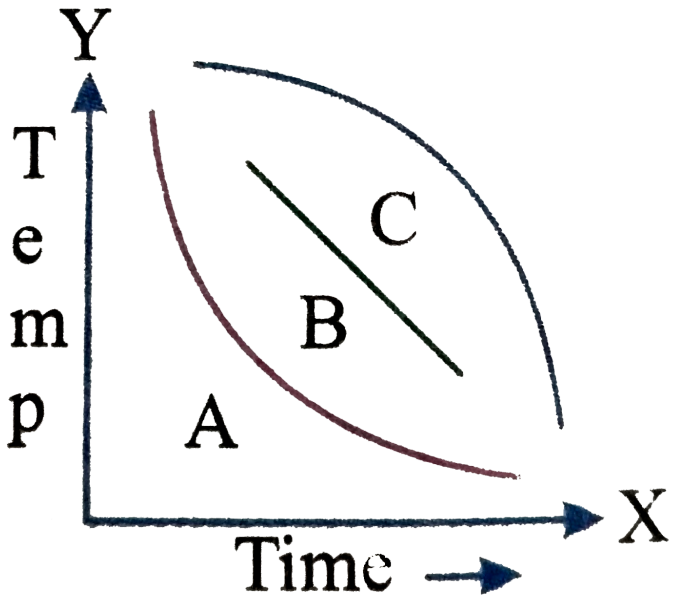
C. very large

D. any value

Answer: B

Watch Video Solution

59. 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. A and C

Answer: A

Watch Video Solution

60. Let there be four articles having colours blue red black and white. When they are heated together and allowed to cool, the article that cool earlier is .

A. Blue

B. Red

C. Black

D. White

Answer: C

Watch Video Solution

61. Which of the following qualities are best suited for cooking utensils ? .

A. High specific heat and low thermal conductivity

B. High specific heat and low thermal conductivity

C. Low specific heat and low thermal conductivity

D. Low specific heat and high thermal conductivity

Answer: D

Watch Video Solution

62. The bulb of a thermometer is spherical and that of another is cylindrical Equal quantity of mercury is filled in them Then .

A. thermometer with spherical bulb will respond quickly

B. thermometer with cylindrical bulb will respond slowly

C. thermometer with spherical bulb will respond slowly

D. thermometer with cylindrical bulb will respond quickly

Answer: D

Watch Video Solution

63. Which of the following methods of flow of heat is (are) based on gravitational attraction ?.

A. Conduction

B. Convection

C. Radiation

D. All of these

Answer: B

Watch Video Solution

64. 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 $O^\circ C$ and temperature of other ends are $30^\circ C$ and $40^\circ C$ 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

Answer: A

Watch Video Solution

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

A. convectional flow is stopped

B. radiation is stopped

C. conduction is easier

D. it is easire to perform the experiment

Answer: A

Watch Video Solution

66. The templitude of radiations from a cylindrical heat source is related to the distance is .

A. $A \propto 1/d^2$

B. $A \propto \frac{1}{\sqrt{d}}$

C. $A \propto d$

D. $A \propto d^2$

Answer: B

Watch Video Solution

67. Kirchoff's law states that

A. a body absorbs radiation of shorter wavelengths and emits radiation of higher wavelength

B. a body absorbs radiation of any wavelenght but emits radiation of specific wavelenghts

C. a body absorbs and emits radiation of same wavelengths

D. none of these

Answer: C

Watch Video Solution

68. If pressure on a gas is increased from P to $2P$ then its heat conductivity

Watch Video Solution

69. Two layers of cloth of equal thickness provide warmer covering than a single layer of cloth of double the thckness, because they .

A. behave like a thermos 2 have lesser thickness

B. have lesser thickness

C. allow heat from atmosphere to the body

D. enclose between them a layer of air

Answer: D

Watch Video Solution

70. In a room containing air, heat can go from one place to another

A. conduction

B. convection

C. radiation

D. all of these

Answer: B

Watch Video Solution

71. The reflectance and emittance of a perfectly black body are rspectively

A. $0, 1$

B. $1, 0$

C. $0.5, 0.5$

D. 0,0

Answer: A

Watch Video Solution

72. Wien's displacement law fails at .

A. low temperature

B. high temperature

C. short wavelenght

D. long wavelength

Answer: D

Watch Video Solution

73. A surface at temperature $T_0 K$ receives power P by radiation from a small sphere at temperature $T < T_0$ and at a distance d. If both T and d are doubled the power received by the surface will become .

A. P

B. $2P$

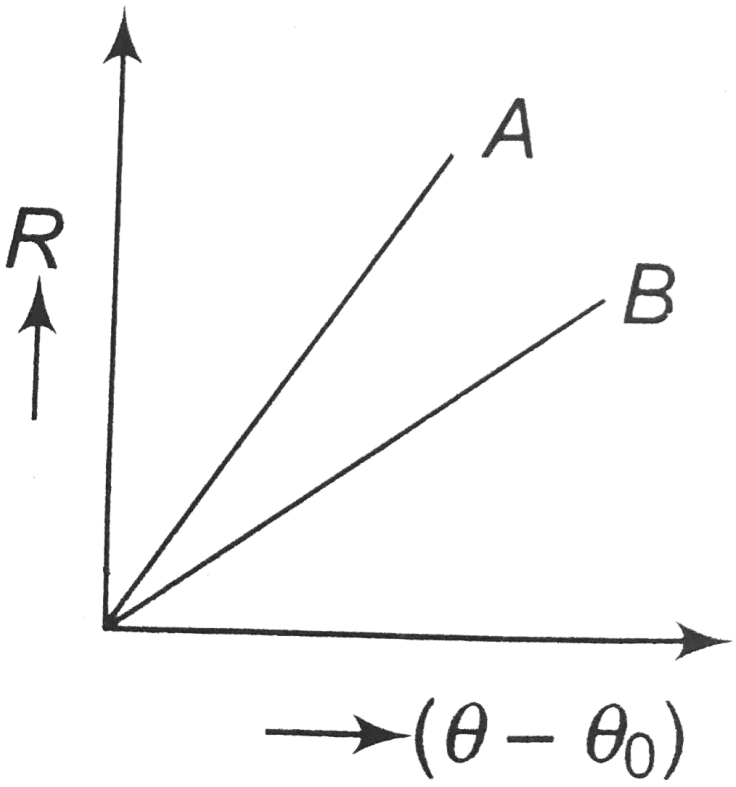
C. $4P$

D. $16P$

Answer: C

Watch Video Solution

74. Two circular disc A and B with equal radii are blackened. They are heated to same temperature and are cooled under identical conditions. What inference do your draw from their cooling curves?



A. A and B have same specific heats

B. Specific heat of A is less

C. Specific heat of B is less

D. Nothing can be said

Answer: B

Watch Video Solution

75. A solid at temperature T_1 is kept in an evacuated chamber at temperature $T_2 > T_1$. The rate of increase of temperature of the body is proportional to

A. $T_2 - T_1$

B. $T_2^2 - T_1^2$

C. $T_2^3 - T_1^3$

D. $T_2^4 - T_1^4$

Answer: D

Watch Video Solution

76. The thermal radiation emited by a body is proportional to T^n where T is its absolute temperature. The value of n is exactly 4 for

A. a balc kbody

B. all bodies

C. bodie painted black only

D. polished bodies only

Answer: B

Watch Video Solution

77. A blackbody does not

A. emit radiation

B. absorb radiation

C. reflect and refract radiation

D. All the above

Answer: C

Watch Video Solution

78. In summer, a mild wind is often found on the shore of a clam river. This is caused due to

A. difference in thermal conductivity of water and soil

B. convection currents

C. conduction between air and the soil

D. radiation from the soil

Answer: B

Watch Video Solution

79. A heater body emits radiation which has maximum intensity near the frequency v_0 The emissivity of the material is 0.5 . If the absolute temperature of the body is doubled,

A. the maximum intensity of radiation will be near the frequency $2v_0$.

B. the maximum intensity of radiation will be near the frequency $2v_0$.

C. the total energy emitted will increase by a factor of 32

D. the total energy emitted will increase by a factor of 8

Answer: A

Watch Video Solution

80. Radiation is passing through a transparent medium then .

A. the temperature of medium increases

B. the temperature of medium decreases

C. the temperature of medium does not alter

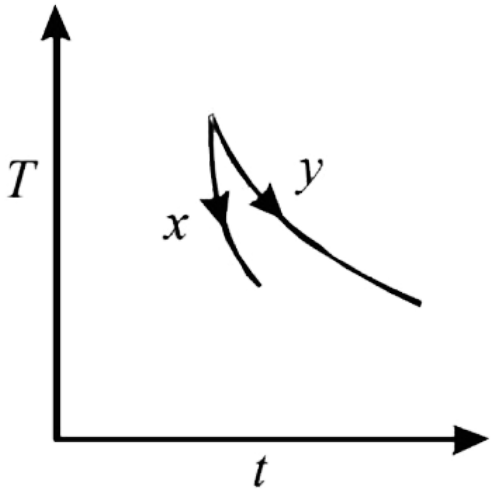
D. the temperature of medium first increases and tne becomes steady

.

Answer: C

Watch Video Solution

81. 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. $e_x > E_y$ and $a_x < a_y$

B. $e_x < E_y$ and $a_x > a_y$

C. $e_x > E_y$ and $a_x > a_y$

D. $e_x < E_y$ and $a_x < a_y$

Answer: C

Watch Video Solution

82. In which of the following process, convection does not take place primarily

A. Sea and Land breeze

B. Boiling of water

C. Warming of glass of bulb due to filamnet

D. Heating of air around a furance

Answer: C

Watch Video Solution

83. If mass-energy equivalence is taken into account, when water is cooled to from ice, the mass of water should

A. increase

B. remain unchange

C. decrease

D. first increase then decrease

Answer: B

Watch Video Solution

84. A sphare II A cube III A thin circular plate All made of the same material having the same mass are initially heated to $200^{\circ} C$ Identify the order in which the objects cool faster when left in air room temperature ?

.

A. III,II and I

B. II,I and III

C. I, II and III

D. II,III and I

Answer: A

Watch Video Solution

85. A beaker full of hot water is kept in a room and it cools from $80^\circ C$ to $75^\circ C$ in t_1 mminutes , from $75^\circ C$ to $65^\circ C$ in t_2 minutes and from $70^\circ C$ to $65^\circ C$ in t_3 min, then

A. $90^\circ C$ to $80^\circ C$ 'in t_1 sec.

B. $80^\circ C$ to $70^\circ C$ in t_2 sec.

C. $70^\circ C$ to $60^\circ C$ in t_3 sec

D. $60^\circ C$ to $50^\circ C$ in t_4 sec

Answer: C

Watch Video Solution

86. In the following which statement is correct .

A. A hot body emits hot radiations only .

B. A cold body absorbs the radiations only

C. A cold body absorbs the radiations only

D. All the bodies emits and absorbs radiations simultaneously .

Answer: D

Watch Video Solution

87. Infrared radiation is detected by

A. Spectrometer

B. Pyrometer

C. Nanometer

D. Photometer

Answer: B

Watch Video Solution

88. Which of the following is the example of ideal black body?

A. Kajal

B. Blackboard

C. A pin hole in a box

D. none of these

Answer: C

Watch Video Solution

89. The earth radiates in the infra-red region of the spectrum. The spectrum is correctly given by

A. Wien's law

B. Rayleigh-Jeans law

C. Planck' s law of radiation

D. Stefan's law of radiation

Answer: A

Watch Video Solution

LEVEL -1 (C.W)

1. In a steady state of heat conduction the temperature of the ends A and B of a rod $100cm$ long per $0^\circ C$ and $100^\circ C$ The temperature of the rod at a point $60cm$ distant from the end A is .

A. $0^\circ C$

B. $40^\circ C$

C. $60^\circ C$

D. $100^\circ C$

Answer: C

Watch Video Solution

LEVEL (C.W)

1. meter rod of area of cross section $4mc^2$ with $K = 0.5calg^{-1}C^{-1}$ is observed that at steady state 360 cal of heat flows per minute The temperature gradient along the rod is .

A. $3^\circ C/cm$

B. $6^\circ C/an$

C. $12^\circ C/m$

D. $20^\circ C / cm$

Answer: A

Watch Video Solution

2. One end of metal bar of area of cross section $5cm^2$ and $25cm$ in length is in steam other in contact with ice, the amount of ice melts in one minute is $(L_{ice} = 80cal / gm, K = 0.8cgs \text{ uits})$.

A. $16gm$

B. $12gm$

C. $24gm$

D. $36gm$

Answer: B

Watch Video Solution

3. Which of the following rods made of same material will conduct more heat in given time when their ends are maintained at the same temperature difference .

A. $l = 1m, r = 1cm$

B. $l = 2m, r = 2cm$

C. $l = 3m, r = 1cm$

D. $l = 100cm, r = 2cm$

Answer: D

Watch Video Solution

4. A cylindrical rod with one end in a steam chamber and the other end is in ice It is found that $1gm$ of ice melts per second If the rod is replaced by another one of same material double the length and double area of cross section, The mass of ice that melts per second is .

A. $2gm$

B. $4gm$

C. $1gm$

D. $0.5gm$

Answer: C

Watch Video Solution

5. In an atomic bomb, the temperature of 10million degrees is developed at the moment of explosion In what region of the spectrum of explosion In what region of the spectrum do the wavelength corresponding to maximum energy density lie ? $\left(b = 0.28 \times 10^{-2} S.\ Iunit\right)$.

A. Ultra-violet

B. Visible

C. Infra-red rays

D. x-rays

Answer: D

Watch Video Solution

6. Solar radiation emitted by sun resembles that emitted by a body at a temperature of $6000K$ Maximum intensity is emitted at a wavelength of about $4800A^{\circ}$ If the sun was cooled down from $6000K$ to $3000K$ then the peak intensity would occure at a wavelenght of .

A. $4800A^{\circ}$

B. $9600A^{\circ}$

C. $2400A^{\circ}$

D. $19200A^{\circ}$

Answer: B

Watch Video Solution

7. Two spheres of the same materical have radii $1m$ and $4m$ nad temperature $4000K$ and $2000K$ respectively The energy radiated per second by the first sphere is .

A. greater than that of the second

B. Less than that of the second

C. equal in both cases

D. the information is incomplete to draw any conclusion

Answer: C

Watch Video Solution

8. Two objects A& B have exactly the same shape and are radiating the same power If their temperatures are in the ratio $\sqrt{3}:1$ then the ratio of their emissivities is .

A. $1:9$

B. $1:9$

C. $3:1$

D. $1:3$

Answer: A

Watch Video Solution

9. A black body at $127^\circ C$ emits the energy at the rate of $10^6 J/m^2$ s the temperature of a black body at which the rate of energy emission is $16 \times 10^6 J/m^2 s$ is .

A. $508^\circ C$

B. $273^\circ C$

C. $400^\circ C$

D. $527^\circ C$

Answer: D

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10. An incandesent light bulb has a tungsten filament that is heated to a temperature $3 \times 106(3)K$ when an electric current passes through it If the surface area of the filament is approximately $10^{-4}mm^2$ and it has an emissivity of 0.3 the power radiated by the bulb is nearly $\left(sigam = 5.67 \times 10^{-8}Wm^{-2}K^{-4}\right)$.

A. $138w$

B. $175w$

C. $200w$

D. $225w$

Answer: A

Watch Video Solution

11. Two black bodies at $327^\circ C$ and $627^\circ C$ are suspended in an environment at $27^\circ C$ The ratio of their emissive powers is .

A. $15:8$

B. $16:3$

C. $3:16$

D. $5:8$

Answer: C

Watch Video Solution

12. A body at $50^\circ C$ cools in a surroundings maintained at $30^\circ C$ The temperature at which the rate of cooling is half that of the beginning is .

A. $16.32^\circ C$

B. $26.3^\circ C$

C. $40^\circ C$

D. $46.3^\circ C$

Answer: C

Watch Video Solution

13. A body cools from $70^\circ C$ to $60^\circ C$ in 8minute The same body cools from $60^\circ C$ to $50^\circ C$ in .

A. 8 minutes

B. less than 8 minute

C. More than 8 minute

D. 1 or 2 or 3 depending on the specific heat of the body .

Answer: C

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LEVEL - 2 (C.W)

1. 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: C

Watch Video Solution

LEVEL - (C.W)

1. Three rods A, B and C have the same dimensions Their conductivities are K_A K and K_C respectively A and B are placed end to end with their

free ends kept at certain temperature difference C is placed separately with its ends kept at same temperature difference The two arrangements conduct heat at the same rate K_c must be equal to .

A. $K_A + K_B$

B. $\frac{K_A + K_B}{K_A K_B}$

C. $\frac{1}{2}(K_A + K_B)$

D. $\frac{K_A + K_B}{K_A K_B}$

Answer: D

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2. Two identical slabs are welded end to end and $20cal$ of heat flows through if for $4\ \min$ If the two slabs are now welded by placing them one through two ends under the same difference of temperatures the time taken is .

A. $1\ \min$

B. $2\ \min$

C. $4\ \min$

D. $16\ \min$

Answer: A

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3. A slab consists of two parallel layers of copper and brass of the same thichness and having thermal conductivities in the ratio $1:4$ If the free face of brass is at $100^\circ C$ anf that of copper at $0^\circ C$ the temperature of interface is .

A. $80^\circ C$

B. $20^\circ C$

C. $60^\circ C$

D. $40^\circ C$

Answer: A

Watch Video Solution

4. Two metal plates of same area and thickness l_1 and l_2 are arranged in series If the thermal conductivities of the materials of the two plates are K_1 and K_2 The thermal conductivity of the combination is .

A. $\frac{2K_1K_2}{K_1+K_2}$

B. $\frac{K_1+K_2}{2}$

C. $\frac{K_1K_2(l_1+l_2)}{K_1l_2+K_2l_2}$

D. K_1+K_2

Answer: C

Watch Video Solution

5. Two hollow suphers of same material one with double the radius of the other and double the thickness of the other filled with ice, the ratio of time in which ice gets melted in the two spheres is .

A. $2:1$

B. $1:2$

C. $4:1$

D. $1:4$

Answer: C

Watch Video Solution

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

A. $6^\circ C$

B. $12^\circ C$

C. $18^\circ C$

D. $24^\circ C$

Answer: B

Watch Video Solution

7. Two rods of length l and $2l$ thermal conductivities $2K$ and K are connected end to end. If cross sectional areas of two rods are eual, then equivalent thermal conductivity of the system is .

A. $(5/6)K$

B. $1.5K$

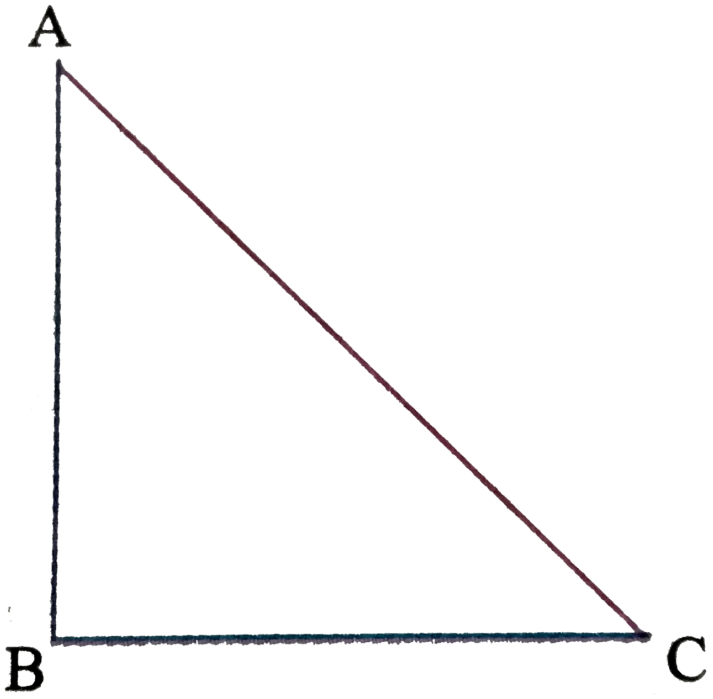
C. $1.2K$

D. $(8/9)K$

Answer: C

Watch Video Solution

8. Three rods of identical cross-sectional area and made from the same metal form the sides of an insosceles triangle ABC right angled at B The pints A and B are maintained at temperatures T and $\sqrt{T}$ respectively in the steady state Assuming that only heat conduction takes place, temperature of point C is .



A. $\frac{3T}{\sqrt{2}+1}$

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

C. $\frac{T}{3\left(\sqrt{2}-1\right)}$

D. $\frac{T}{\sqrt{2}-1}$

Answer: A

Watch Video Solution

9. A cube of side $10cm$ is filled with ice of density $0.9/c.\ c$ Thickness of the walls of the cube is $1mm$ and thermal conductivity of the material of the cube is steam bath maintained at a placed in steam bath maintained at a temperature of $100^\circ C$ the time in which ice completely melts is $(L_{ice} = 80cal/gm)$.

A. $6\,\text{sec}$

B. $12\,\text{sec}$

C. $24\,\text{sec}$

D. $48\,\sec$

Answer: B

Watch Video Solution

10. A slab of stone area $3600cm^2$ and thickness $10cm$ is exposed on the lower surface to steam at $100^\circ C$ A block of ice at $0^\circ C$ rest on upper surface of the slab. In one hour $4.8kg$ of ice is melted. The thermal conductivity of the stone in $Js^{-1}m^{-1}k^{-1}$ is (latent heat of ice $= 3.36 \times 10^5 J/Kg$.

A. 12.0

B. 10.5

C. 1.02

D. 1.24

Answer: D

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11. A black body is at a temperature of $2800K$ The energy of radiation emitted by this object with wavelength between $499nm$ and 500 nm is U_1 between 999nm and 1000nm is U_2 and between 1499 nm and 1500 nm is U_3 The Wien's constant $b = 2.80 \times 10^6$ nm K Then .

A. $U_1 = 0$

B. $U_3 = 0$

C. $U_1 > U_2$

D. $U_2 > U_1$

Answer: D

Watch Video Solution

12. When the temperature of a black body increases, it is observed that the wavelength corresponding to maximum energy changes from $0.26\mu m$

to $0.13\mu m$. The ratio of the emissive powers of the body at the respective temperatures is

A. $\frac{16}{1}$

B. $\frac{4}{1}$

C. $\frac{1}{4}$

D. $\frac{1}{16}$

Answer: D

Watch Video Solution

13. For an enclosure maintained at 2000K, the maximum radiation occurs at wavelength λ_m. If the temperature is raised to 3000K, the peak will shift to

A. $0.5\lambda_m$

B. λ_m

C. $4\lambda_m$

D. $8\lambda_m$

Answer: A

Watch Video Solution

14. The power radiated by a black is P and it radiates maximum energy around the wavelength λ_0 If the temperature of the black body is now changed so that it radiates maximum energy around a wavelength $3\lambda_0/4$ the power radiated by it will increase by a factor of .

A. $4/3$

B. $16/9$

C. $64/27$

D. $256/81$

Answer: D

Watch Video Solution

15. The rates of heat radiation from two patches of skin each of area A on a patient's chest differ by 2% If the patch of the lower temp is at $300K$ and emissivity of both the patches is assumed to be unity, the temp of other patch would be .

A. $306K$

B. $312K$

C. $308.5K$

D. $301.5K$

Answer: D

Watch Video Solution

16. A spherical black body with a radius of $12cm$ radiates $450W$ power at $500K$. If the radius were halved and the temperature doubled, the power radiated in watt would be

A. 225

B. 450

C. 900

D. 1800

Answer: D

Watch Video Solution

17. If the temperature of the sun were to increase form T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously will be

A. 4

B. 16

C. 32

D. 64

Answer: D

Watch Video Solution

18. The radiation emitted by a star A is 1000 times that of the sun. If the surface temperature of the sun and star A are $6000K$ and $2000K$ respectively. The ratio of the radii of the star A and the sun is:

A. $300:1$

B. $600:1$

C. $900:1$

D. $1200:1$

Answer: C

Watch Video Solution

19. Two electric bulbs have filaments of lengths L and $2L$ diameters $2d$ and d and emissivities $3e$ and 4e If their temperatures are in the ratio 2:3 their powers will be in the ratio of .

A. $8:27$

B. $4:27$

C. $8:3$

D. $4:9$

Answer: B

Watch Video Solution

20. If the absolute temperature of a black body is doubled the percentage increase in the rate of loss of heat by radiation is .

A. $15\ \%$

B. $16\ \%$

C. $1600\ \%$

D. $1500\ \%$

Answer: D

Watch Video Solution

21. A sphere and a cube of same material and same volume are heated up to same temperature and allowed to cool in the same sorroundings. The radio of the amounts of radiations emitted in equal time intervals will be

A. $1:1$

B. $\frac{4\pi}{3}:1$

C. $\left(\frac{\pi}{6}\right)^{1/3}:1$

D. $\frac{1}{2}\left(\frac{4\pi}{3}\right)^{2/3}:1$

Answer: C

Watch Video Solution

22. A black metal foil is warmed by radiation from a small sphere at temperature T and at a distance d it is found that the power received by the foil is P If both the temperature and the distance are doubled the power received by the foil will be .

A. $64P$

B. $16P$

C. $4P$

D. $8P$

Answer: C

Watch Video Solution

23. A very small hole in an electric furnace is used for heating metals. The hole nearly acts as black body. The area of the hole is $200mm^2$ To keep a

metal at $727^{\circ}C$ heat energy flowing throungh this hole per sec in joules is $\left(sigam = 5.67 \times 10^{-8} Wm^{-2} K^{-4}\right)$.

A. 22.68

B. 2.268

C. 1.134

D. 11.34

Answer: D

Watch Video Solution

24. The surface of a black body is at a tempera ture $727^{\circ}C$ and its cross section is $1m^2$ Heat radi ated from this surface in one minute in Joules is (Stefan's constant $= 5.7 \times 10^{-8} W/m^2/k^4$).

A. 34.2×10^5

B. 2.5×10^5

C. 3.42×10^5

D. 2.5×10^6

Answer: A

Watch Video Solution

25. A body cools down from $50^\circ C$ to $45^\circ C$ in 5 minutes and to $40^\circ C$ in another 8 minutes. Find the temperature of the surrounding.

A. $34^\circ C$

B. $30^\circ C$

C. $43^\circ C$

D. $37^\circ C$

Answer: A

Watch Video Solution

26. A hot body is placed in cold surroundings It's rate of cooling is $3^\circ C$ per minute when its temperature is $70^\circ C$ and $1.5^\circ C$ per minute when its temperature $50^\circ C$ it s rate of cooling when its temperature is $40^\circ C$.

A. $0.25^\circ C/\ \min$

B. $0.5^\circ C/\ \min$

C. $0.75^\circ C/\ \min$

D. $1^\circ C/\ \min$

Answer: C

Watch Video Solution

27. A calorimeter of water equivalent $5g$ has water of mass $55g$ upto a certain level Another identical calorimeter has a liquid of mass '38g' upto same level As both of them cool in the same surrounding from $50^\circ C$ to $46^\circ C$ water takes $80s$ where as the liquid takes $32s$ to cool. If the specific

heat of water is $1cal/g-.^{\circ}C$ the specific heat of the liquid in $cal/g-.^{\circ}C$ is .

A. 0.8

B. 0.4

C. 0.5

D. 0.2

Answer: C

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LEVEL-III (C.W)

1. One end of a copper rod of uniform cross section and length 1.5 m is kept in contact with ice and the other end with water at $100^{\circ}C$. At what point along its length should a temperature of $200^{\circ}C$ be maintained so that in the steady state, the mass of ice melting be equal to that of the steam produced in same interval of time. Assume that the whole system

is insulated from surroundings:

$[L_{\text{ice}} = 80cal/g, L_{\text{steam}} = 540cal/g]$

A. $8.59cm$ from ice end

B. 10.34 cm from water end

C. 10.34 cm from ice end

D. 8.76 cm from water end

Answer: B

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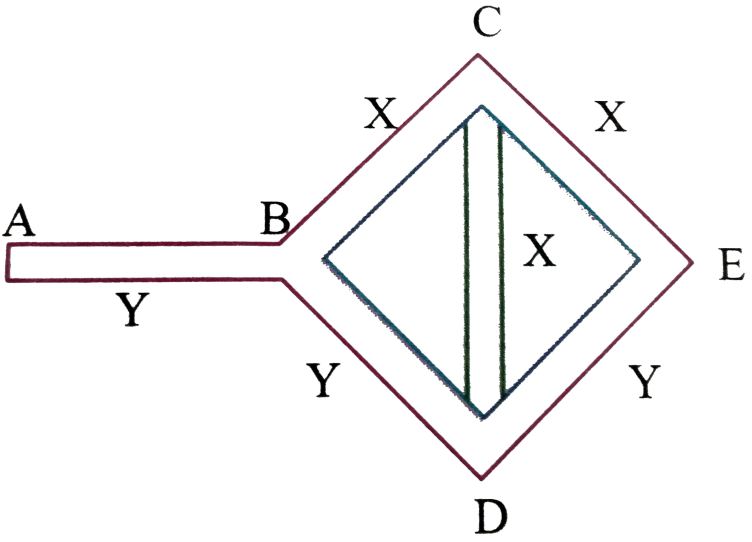
LEVEL- (C.W)

1. Three rods of material 'x' and three rods of materialy are connected as shown in All the rods are of identical length and cross section If the end A is maintained at $60^\circ C$ and the junction E at $10^{\circ 0C}$ find effective Thermal Resistance Given length of each rod =1 area of cross-section =A

conductivity of x=K and conductivity of $y = 2K$



A. $\frac{4l}{3KA}$

B. $\frac{7l}{6KA}$

C. $\frac{4KA}{3l}$

D. $\frac{7KA}{3l}$

Answer: B

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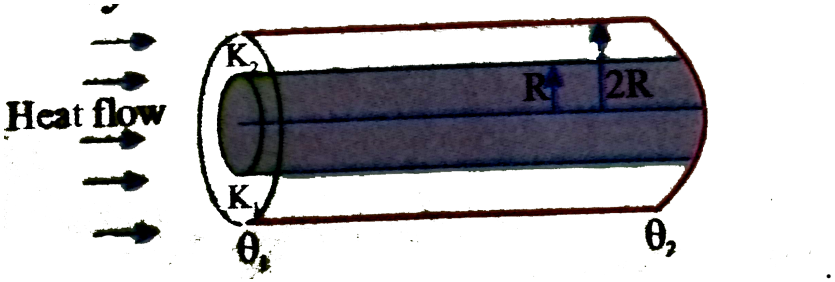
2. A cylinder of radius R made of a material of thermal conductivity K_1 is surrounded by cylindrical shell of inner radius R and outer radius $2R$ made of a material of thermal con-ductivity K_2 The two ends of the combined system are maintained at two differnet tem-peratures There is no loss of heat across the cylindrical surface and system is in steady state What is the effective thermal conductivity of the system



A. $K_1 + K_2$

B. $\frac{K_1 K_2}{K_1 + K_2}$

C. $\frac{K_1 + 3K_2}{4}$

D. $\frac{K_1 + 8K_2}{9}$

Answer: D

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3. Water is being boiled in a flat bottomed kettle placed on a stove The area of the bottom is $300cm^2$ and the thickness is $2mm$ If the amount pf steam produced is $1gm\ \min^{-1}$ then the difference of the temperature between the inner and the outer surface of the bottom is (thermal conductivity of the matrial of the kettle $0.5ca\,\mathrm{lcm}^{-1}C^{-1}$ latent heat of the steam is equal to $540calg^{-1}$) .

A. $12^\circ C$

B. $2^\circ C$

C. $12^\circ C$

D. $0.012^\circ C$

Answer: D

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4. A point source of heat of power P is placed at the centre of a spherical shell of mean radius R. The material of the shell has thermal conductivity K. If the temperature difference between the outer and inner surface of the shell in not to exceed T, the thickness of the shell should not be less than .....

A. $\frac{4\pi KR^2T}{P}$

B. $\frac{4\pi KR^2}{TP}$

C. $\frac{4\pi R^2T}{KP}$

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

Answer: A

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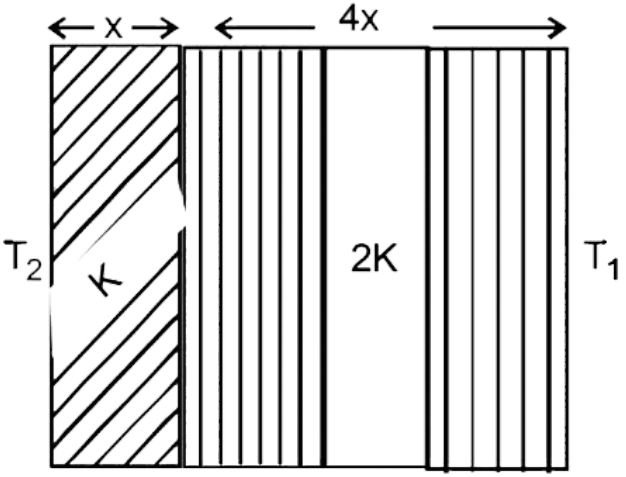
5. The temperature of the two outer surfaces of a composite slab, consisting of two materials having coefficients of two materials having coefficients of thermal conductivity K and 2K and thickness x and 4x,

respectively, are T_2 and $T_1(T_1 > T_1)$. The rate of heat transfer through the slab, in a steady state is $\left(\frac{A(T_2 - T_1)K}{2}\right)f$, with f equal to



A. 1

B. $1/2$

C. $2/3$

D. $1/3$

Answer: D

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6. A and B are two points on uniform metal ring whose centre is O The angle $AOB = \theta$ A and B are maintaind at two different constant temperatures When $\theta = 180^\circ$ the rate of total heat flow from A to B is $1.2W$ When $\theta = 90^\circ$ this rate will be .

A. 0.6 watt

B. 0.9 watt

C. 1.6 watt

D. 1.8 watt

Answer: C

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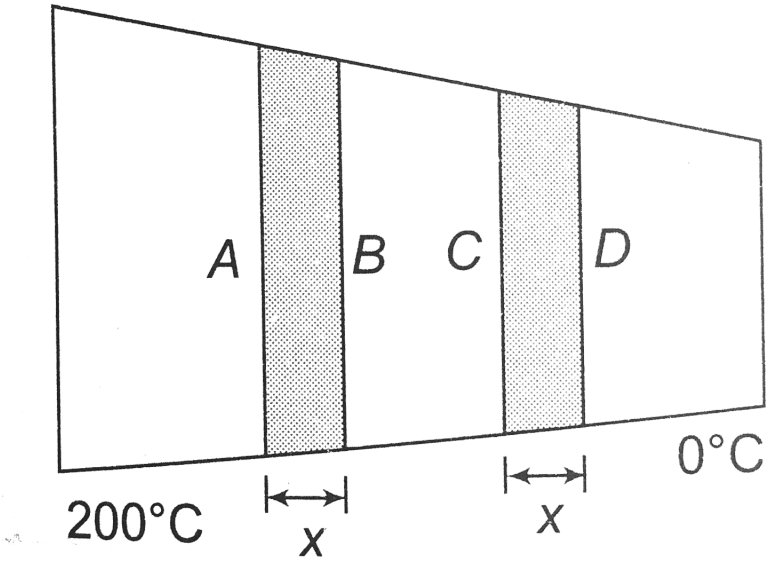
7. Two ends of a conducting rod of varying cross-section are maintained at $200^\circ C$ and $0^\circ C$ respectively. In steady state:



A. temperature difference across AB and CD are equal

B. temperature difference across AB and CD

C. temperature difference across AB and CD

D. temperature difference may be equal or differnet depeding on the thermal conductivity of the rod .

Answer: C

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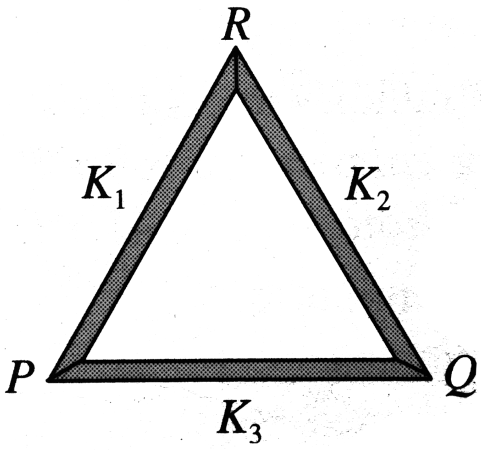

8.

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: C

Watch Video Solution

9. A boiler is made of a copper plate $2.4mm$ thick with an inside coating of a $0.2mm$ thick layer of tin The surface area exposed to gases at $700^{\circ}C$ is $400cm^2$ The maximum amount of steam that could be generated per hour at atmospheric pressure is

$\left(\left(K_{cu}=0.9cal/cm-s-^{0}\ \&k_{\text{tin}}=0.15cal/cm-s-^{0}\ C\ \text{and}\ L_{steam}=5\right.\right.$

.

A. $5000Kg$

B. $1000Kg$

C. $4000Kg$

D. $200Kg$

Answer: C

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10. Ice starts forming in lake with water at $0^\circ C$ and when the atmospheric temperature is $-10^\circ C$. If the time taken for $1cm$ of ice be 7 hours. Find the time taken for the thickness of ice to change from $1cm$ to $2cm$

A. $7hour$

B. $14hour$

C. $< 7hour$

D. $> 14hour$

Answer: D

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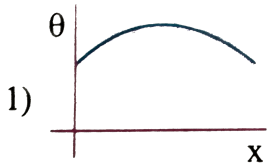
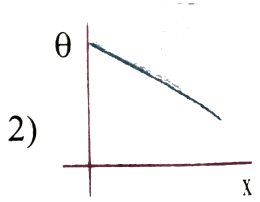
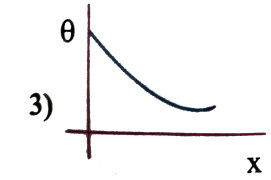
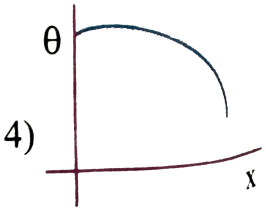
11. A long metallic bar is carrying heat from one of its ends to the other end under steady-state. The variation of temperature θ along the length x of the bar from its hot end is best described by which of the following figures?

A. 

B. 

C. 

D. 

Answer: B

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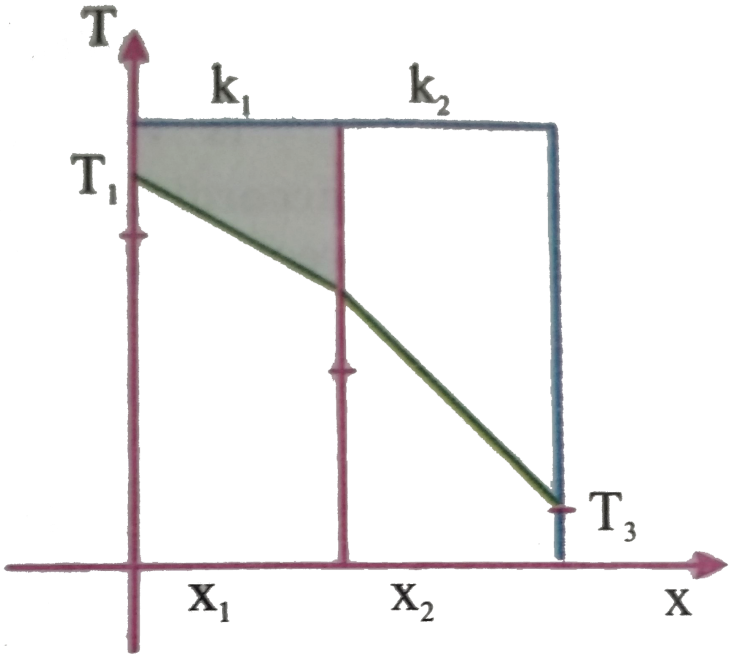
12. The temperature drop through each layer of a two layer furnace wall is shown in Assume that the external temperature T_{10} and T_3 are

mainitained constant and $T_1 > T_3$ If the thichness of the layers x_1 and x_2 are the same which of the following statements are correct



A. $k_1 > k_2$

B. $k_1 < k_2$

C. $k_1 = k_2$ but heat flow through material (1) is less then through (2) .

D. $k_1 = k_2$ but heat flow through material (1) is less then through (2) .

Answer: A

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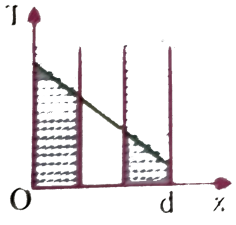
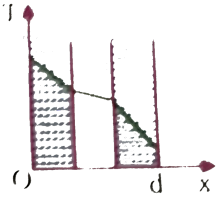
13. The wall with a cavity consists of two layers of brick separated by a layer of air All three lay-ers have the same thickness and the thermal conductivity of the brick is much greater than that of air The left layer is at a higher temperature than the tight layer and steady state condition exists Which of the following graphs perdicts correctly the variation of temperature T with distance d inside the cavity ?.

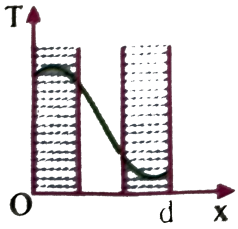
A.

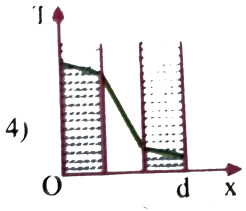


B.



C.



D. 

Answer: D

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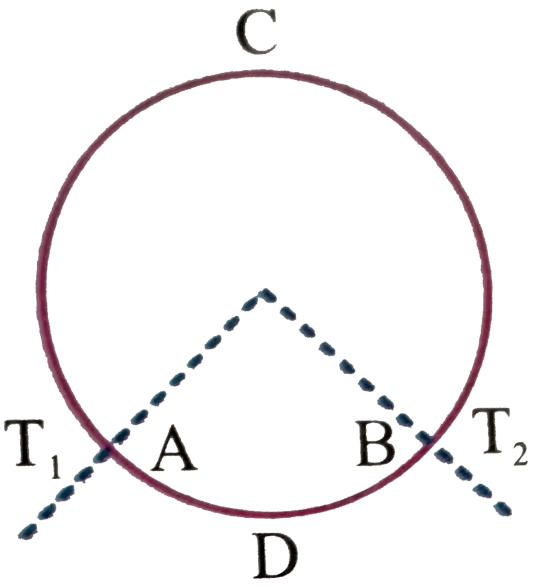
14. A ring consisting of two parts ADB and ACB of same conductivity k carries an amount of heat H The ADB part is now replaced with another metal keeping the temperature $T_{91})$ and T_2 constant The heat carried increases to $2H$ What should be the conductivity of the new ADB Given

$\frac{ACB}{ADB} = 3$



A. $\frac{7}{3}K$

B. $2K$

C. $\frac{5}{2}K$

D. $3K$

Answer: A

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15. Two metallic spheres S_1 and S_2 are made of the same material and have got identical surface finish. The mass of S_1 is thrice that of S_2. Both the spheres are heated to the same high temperature and placed in the same room having lower temperature but are thermally insulated from each other. the ratio of the initial rate of cooling of S_1 to that of S_2 is

$(a)\frac{1}{3}(b)\frac{1}{\sqrt{3}}(c)\frac{\sqrt{3}}{1}(d)\left(\frac{1}{3}\right)^{\frac{1}{3}}$

A. $1/3$

B. $(1/3)^{1/3}$

C. $1/\sqrt{3}$

D. $\sqrt{3}/1$

Answer: B

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16. The temperature of an spherical isolated black body falls from T_1 and T_2 in time t them time t is

A. $t = c\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

B. $t = c\left(\frac{1}{T_2^2} - \frac{1}{T_1^2}\right)$

C. $t = c\left(\frac{1}{T_2^3} - \frac{1}{T_1^3}\right)$

D. $t = c\left(\frac{1}{T_2^4} - \frac{1}{T_1^4}\right)$

Answer: C

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17. A star behaves like a perfectly black body emitting radiant energy The ratio of radiant energy per second by this star to that emitted by another star having 8 times the radius of former, but having temperature, one-fourth that of the former in Kelvin is .

A. $1:4$

B. $1:16$

C. $4:1$

D. $16:1$

Answer: C

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18. A sphere of density 'd' specific heat capacity 'c' and radius 'r' is hung by athermally insulating thread in an enclosure which is kept at lower temperature than the shpere The temperature of the sphere starts to drop at rate which is proportional to .

A. c/r^3d

B. $1r^3dc$

C. $3r^3dc$

D. $1/rdc$

Answer: D

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

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

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

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

Answer: B

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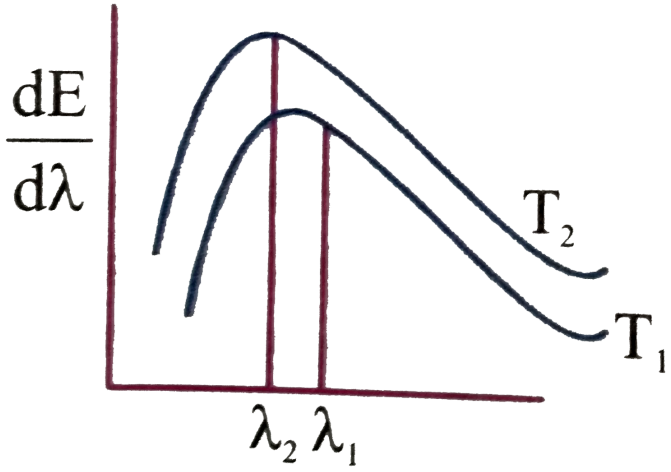
20. The spectral emissive power E_λ for a body at temperature T_1 is poltted againist the wavelenght and area under the curve is found to be $A. At$ a different temperature T_2 the area is found to be A then

$\lambda_1 / \lambda_2 =$



A. 3

B. $1/3$

C. $1/\sqrt{3}$

D. $\sqrt{3}$

Answer: D

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21. A heated object (at time $t = 0$ and temperature $T = T_0$) is taken out of the oven to cool and placed on a table near an open window Write an expression for its temperature as function of time T where T_s is the surrounding temperature .

A. $T = T_s - (T_0 + T_s)e^{-kt}$

B. $T = T_s + (T_0 + T_s)e^{-kt}$

C. $T = T_s + (T_0 - T_s)e^{-kt}$

D. $T = T_s - (T_0 - T_s)e^{-kt}$

Answer: C

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22. A system S receives heat continuously from an electric heater of power $10W$. The temperature of S becomes constant at $50^\circ C$ when the surrounding temperature is $20^\circ C$. After the heater is switched off, S cools from $35.1^\circ C$ to $34.9^\circ C$ in $1\ \min\ ute$. the heat capacity of S is

A. $750 J(.^{\circ} C)^{-1}$

B. $1500 J(.^{\circ} C)^{-1}$

C. $3000 J(.^{\circ} C)^{-1}$

D. $6000 J(.^{\circ} C)^{-1}$

Answer: B

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23. According to Newton's law of cooling, the rate of cooling of a body is proportional to $(\Delta\theta)^n$, where $\Delta\theta$ is the difference of the temperature of the body and the surroundings, and n is equal to

A. 2

B. 3

C. 4

D. 1

Answer: D

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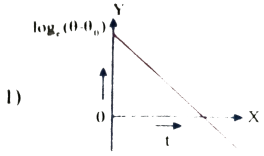
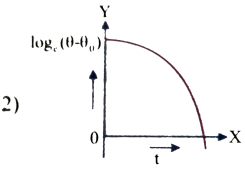
24. A liquid in a beaker has temperature $\theta(t)$ at time t and θ_0 is temperature of surroundings, then according to Newton's law of cooling the correct graph between $\log_e(\theta - \theta_0)$ and t is :

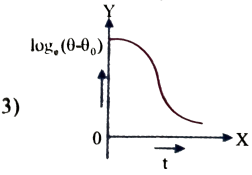
A. 1)



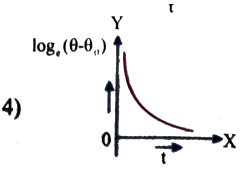
B. 2)



C. 3)



D. 4)



Answer: A

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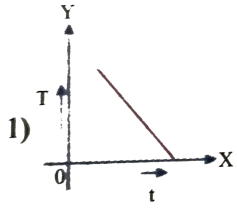
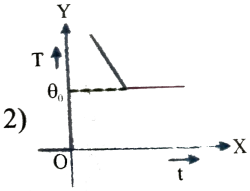
25. If a piece of metal is heated to temperature θ and the allowed to cool in a room which is at temperature θ_0, the graph between the temperature T of the metal and time t will be closet to

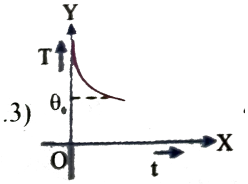
A.

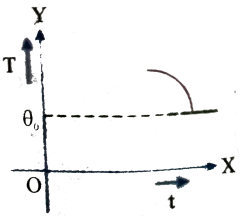


B.



C.



D. 4) 

Answer: C

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NCERT BASED QUESTIONS

1. A sphere a cube and thin circular plate, all made of the same material and having the same mass are initially heated to a temperature of $1000^\circ C$. Which one of these will cool first?

A. Plate will cool fastest and cube the slowest

B. Sphere will cool fastest and cube the slowest

C. Plate will cool fastest and sphere the slowest

D. Cube will cool fastest and plate the slowest .

Answer: C

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2. A thin rod, length L_0 at $0^\circ C$ and coefficient of linear expansion α has its two ends mintained at temperatures θ_1 and θ_2 respectively Find its new length .

A. $L_0[1+\alpha(\theta_1+\theta_2)]$

B. $L_0\left(1+\alpha\left(\frac{\theta_1+\theta_2}{2}\right)\right)$

C. $L_0(1+\alpha\theta_1)$

D. $L_0\left(1+\alpha\left(\frac{\theta_1+\theta_2}{2}\right)\right)$

Answer: B

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3. According to stefan's law of radiation a black body radiates energy σT^4 from is unit surface area every second where T is the surface temperature of the black body and $\sigma = 5.67 \times 10^{-8} W/m^2 K^4$ is known as Stefan's of as a ball of radius $0.5m$ When detonated it reaches temperature of $10^6 K$ and can be treated as a black body Estimate the power it radiates .

A. $1.5 \times 10^{17} W$

B. $1.1 \times 10^{17} W$

C. $1.8 \times 10^{17} W$

D. $2.1 \times 10^{17} W$

Answer: C

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4. Gulab jamuns (assumed to be spherical) are to be heated in on oven They are available in two sizes, one twice bigger (in radius) than the other

Pizzas (assumed to discs) are also to be heated ibn oven They are also in two sizes, one twice bigger (in radius) than the other All four are put together to be heated option to oven temperature. Choose the correct option from the following .

A. Both size gulab jamuns will get heated in the same time

B. Smaller gulab jamuns are heated before bigger ones

C. Smaller pizzas are heated before bigger ones

D. Bigger pizzas heated before bigger ones

Answer: B::C

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5. A glass full of hot milk is poured in the table. It begins to cool gradually. Which of the following is incorrect?

A. The rate of cooling is constant till milk attains the temperature of the surrounding

B. The temperatue of milk falls off exponentially with time

C. While cooling there is a flow of heat from milk to surrounding as well as from surrounding to the milk but net flow of heat is from milk to the surrounding and that is why it cools

D. All three phenomenon, conduction, convection and radiation are responsible for the loss of heat from milk to the surroundings

Answer: B::C::D

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SINGLE ANSWER QUESTIONS Passage

1. A body is kept inside a container the temperature of the body is T_1 and the temperature of the container is T_2 the rate at which body absorbs the energy is α The emissivity of the body is The radiation striking the

body is either absorbed or reflected

A good absorber is .

A. good reflector

B. poor reflector

C. average reflector

D. assessment not possible

Answer: B

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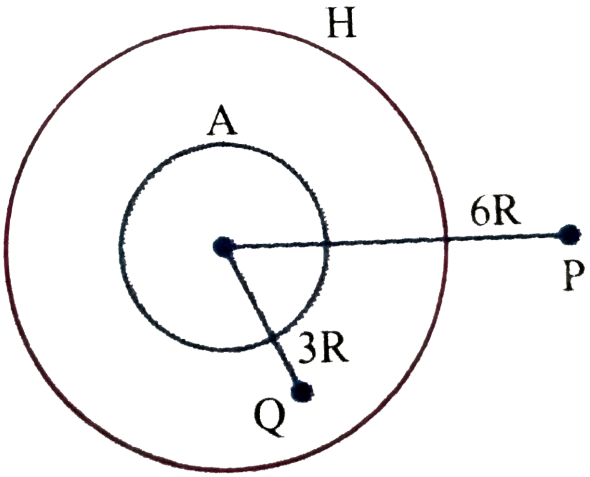
SINGLE ANSWER QUESTIONS Passage -1

1. Consider a spherical body A of radius R which is placed concentrically in a hollow enclosure H of radius $4R$ as shown in the The temperature of the body A and H are T_A and T_H respectively Emissivity transmittivity and reflactivity of two bodies A and H are (e_a, e_H), $?(t_A, t_H)$, and (r_A, r_H) respectively (Assume no absorption of the thermal energy by

the space in between the body and enclosure as well as outside the enclousre and all radiations to be emitted and absorbed normal to the surface $\left[Tske\sigma \times 4\pi r^2 \times 300^4 = \beta J/s\right]$



The twemperature of H is $T_H = 0K$ For H take $e_H = 0.5$ and $t_H = 0.5$

For this situation mark out the correct statements (s) .

A. The rate at which A loses the energy is $\beta J/s$.

B. The rate at which sperical surface containing P rectives the energy is $\frac{\beta}{2} J/s$.

C. The rate at which sperical surface containing Q receives the energy is $\beta J/s$.

D. All of the above

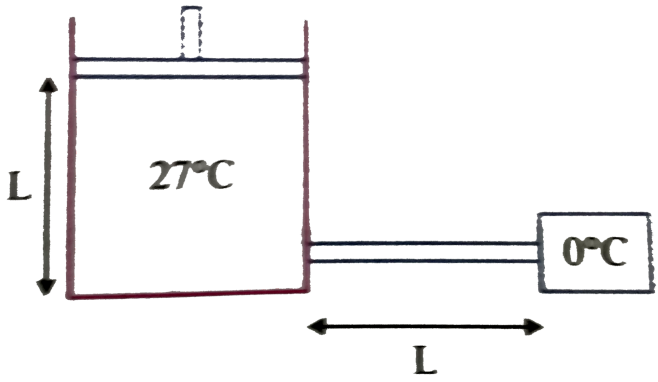
Answer: D

View Text Solution

SINGLE ANSWER QUESTIONS

1. 0.5 mole of an ideal gas at constant temperature $27^\circ C$ kept inside a cylinder of length L and cross-section area A closed by a massless piston The cylinder is attached with a conducting rod of length L cross-section area $(1/9)m^2$ and thermal conductivity k whise other end is maintained at $0^\circ C$ If piston is moved such that rate of heat flow through the conducing rod is constant then find velocity of piston when it is at height $L/2$ from the bottom of cylinder [Neglect any kind of heat loss from

system



A. $\frac{k}{50R}$

B. $\frac{k}{100R}$

C. $\frac{k}{110R}$

D. $\frac{k}{90R}$

Answer: B

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2. 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. $25:1$

C. $1:25$

D. $8:25$

Answer: D

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3. A calorimeter of negligible heat capacity contains 100 of water at $40^\circ C$. The water cools to $35^\circ C$ in 5 minutes. The water is now replaced by k-oil of equal volume at $40^\circ C$. Find the time taken for the temperature to become $35^\circ C$ under similar conditions. Specific heat capacities of water and K-oil are $4200 Jkg^{-1}K^{-1}$ and $2100 Jkg^{-1}K^{-1}$ respectively. Density of K-oil $= 800 kgm^{-3}$.

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4. The two ends of a metal rod are maintained at temperatures $100^\circ C$ and $110^\circ C$. The rate of heat flow in the rod is found to be $4.0 j / s$. If the ends are maintaind at temperatures $200^\circ C$ and $210^\circ C$, the rate of heat flow will be :

A. $0.6W$

B. $0.9W$

C. $1.6W$

D. $1.8W$

Answer: C

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5. Three discs, A, B and C having radii 2m, 4m and6m respectively are coated with carbon black on their outer surfaces. The wavelengths

corresponding to maximum intensity are $300nm, 400nm$ and $500nm$, respectively. The power radiated by them are Q_A, Q_B and Q_C respectively

(a) Q_A is maximum (b) Q_B is maximum (c) Q_C is maximum (d) $Q_A = Q_B = Q_C$

A. Q_A is maximum

B. Q_B is maximum

C. Q_C is maximum

D. $Q_A = Q_B = Q_C$

Answer: B

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6. In which of the following process, convection does not take place primarily

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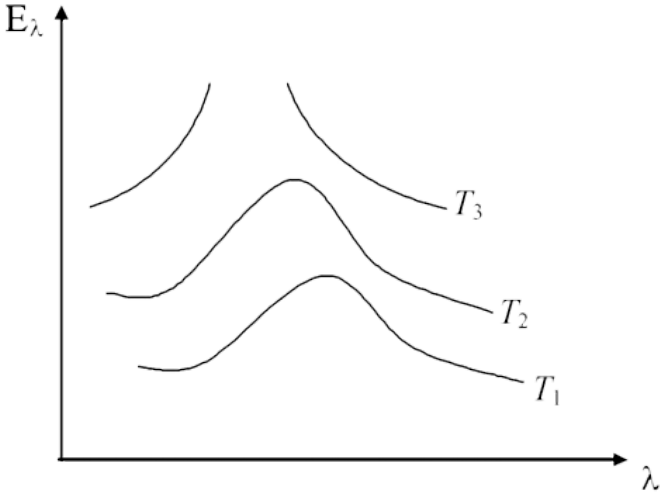
7. Variation of radiant energy emitted by sun, filament of tungsten lamp and welding arc as a function of its wavelength is shown in figure. Which of the following option is the correct match?



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8. 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 .....

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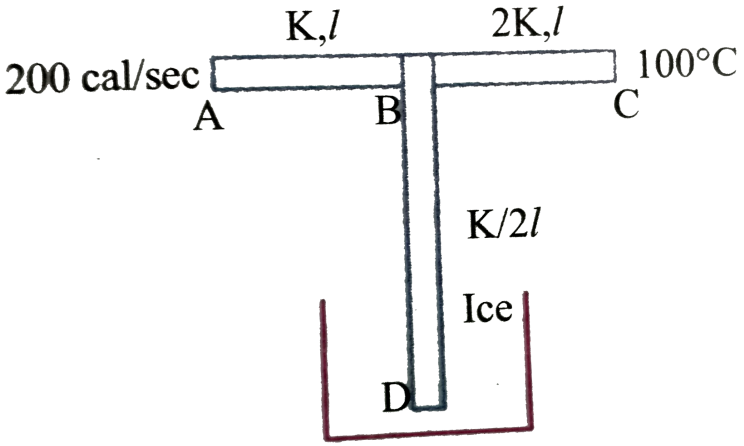
9. Three rods AB, BC and BD of same length l and cross-sectionsl area A are arranged as shown . The end D is immersed in ice whose mass is $440gm$ Heat is being supplied at constant rate of $200cal/\sec$ from the end Time in which whole ice will melt (Latent heat of fusion of ice is $80cal/gm$



A. $40/3$ min

B. 700 sec

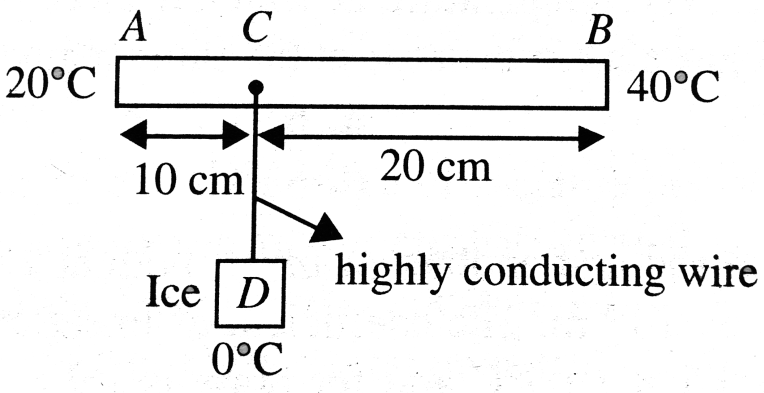
C. $20/3$ min

D. indefiniely long time

Answer: A

Watch Video Solution

10.



As shown in Fig. AB is rod of length 30 cm and area of cross section 1.0 cm^2 and thermal conductivity 336 SI units. The ends A and B are maintained at temperatures $20^\circ C$ and $40^\circ C$, respectively .A point C of this rod is connected to a box D, containing ice at $0^\circ C$ through a highly conducting wire of negligible heat capacity. The rate at which ice melts in the box is (assume latent heat of fusion for ice $L_f = 80cal/g$)

A. $84mg/s$

B. $84g/s$

C. $20mg/s$

D. $40mg/s$

Answer: D

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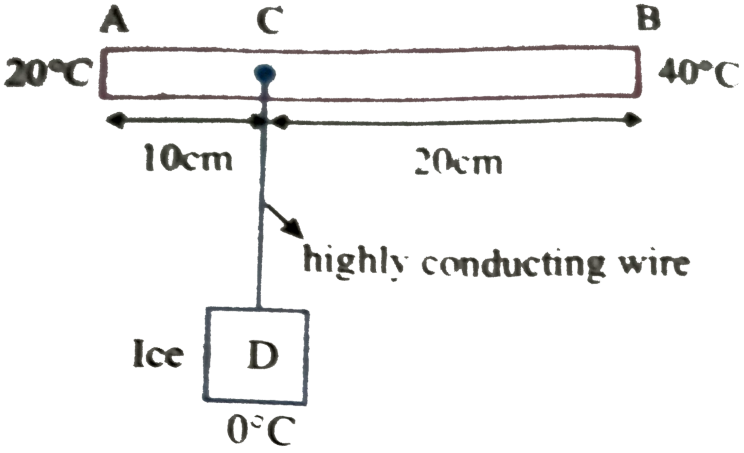
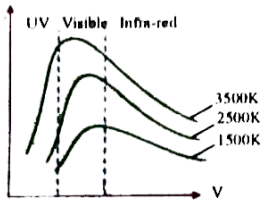
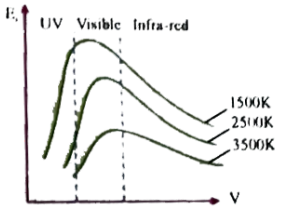
11. Which of the following graphs shows the correct variation in intensity of heat radiations by black body and frequency at a fixed temperature



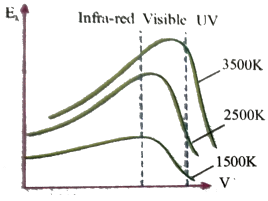
A.



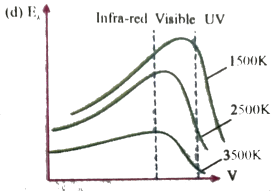
B.



C.



D.



Answer: C

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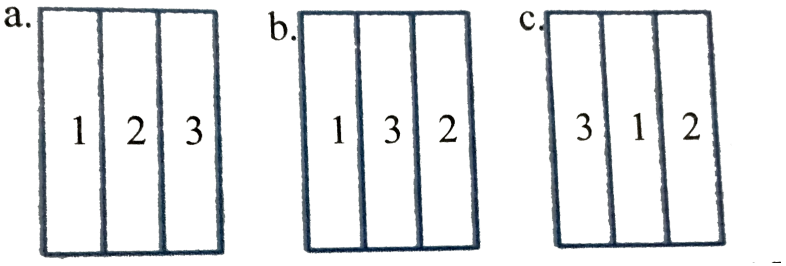
12. Three different arrangemnets of matrials 1 and $2, 3$ to from a wall Thremal conductivities are $k_1 > k_2 > k_3$ The left side of the wall is $20^\circ C$ higher than the right side Temperature difference ΔT across the

material 1 has following relation in three cases



A. $\Delta T_a > \Delta b +_b > \delta T_c$

B. $\Delta T_c = \Delta T_b = \Delta T_c$

C. $\Delta T_a = \Delta T_b > \Delta T_c$

D. $\Delta T_a = \Delta T_b < \Delta T_c$

Answer: B

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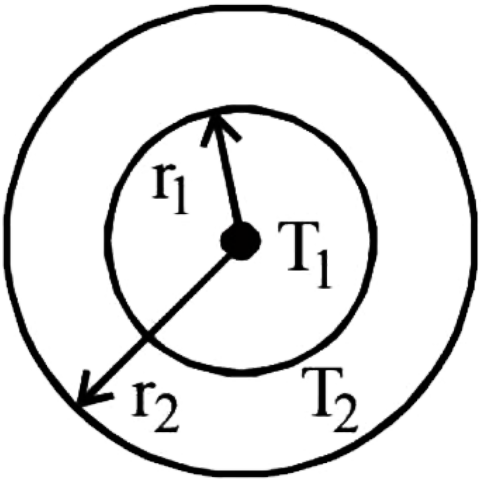
13. The figure shows a system of two concentric spheres of radii r_1 and r_2 are kept at temperature T_1 and T_2, respectively. The radial rate of flow of heat in a substance between the two concentric spheres is

proportional to



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

B. $(r_2 - r_1)$

C. $(r_2 - r_1)(r_1 r_2)$

D. $In\left(\frac{r_2}{r_1}\right)$

Answer: A

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14. Two identical objects A and B are at temperatures T_A and T_B. Respectively. Both objects are placed in a room with perfectly absorbing walls maintained at a temperature $T(T_A > T > T_B)$. The objects A and B attain the temperature T eventually. Select the correct statements from the following:

A. A only emits radiation while B only absorbs it untilboth attain the temperatures T .

B. A loses more heat by radiation than it absorbs, while B absords more radiation than it emits until they attain the temperature T

C. Both A and B only absorb radiation but do not emit it they attain the temperature T .

D. Each object continous to emit and absorb radiation even after attaiing the temperature T .

Answer: B::D

Watch Video Solution

15. Two solid spheres are heated to the same temperature allowed to cool under identical conditions Compare (i) initial rates of fall of temperatre, and (ii) initial rates of loss of heat Assume that all the surfaces have the same emissivity and ratios of their radii specific heats and densities are respectively $1:\alpha 1:\beta, 1:\gamma$.

A. $\alpha\beta\gamma:1$

B. $1:\alpha^2$

C. $\beta=\alpha\gamma$

D. $1:\alpha^3$

Answer: A::B

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16. 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. the temperature of B is $1934K$

B. $\lambda_B = 1.5\mu m$

C. the temperature of B is $11604K$

D. the temperature of B is 2901 K

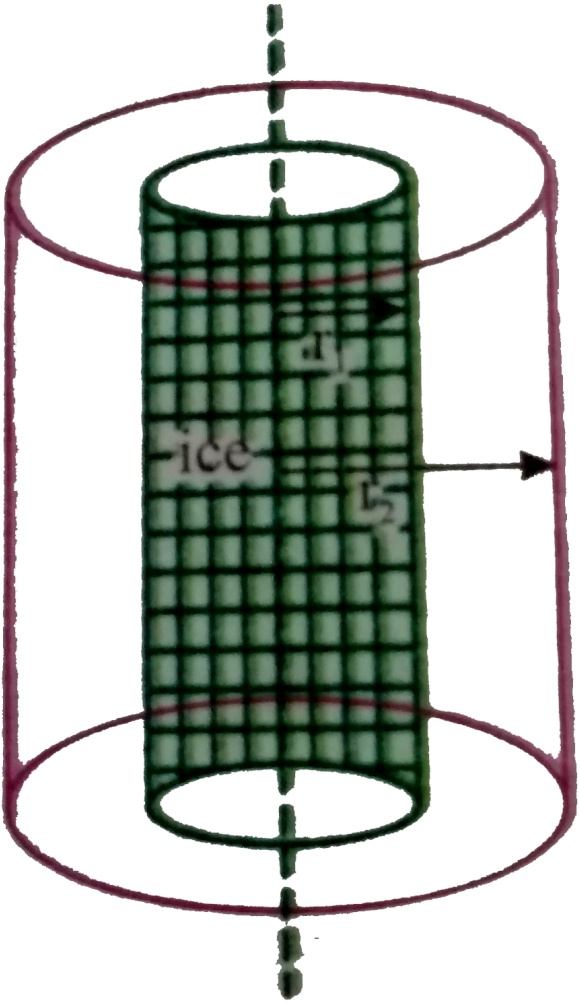
Answer: A::B

Watch Video Solution

17. A $100cm$ long cylindrical flask with inner and outer diameter $2cm$ and $4cm$ respectively is completely filled with ice as shown in the The constant temperature outside the flask is $40^\circ C$

(Thermal conductivity of the flask is

$0.693 W/m^\circ C, L_{ice} = 80 cal/gm \& In 2 = 0.693)$



A. Rate of heat flow from outside to the flask is $80\pi J/s$

B. The rate at which ice melts is $\frac{\pi}{4200} kg/s$

C. The rate at which ice melts is $100\pi kg/s$

D. Rate of heat flow from outside to flask is $40\pi J/s$

Answer: A::B

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18. A metal cylinder of mass $0.5kg$ is heated electrically by a $12W$ heater in a room at $15^\circ C$ The cylinder temperature rises nuniformly to $25^\circ C$ in 5 min and finally becomes constant at $45^\circ C$ Asuming that the rate of heat loss is proporational to the excess temperature over the surroundings .

A. The rate of loss of heat of the cylinder to surrounding at $20^\circ C$ is $2W$.

B. The rate of loss of heat of the cylinder to surrounding at $45^\circ C$ is $2W$.

C. Specific heat capacity of metal is $\frac{240}{In(3/2)} J/kg^\circ C$

D. None of these

Answer: A::C

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19. When we consider convection with radiation in Newton's law of cooling while temperature of the object in consideration is sightly higher than the environment temperature Choose correct statements about rate of heat loss .

A. direactly proporational to emissivity

B. direactly proporational to Stefan's constant

C. directly proportional to surface area

D. directly proportional to temperature difference of body and room .

Answer: C::D

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20. An incandesent bulb has a thin filament of tungsten that is heated to high temperature by passing an electric current The hot filament emits

black-body radiation The filament is observed to break up at random locations after a sufficiently long time of operation due to non-uniform evapo ration of operation due to non-uniform evapo ration of ungsten from the filament If the buld is powered at constant voltage which of the following statement (s) is (are) ture ? .

A. The temperature distribution over the filament is uniform

B. The resistance over small sections of the filament decreases with time

C. The filament emits more light at higher band of frequencies before it breaks up

D. The filament consumes less electrical power to words the end of the life of the bulb

Answer: C::D

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21. A spherical black body of radius r radiated power P at temperature T when placed in surroundings at temprature $T_0(< < T)$ If R is the rate of colling .

A. $P\alpha(T - T_0)$

B. PaT^4

C. $P\alpha r^2$

D. $R\alpha\frac{1}{r}$

Answer: C::D

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22. The total energy of a blackbody radiation source is collected for one minute and used to heat water The temperature of the water in creases from $20^\circ C$ to $20.5^\circ C$ If the absolute temperature of the blackbody is diubled and the experiment repeated which of the following statements would be most nearly $COR - RECT$? .

A. The temperature of the water would increases from $20^\circ C$ to final temperature of $28^\circ C$

B. The temperature of the water would increases from $20^\circ C$ to final temperature of $36^\circ C$

C. Rate of heat emission by the body will increases 8 times

D. Rate of heat emission by the body will increases 16 times

Answer: A::D

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23. A body is kept inside a container the temperature of the body is T_1 and the temperature of the container is T_2 the rate at which body absorbs the energy is α The emissivity of the body is The radiation striking the body is either absorbed or reflected

Ater a long time the temperature of the body will be .

A. T_1

B. T_2

C. $T_1 + \frac{T_1 - T_2}{2}$

D. None of these

Answer: B

Watch Video Solution

24. A body is kept inside a container the temperature of the body is T_1 and the temperature of the container is T_2 the rate at which body absorbs the energy is α The emissivity of the body is The radiation striking the body is either absorbed or reflected

At what rate of body will absorb the radiant energy .

A. If is the time,rate is $(T_1 - T_2)t$

B. e

C. both of the above

D. None of these

Answer: B

Watch Video Solution

25. A body is kept inside a container the temperature of the body is T_1 and the temperature of the container is T_2 the rate at which body absorbs the energy is α The emissivity of the body is The radiation striking the body is either absorbed or reflected

At what rate of body will basorb the radiant energy .

A. α, but $\alpha \neq e$

B. $(T_1 - T_2)/t$ where is the time

C. e, but $e = \alpha$

D. None of these

Answer: C

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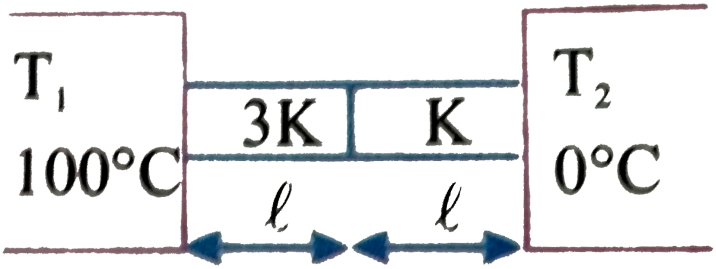
26. Two rods A and B of same cross sectional are A and length l connected in series between a source $(T_1 = 100^\circ C)$ and a sink $(T_2 = 0^\circ C)$ as shown in The rod is laterally insulated



The ratio of thermal resistance of the rod is .

A. $\frac{R_A}{R_B} = \frac{1}{3}$

B. $\frac{R_A}{R_B} = 3$

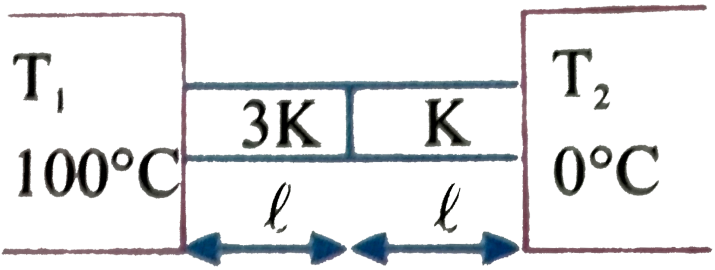
C. $\frac{R_A}{R_B} = \frac{3}{4}$

D. $\frac{4}{3}$

Answer: A

Watch Video Solution

27. Two rods A and B of same cross sectional are A and length l connected in series between a source $(T_1 = 100^\circ C)$ and a sink $(T_2 = 0^\circ C)$ as shown in The rod is laterally insulated



If A_A and T_B are the temperature drops across temperature gradients the rod A and B then .

A. $\frac{T_A}{A_B} = \frac{3}{1}$

B. $\frac{T_A}{T_B} = \frac{1}{3}$

C. $\frac{T_A}{T_B} = \frac{3}{4}$

D. $\frac{T_A}{T_B} = \frac{4}{3}$

Answer: B

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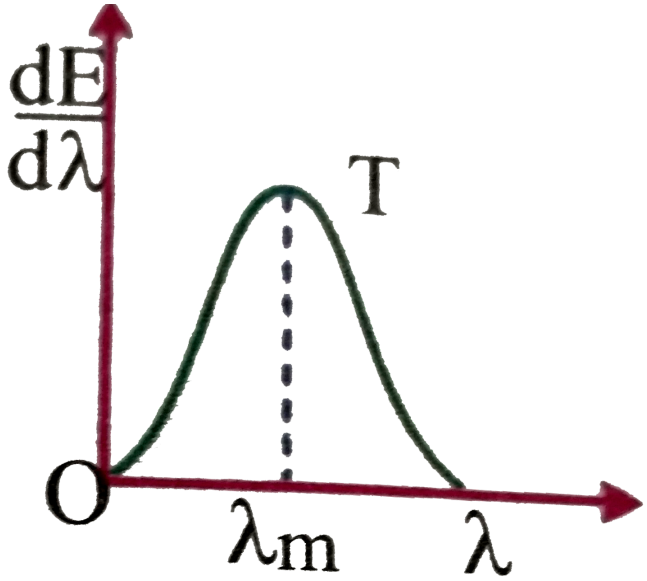
28. The shows a radiant energy spectrum graph for a black body at at temperature T



Choose the correct statements (s) .

A. The radiant energy is not equally distributed among all the possible wavelengths

B. For a particular wavelength the spectral intensity is maximum

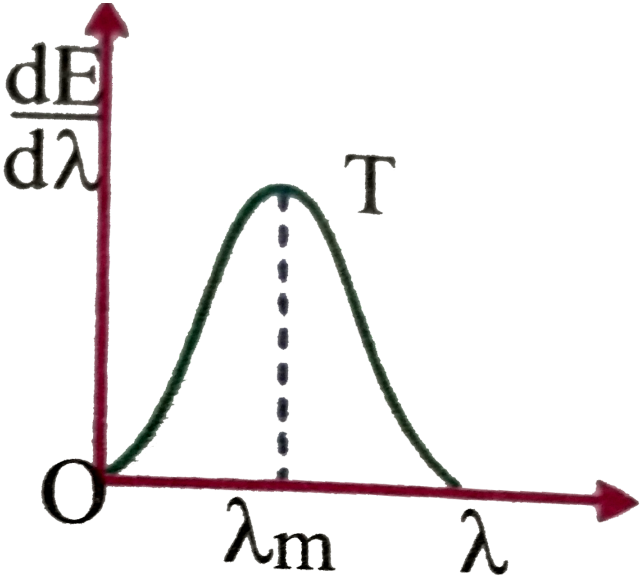
C. The area under the curve is equal to the total rate at which heat is radiated by the body at that temperature .

D. None of these

Answer: B::C

Watch Video Solution

29. The shows a radiant energy spectrum graph for a black body at at temperature T



If the temperature of the body is raised to a higher temperature T then choose the correct statement (s).

A. The intensity of radiation for every wavelength increase

B. The maximum intensity occurs at a shorter wavelength

C. The area under the graph increases

D. The area under the graph is proportional to the fourth power of temperature .

Answer: A::B::C

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30. A rod of length l with thermally insulated lateral surface is made of a matrical whose thermal conductivity varies as $K = C/T$ where C is a constant The ends are kept at temperature T_1 and T_2 The temperature at a distance x from the first end where the temperature is $T_1, T = T_1\left(\frac{T_2}{T_1}\right)^{nx/2l}$ Find the value of n? .

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31. A solid copper shere of density ρ specific heat c and radius r is at temperature T_1 It is suspended inside a chamber whose walls are at

temperature 0 K The time required for the temperature of sphere to drop to T_2 is $\frac{r\rho c}{xe\sigma}\left(\frac{1}{T_2^3}-\frac{1}{T_1^3}\right)$ Find the value of x? Take the emmissivity of teh sphere to be equal to e .

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32. Two identical rods are connected between two containers. One of them is at $100^\circ C$ containing water and another is at $0^\circ C$ containing ice. If rods are connected in parallel then the rate of melting of ice is $q_1 g/s$. If they are connected in series then teh rate is $q_2 g/s$. The ratio q_2/q_1 is

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33. Two spherical bodies A (radius 6cm) and B (radius 18cm) are at temperature T_1 and T_2 respectively The maximum intensity in the emission spectrum of A is at $500nm$ and in that of B is at $1500nm$ considering them to be black bodies, what will be the ratio of total energy radiated by A to that of B .

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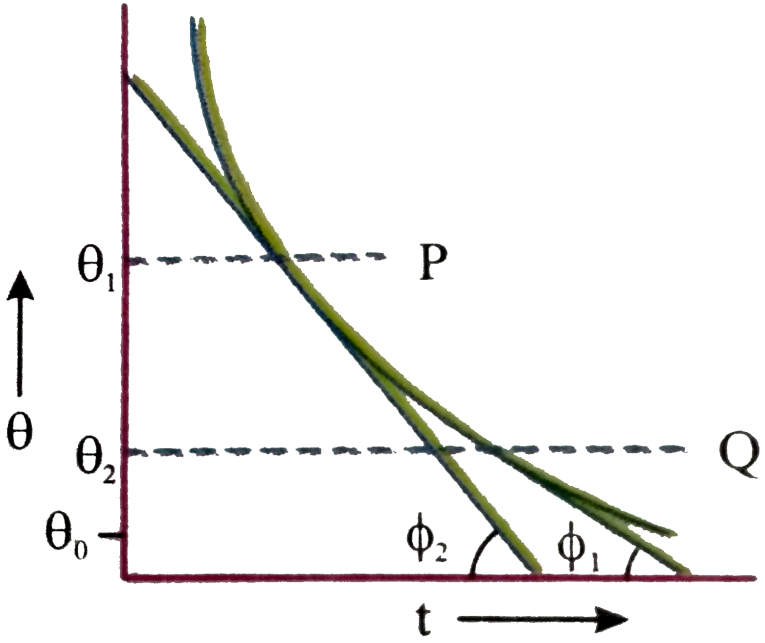
34. A body cools in a surrounding which is at a constant temperature of θ_0 Assume that it obeys Newton's law of cooling Its temperature θ is plotted against time t Tangents are drawn to the curve at the points $P(\theta = \theta_1)$ and $Q(\theta = \theta_2)$ These tangents meet the time axis at angle of ϕ_2 andϕ_1 as shown



A. $\frac{\tan\phi_2}{\tan\phi_1} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$

B. $\frac{\tan\phi_2}{\tan\phi_1} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$

C. $\frac{\tan\phi_2}{\tan\phi_1} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$

D. $\frac{\tan\phi_2}{\tan\phi_1} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$

Answer: B

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35. A body with an initial temperature θ_1 is allowed to cool in a surrounding which is at a constant temperature of $\theta_0(\theta < \theta_1)$ Assume that Newton's law of cooling is obeyed Let $k =$ constant The temperature of the body after time t is best experssed by .

A. $(\theta_i - \theta_0)e^{-kt}$

B. $(\theta_i - \theta_0)In(kt)$

C. $\theta_0 + (\theta_i - \theta_0)e^{-kt}$

D. $\theta_i e^{-kt} - \theta_0$

Answer: C

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36. The intensity of radiation emitted by the sun has its maximum value at a wavelenght of $510nm$ and that emitted by the north star has the maximum value at $350nm$ If these stars behave like balackbodies the nthe ratio of the surface temperature of the sun and the north star is .

A. 1.46

B. 0.69

C. 1.21

D. 0.83

Answer: B

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37. A rod of unifrom cross section is heated at temperature t_0 at a point which is at n_1 times if its length $(n_1 < 1)$ from its one end in stready state The temperature at this end is t_1 and at other end is t_2 Rate of vapourisation of water at either end of the rod is same. The end at which temperature is t_2 is how much more far away that the other end from the point at which the rod is heated .

A. $\frac{n_1(t_0 - t_2)}{t_0 - t_1}$

B. $\frac{n_1(t_0 - t_2)}{t_0 - t_1}$

C. $\frac{2n_1 t_0}{t_0 - t_2}$

D. $\frac{2n_1(t_1 - t_2)}{t_0 - t_1}$

Answer: D

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38. A body obeying Newton's law of cooling cools in a surrounding which is at a constant temperature Its temperature θ is plotted against time

There are two points on the curve with temperatures θ_2 and $\theta_1(\theta_2 > \theta_1)$ such that tangents on these points make angles of 2ϕ and half of its with time axis respectively Find the temperature of the surrounding .

A. $\theta_1 \cos 2\phi - \theta_2(1 + \cos 2\phi)$

B. $\theta_1(1 + \cos 2\phi) - \theta_2 \cos 2\phi$

C. $(\theta_2 - \theta_1)\cos 2\phi$

D. $\frac{2\theta_1 + \theta_2(1 + \tan^2 \phi)}{(1 - \tan^2 \phi)}$

Answer: B

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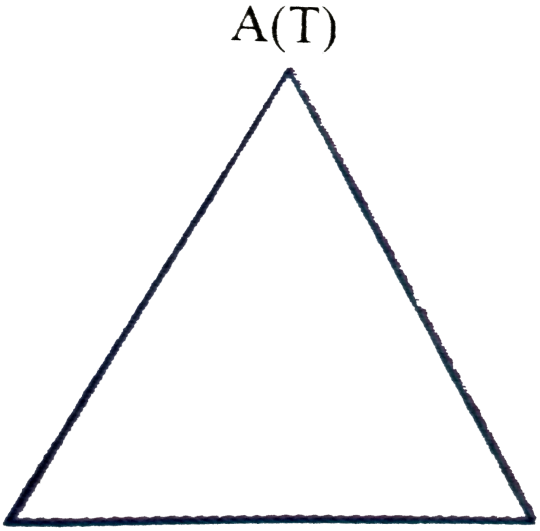
39. The three rods of same meterial and crosssectional area from the sides of a triangle ABC The points A, B and C are maintained at temperature $TT\sqrt{2}$ and $\frac{3T}{\left(\sqrt{2}+1\right)}$ respectively Assuming that only heat conducting takes place the system is in steady state, find the angle at B The temperature difference per unit length along SB and CA is

equal



A. 30°

B. 45°

C. 60°

D. 90°

Answer: D

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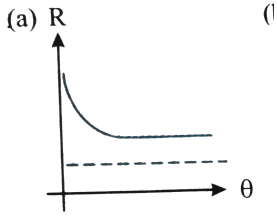
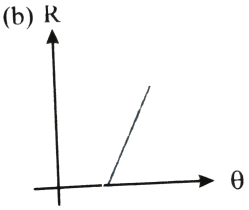
40. Themperature of a body θ is slightly more than the temperature of the surrounding θ_0 its rate of cooling (R) versus temperature of body (θ) is plotted its shape would be .

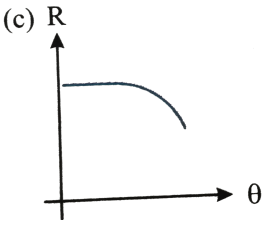
A.



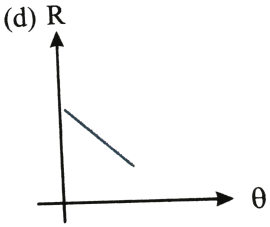
B.



C.



D.



Answer: B

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41. A body cools from $80^\circ C$ to $70^\circ C$ in 10 minutes Find the required further fir it to cool from $70^\circ C$ to $60^\circ C$ Assume the temperature of the surrounding to be $30^\circ C$.

A. $101 \log_e\left(\frac{4}{3}\right)$

B. $101 \log_e\left(\frac{5}{4}\right)$

C. $10 \times \frac{\log_e\left(\frac{4}{3}\right)}{\log_e\left(\frac{5}{4}\right)}$

D. $10 \times \frac{\log_e\left(\frac{5}{4}\right)}{\log_e\left(\frac{4}{3}\right)}$

Answer: C

Watch Video Solution

42. 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 $20W/m^2$

B. The emissive power of b is $200W/m^2$

C. The power emitted by B is $20W$

D. The power emitted by B is $180W$

Answer: A

Watch Video Solution

43. A spherical shell of inner radius R_1 and outer radius R_2 is having variable Where 'r' is the distance from the centre Two surface of the shell are maintained at temperature T_1 respectively $(T_1 < T_2)$ The heat current flowing through the shell would be .

Watch Video Solution

44. A radiator whose temperature is $T^\circ C$ is used to heat the room in the cold weater The radiator is able maintain a room temmperature of $30^\circ C$ when ouside temperature is $10^\circ C$ and $15^\circ C$ when outside temperature is $30^\circ C$ Determine the temperature of the radiator [Assume Newton's law of cooling to be valid] .

A. $85^\circ C$

B. $15^\circ C$

C. $98.6^\circ C$

D. $150^\circ C$

Answer: D

Watch Video Solution

45. The Thin walled spheres of different matrials one with double the radius and one fourth wall thickness of the other are filled with ice if the time taken for complete metting of ice in the sphere of larger radius is $25\ \min$ and that for smaller one is $6\ \min$ the ratio of the thermal condutivities of the matrials of larger sphere to the smaller sphere is .

A. $4:5$

B. $25:1$

C. $1:25$

D. $8:25$

Answer: D

Watch Video Solution

46. An object is being heated by a heater supplying $60W$ of heat. Temperature of surrounding is $20^\circ C$ and the temperature of object becomes constant at $50^\circ C$ Now the heater is switched off What is the

rate at which the object will lose heat when its temperature has dropped to $30^\circ C$.

A. $20W$

B. $30W$

C. $40W$

D. $60W$

Answer: A

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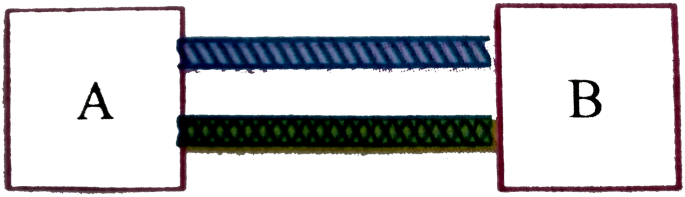
47. The container A is constantly maintained at $100^\circ C$ and insulated container B in the contains ice at $0^\circ C$ Different rods are used to connect them For a rod made of copper, it takes 30 mintes for the ice to melt and for a rod of steel of same cross-section taken in different experiment it takes 60 minutes for ice to melt. When these rods are simultaneously

connected in parallel, the ice melts is



A. 15 minutes

B. 20 minutes

C. 45 minutes

D. 90 minutes

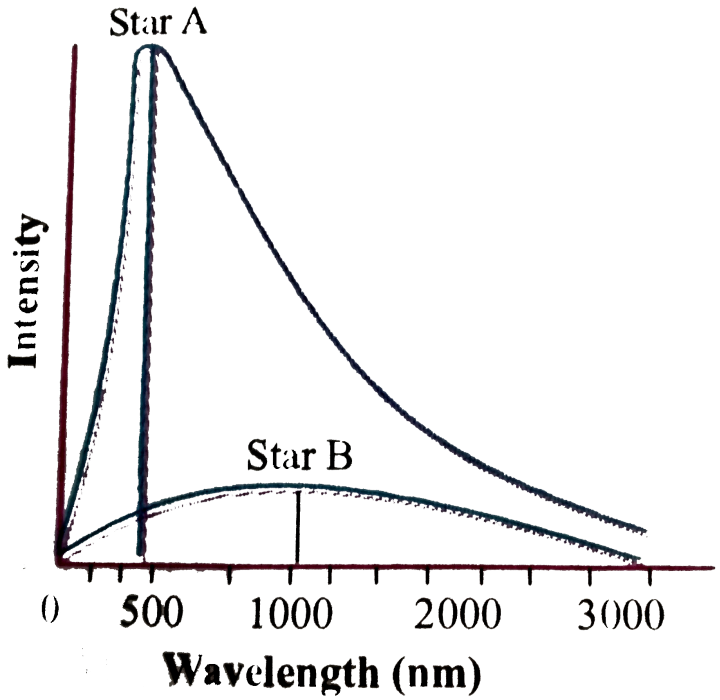
Answer: B

Watch Video Solution

48. The spectra of radiation emitted by two distant stars are shown below

The ratio of the surface temperature of star A to that of star B, $T_A : T_B$

is approximately



A. 2 : 1

B. 4 : 1

C. 1 : 2

D. 1 : 1

Answer: A

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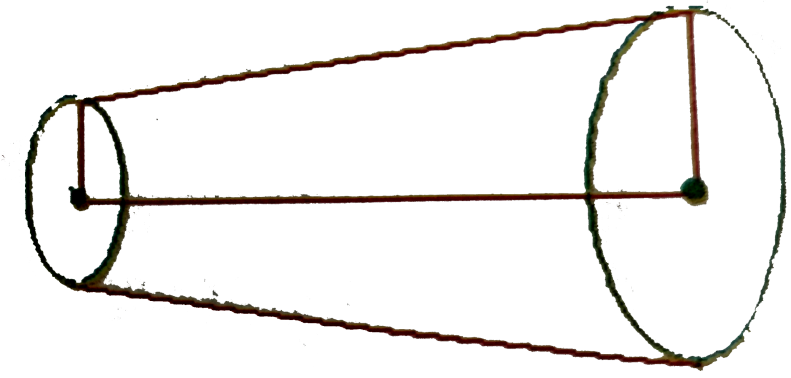
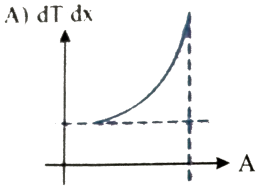
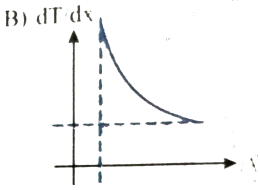
49. An irregular rod of same uniform material as shown in is conducting heat at a steady rate. The temperature gradient at varoius sections versus area of cross section graph will be



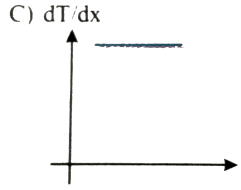
A.



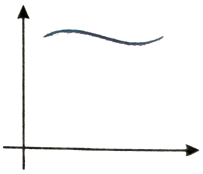
B.



C.



D) dT/dx

D. 

Answer: B

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50. A solid copper sphere of dimater $10mm$ is cooled to temperature of $150K$ and is then placed in an enclousure at $290K$ Assuming that all interchange of heat is by radiation, calculate the initial rate of rise of temperature of the sphere The sphere may be treated as a black body

$\rho_{copper} = 8.93 \times 10^3 kg/m^3$

$s = 3.7 \times 10^2 Jkg^{-2}K^{-1}, \sigma = 5.7 \times 10^8 Wm^{-2}K^{-4}$.

A. $0.68K/s$

B. $0.68K/s$

C. $0.34K/s$

D. $0.034K/s$

Answer: B

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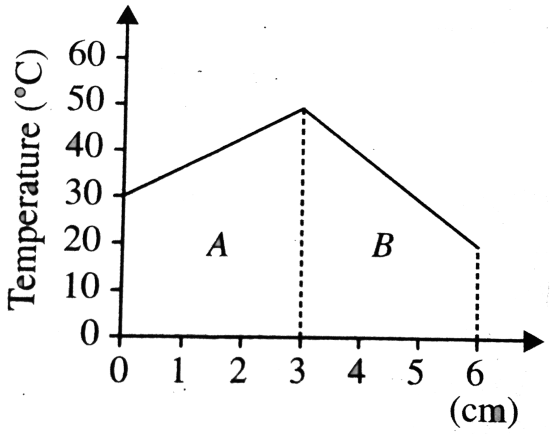

51.

The temperature across two different slabs A and B are shown I the steady state (as shown Fig) The ratio of thermal conductivities of A and B is

A. $2:3$

B. $3:2$

C. $1:1$

D. $5:3$

Answer: B

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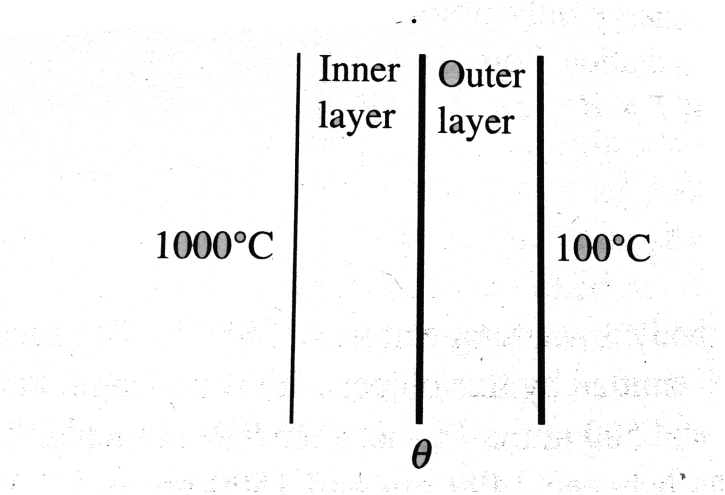
52.



The temperature drop through a two layer furnace wall is $900^{\circ}C$. Each layer is of equal area of cross section. Which of the following actions will result in lowering the temperature θ of the interface?

A. By increasing the thermal conductivity of outer layer .

B. By increasing the thermal conductivity of outer layer .

C. By increasing the thermal conductivity of outer layer .

D. By increasing the thermal conductivity of outer layer .

Answer: A::B

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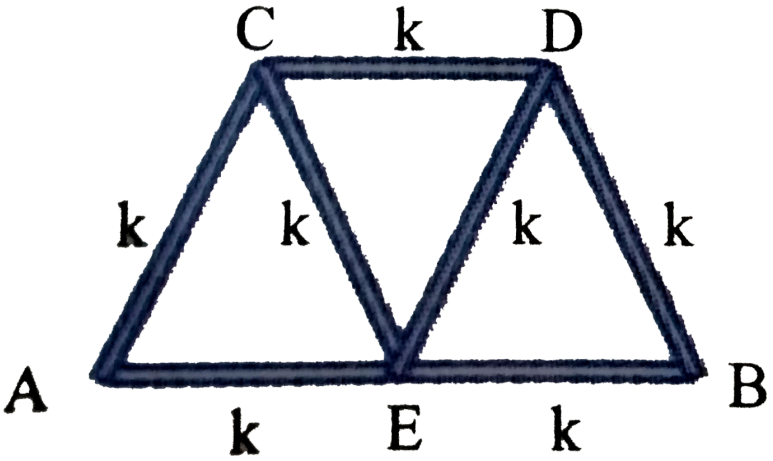
53. Seven identical rods of matrical of thermal conductivity k are connected as shown in All the rod are of identical length l and cross sectional area A if the one end b is kept at $100^\circ C$ and the other end is kept at $0^\circ C$ The temperatures of the junctions C, D and $E(\theta_D \text{ and } \theta_E)$ be in the steady state



A. $\theta_C > \theta_E > \theta_D$

B. $\theta_E = 50^\circ C \text{ and } \theta_D = 37.5^\circ C$

C. $\theta_E = 50^\circ C, \theta_C = 62.5^\circ C$ and $\theta_D = 37.5^\circ C$

D. $\theta_E = 50^\circ C, \theta_C = 60^\circ C$ and $\theta_D = 40^\circ C$

Answer: A::C

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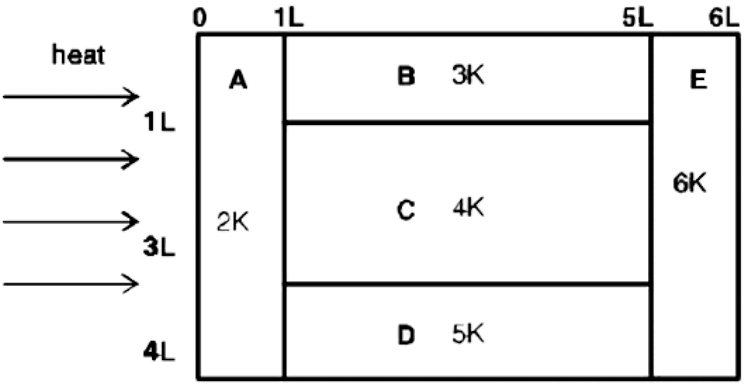
54. A composite block is made of slabs A,B,C,D and E of different thermal conductivities (given in terms of a constant K and sizes (given in terms of length, L) as shown in the figure. All slabs are of same width. Heat 'Q' flows only from left to right through the blocks. Then in steady state



A. heat flow through A and E slabs are same

B. heat flow through slab E in maximum

C. temperature difference across slab E is smallest

D. heat flow through C= heat flow through $B +$ heat flow through D .

Answer: A::B::C::D

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55. In Newton's law of cooling $\frac{d\theta}{dt} = -k(\theta - \theta_0)$ the constant k is proportional to .

A. A: surface of the body

B. S in the specific heat of the body

C. $\frac{1}{m}$ being the mass of the body

D. e is the emissivity of the body

Answer: A::C

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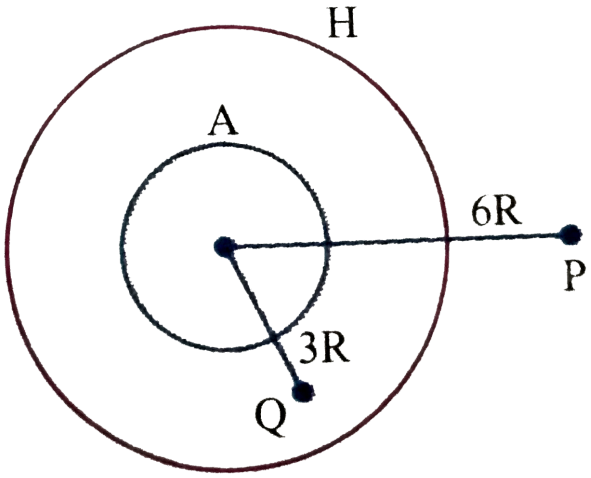
56. Consider a spherical body A of radius R which is placed concentrically in a hollow enclosure H of radius $4R$ as shown in the The temperature of the body A and H are T_A and T_H respectively Emissivity transmittivity and reflactivity of two bodies A and H are (e_a, e_H), $?(t_A, t_H)$, and (r_A, r_H) respectively (Assume no absorption of the thermal energy by the space in between the body and enclosure as well as outside the enclousre and all radiations to be emitted and absorbed normal to the surface $\left[Tske\sigma \times 4\pi r^2 \times 300^4 = \beta J/s\right]$



In above quations if body A has then mark out the correct statements (s) .

A. The rate at which A loses the energy is $\beta J / s$.

B. The rate at which the spherical surface containing P receives the energy is zero

C. The rate at which the spherical surface containing P receives the energy is β

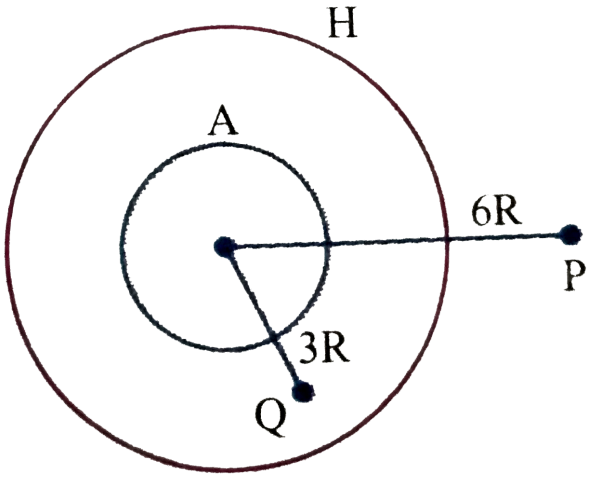
D. All of these

Answer: D

View Text Solution

57. Consider a spherical body A of radius R which is placed concentrically in a hollow enclosure H of radius $4R$ as shown in the The temperature of the body A and H are T_A and T_H respectively Emissivity transmittivity and reflactivity of two bodies A and H are (e_a, e_H), $?(t_A, t_H)$, and (r_A, r_H) respectively (Assume no absorption of the thermal energy by the space in between the body and enclosure as well as outside the enclousre and all radiations to be emitted and absorbed normal to the

surface $\left[Tske\sigma \times 4\pi r^2 \times 300^4 = \beta J/s\right]$



Consider two cases, first one in which A is a perfect black body and the second in which A is a non-black In both the cases temperature of boby A is same equal to $300K$ and H is at temperature $600K$ For $Ht =$ and $a \neq 1$ For this situation mark out the correct statements (s) .

A. The bodies lose their distinctiveness inside the enclosure and both of them emit the same radiation as that of the black body .

B. The rate of heat loss by A in both cases is the same and is equal $\beta J/s$.

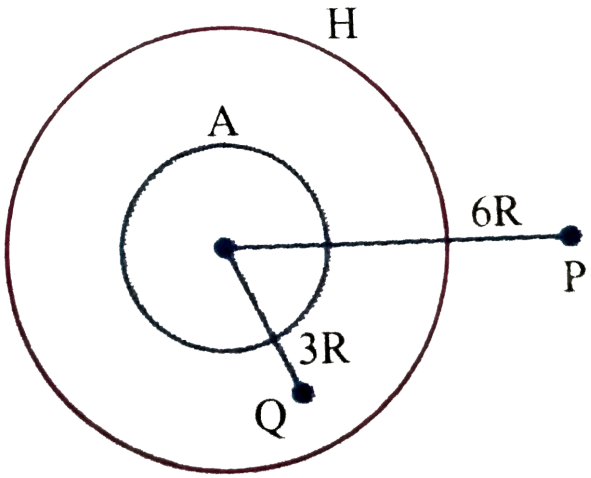
C. The rate of heat loss by A in both cases are different .

D. From this information we can calculate exact rate of heat loss by A in different cases .

Answer: C

View Text Solution

58. Consider a spherical body A of radius R which is placed concentrically in a hollow enclosure H of radius $4R$ as shown in the The temperature of the body A and H are T_A and T_H respectively Emissivity transmittivity and reflactivity of two bodies A and H are (e_a, e_H), $?(t_A, t_H)$, and (r_A, r_H) respectively (Assume no absorption of the thermal energy by the space in between the body and enclosure as well as outside the enclousre and all radiations to be emitted and absorbed normal to the surface $\left[Tske\sigma \times 4\pi r^2 \times 300^4 = \beta J/s\right]$



In the previous question if the enclosure is considered as perfect black body and is maintaind at same temperature as that of temperature of body A then in the two cases .

A. the body A emits radiation at the same are

B. the body A emits radiation at different rates

C. the temperature of body A remains constant .

D. None of these

Answer: B

View Text Solution

59. A highly conducting solid sphere of radius R density ρ and specific heat s is kept in an evacuted chamber. A parallel beam of thermal radiation of instensity I is incident on its surfcae Consider the sphere to be a perfectly black body and its temperature at certain instant considered at $t = 0$ is T_0 [Take Stefan's constant as σ] Answer the following questions based on above information

The equation which gives the temperature T of the sphere as a function of time is .

A. $\int_{To}^{T} \frac{dT}{I - 4\sigma T^4} = \int_{0}^{t} \frac{3dt}{4R\rho s}$

B. $\int_{To}^{T} \frac{dT}{I - 4\sigma T^4} = \int_{0}^{t} \frac{3dt}{4R\rho s}$

C. $\int_{To}^{T} \frac{dT}{I - 4\sigma T^4} = \int_{0}^{t} \frac{3dt}{8R\rho s}$

D. $\int_{To}^{T} \frac{dT}{I - 4\sigma T^4} = \int_{0}^{t} \frac{3dt}{4R\rho s}$

Answer: A

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60. A highly conducting solid sphere of radius R density ρ and specific heat s is kept in an evacuted chamber. A parallel beam of thermal radiation of instensity I is incident on its surfcae Consider the sphere to be a perfectly black body and its temperature at certain instant considered at $t = 0$ is T_0 [Take Stefan's constant as σ] Answer the following questions based on above information

The maximum attainable temperature of the sphere is .

A. $\left(\frac{I}{4\sigma}\right)^{1/2}$

B. $\left(\frac{I}{2\sigma}\right)^{1/3}$

C. $\left(\frac{I}{4\sigma}\right)^{1/4}$

D. Never occurs

Answer: C

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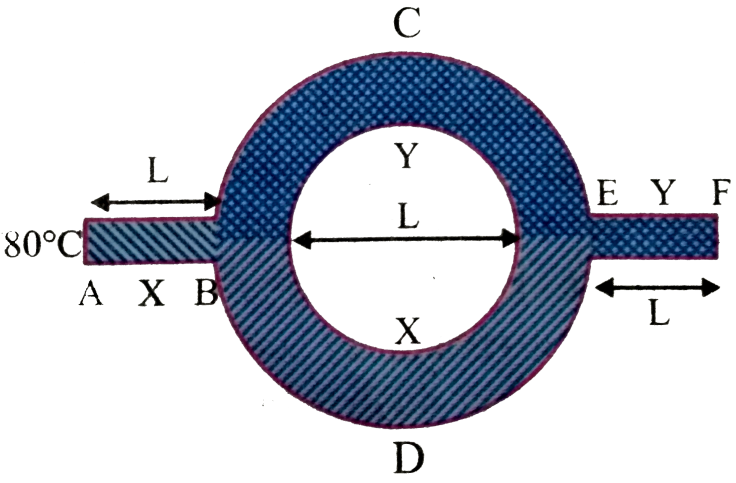
61. A few rods of materials X and Y are connected as shown in The cross-sectional areas of all the rods are same if the end A is maintaind at $80^\circ C$ and the end F is maintained at $10^2 C$ If the temperature of junctions B and E in steady state are $\frac{39.48^\circ C}{n_1}$ and $\frac{60.52^\circ C}{n_2}$ Find n_1 and n_2 Given thermal conductivity of material X double that of Y



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62. A hot body placed in air is cooled down according to newton's law of cooling the rate of decrease of temperature being k times the temperature difference from the surrounnding Starting from $t = 0$ The

time in which the body will lose half of the maximum heat is $\frac{x \ln 2}{2k}$ Find the value of x .

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63. One end of a uniform rod of length $1m$ is placed in boilling water while its other end is placed in boiling water while its other end is placed in melting ice A point P on the rod is maintained at a constant temperature of $800^\circ C$ mass of stam produced per second is equal to the mass of ice melted per second. is equal to mass of ice melted per second If specific latent heat of steam is 7 times the specific latent heat of ice, then the distance of P from the steam chamber is $n/18$ m Find the value of n ? .

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64. Two identical rods are connected between two containers. One of them is at $100^\circ C$ containing water and another is at $0^\circ C$ containing ice.

If rods are connected in parallel then the rate of melting of ice is $q_1 g/s$. If they are connected in series then teh rate is $q_2 g/s$. The ratio q_2/q_1 is

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65. A metal rod AB of length 10x has its one end A in ice at $0^\circ C$, and the other end B in water at $100^\circ C$. If a point P one the rod is maintained at $400^\circ C$, then it is found that equal amounts of water and ice evaporate and melt per unit time. The latent heat of evaporation of water is $540 cal/g$ and latent heat of melting of ice is $80 cal/g$. If the point P is at a distance of λx from the ice end A, find the value λ. [Neglect any heat loss to the surrounding.]

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66. A metal is heated in a furnace where a sensor is kept above the metal surface to read the power radiated (P) by the metal. The sensor has scale that displays $\log_2, (P/P_0)$, where P_0 is constant. When the metal surface is at a temperature of $487^\circ C$, the sensor shows a value 1. Assume that

the emissivity of the metallic surface remains constant. What is the value displayed by the sensor when the temperature of the metal surface is raised to $2767^\circ C$?

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67. The distance of the Earth from the Sun is 4 times that of the planet Mercury from the Sun The temperature of the Earth in radiative equilibrium with the Sun is $290K$ The radiative euilibrium temperature of the Mercury is 5.80×10^n Find the value of n Assume all three bodies to be black body .

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68. A metal block is placed in a room which is at $10^\circ C$ for long time. Now it is heated by an electric heater of power $500W$ till its temperature becomes $50^\circ C$ Its initial rate of rise of temperature is $2.5^\circ C/\sec$ The heater is switched off and now a heater of $100W$ is required to maintain the temperature of the block at $50^\circ C$ The heat radiated per second when

the block was $30^\circ C$ is given as α watt. Find the value of $\left(\frac{\alpha}{10}\right)$ (Assume Newton's law of cooling to be valid .

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LEVEL-I(H.W)

1. In the steady state the two ends of a meter rod are at $30^\circ C$ and $20^\circ C$ the temperature at the $40^{th} cm$ from the end at higher temperature is .

A. $22^\circ C$

B. $26^\circ C$

C. $25^\circ C$

D. $24^\circ C$

Answer: B

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2. A body of length $1m$ having cross sectional area $0.75m^2$ has heat flow through it at the rate of $6000\text{Joule}/\sec$. Then find the temperature difference if $K = 200Jm^{-1}K^{-1}$.

A. $20^\circ C$

B. $40^\circ C$

C. $80^\circ C$

D. $100^\circ C$

Answer: B

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3. A 3cm cube of iron one face at $100^\circ C$ and the other in a block of ice at $0^\circ C$ If K of iron $= 0.2CGS$ units and L for ice is $80cal/gm$ then the amount of ice that melts in 10 minutes is (assume steady state heat trans fer) .

A. $450g$

B. $900g$

C. $350g$

D. $500g$

Answer: A

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4. The heat is flowing through two cylinderical rods of same material. The diameters of the rods are in the ratio $1:2$ and their lengths are in the ratio $2:1$. If the temperature difference between their ends is the same, the ratio of rates of flow of heat through them will be

A. $1:1$

B. $2:1$

C. $1:4$

D. $1:8$

Answer: D

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5. One end of a cylindrical rod is kept in steam chamber and the other end in melting Ice. Now $0.5gm$ of ice melts in $1\sec$ if the rod is replaced by another rod of same length half the diameter then rate of melting of ice will be (in gm/sec) .

A. 0.25

B. 0.5

C. 1

D. 2

Answer: A

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6. The wavelength of maximum energy released during an atomic axplosion was $2.93 \times 10^{-10} m$. Given that Wien's constant is $2.93 \times 10^{-3} m - K$, the maximum temperature attained must be of the order of

A. $10^{-7} K$

B. $10^{7} K$

C. $10^{-13} K$

D. $5.86 \times 10^{7} K$

Answer: B

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7. What will be the ratio of temperatures of sun and moon if the wavelengths of their maximum emission radiations rates are $140 A^{\circ}$ and $4200 A^{\circ}$ respectively .

A. $1:30$

B. $30:1$

C. $42:14$

D. $14:42$

Answer: B

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8. The rate of radiation from a black body at $1^\circ C$ is E The rate of radiation from this black body at $273^\circ C$ is .

A. $2E$

B. $E/2$

C. $16E$

D. $E/16$

Answer: C

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9. Two bodies of same shape, same size and same radiating power have emissivities 0.2 and 0.4 The ratio of their temperature is .

A. $\sqrt{3}:1$

B. $\sqrt{2}:1$

C. $\sqrt{5}$

D. $1:\sqrt{3}$

Answer: B

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10. Two spheres have radii $1m, 2m$ are at same temperatures, have emissivites e 2e then ratio of radiant energy emitted per second is .

A. $1:2$

B. $1:4$

C. $1:8$

D. $1:1$

Answer: C

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11. The radiant power of a furnace of surface area of $0.6m^2$ is $34.2KW$ The temperature of the furance s $\left[\sigma = 5.7 \times 10^{-8} Wm^{-2}K^{-4}\right.$.

A. $3400K$

B. $1012K$

C. $1000K$

D. $5700K$

Answer: C

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12. How many watt of energy is required to keep a black body in the form of a cube of side $1cm$ at $2000K$ (Temprature of surroding is $27^{\circ}c$ and $\sigma = 5.57 \times 10^{-5} Wm^{-2} K^{-4}$.

A. $444KW$

B. $544KW$

C. $644KW$

D. $64KW$

Answer: B

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13. Two spheres of the same materical have radii $1m$ and $4m$ and temperature $400K$ and $2000K$ respectively The ratio of the energy radiated per second by the first sphere to that by the second is .

A. $1:1$

B. $16:1$

C. $4:1$

D. $1:9$

Answer: A

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14. If the temperature of the sun were to increase form T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously will be

A. 4

B. 16

C. 32

D. 64

Answer: D

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15. Amount of heat radiations emitted by a solid sphere of radius r at any temperatures is proportional to the following .?

A. r

B. r^2

C. r^3

D. r^4

Answer: B

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16. The rates of coling of a body at tempeerature $100^\circ C$ and $80^\circ C$ are x_1 and x_2 respectively, when placed in a room of tmpeerature $40^\circ C$ then

$\frac{x_1}{x_2}$ is .

A. $4/5$

B. $5/4$

C. $3/2$

D. $2/3$

Answer: C

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17. A vessel full of hot water is kept in a room and it cools from $80^\circ C$ to $75^\circ C$ in T_1 minutes, from $75^\circ C$ to $70^\circ C$ in T_2 minutes and from $70^\circ C$ to $65^\circ C$ in T_3 minutes Then .

A. $T_1 = T_2 = T_3$

B. $T_1 > T_2 > T_3$

C. $T_1 < T_2 = T_3$

D. $T_1 < T_2 < T_3$

Answer: D

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18. Radius of a shere is R density is d and specific heat is s, Is is heated and then allowed to cool Its rate of decrease of temperature will be proportional to .

A. Rds

B. $1/Rds$

C. $1/R^2ds$

D. R^2ds

Answer: B

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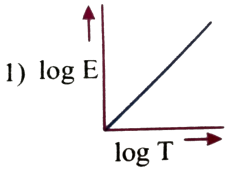
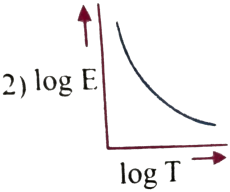
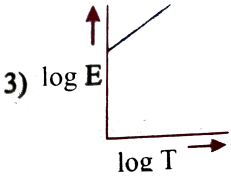
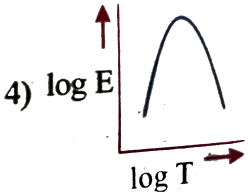
19. If the rate of emission of radiation by a body at temperature TK is E then graph between log E and log T will be .

A. 

B. 

C. 

D. 

Answer: A

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LEVEL-II(C.W)

1. Three metal rods of coefficient of thermal conductivities $K, 2K, 3K$ conducts heats of $3Q, 2Q, Q$ per seconds through unit area then the ratio of temperature gradients .

A. $9:3:1$

B. $9:1:1$

C. $3:1:1$

D. $1:1:1$

Answer: A

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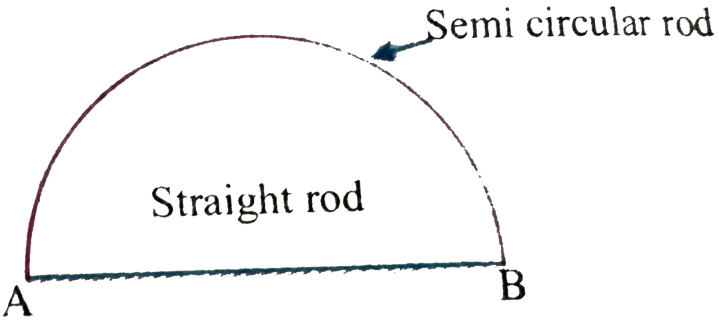
2. Two rods one is semi circular of thermal conductivity K_1 and otheir is straight of thermal conductivity K_2 and of same cross sectional area are joined as shown in the The points A and B are maintained at same

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. $3 : 2$

Answer: C

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3. Two identical rods of same metal are first waleded in series and then in parallel are maintained at same temperature difference then the ratio of

heats conducted in same time is .

A. $1:1$

B. $1:2$

C. $1:4$

D. $1:3$

Answer: C

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4. Two slabs A and B of equal surface area are placed one over the other such that their surfaces are completely in contact The thickness and coefficient of thermal conductivities of slab A is twice that B The first surface of slab A is maintained at $100^\circ C$ while the second surface of slab B is maintained at $25^\circ C$ The temperature at the contact of their surfaces is .

A. $15^\circ C$

B. $62.5^\circ C$

C. $55^\circ C$

D. $85^\circ C$

Answer: B

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5. Three metal rods of same lenghs and same area of cross sections having conductivities $1, 2, 3,$ units are connected in series Then their effective conductivity will be .

A. 2 units

B. 1.6 units

C. 2.4 units

D. 2.8 units

Answer: B

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6. Two hollow supheres of thickness are filled with ice The ratio of their diameter is $1:2$ and the materials is $2:3$ The ratio of times in which the ice gets melted in the two spheres is .

A. $3:4$

B. $4:3$

C. $3:8$

D. $8:3$

Answer: A

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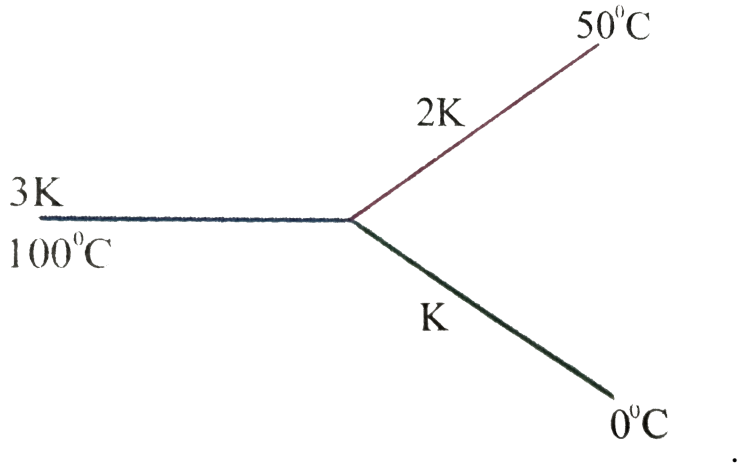
7. Three rods of same dimensions have thermal condutivity $3K, 2K$ and K They are arranged as shown in Then the temperature of the junction in

steady state is



A. $\frac{200}{3}.^{\circ} C$

B. $\frac{100}{3}.^{\circ} C$

C. $75^{\circ} C$

D. $\frac{50}{3}.^{\circ} C$

Answer: A

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8. Three rods of lengths $L, 21$ and $3L$ having thermal conductivities $3K, 2K$ and K are connected end to end If cross sectional areas of three

rods are equal If cross sectional areas of three rods are equal then equivalent thermal conductivity of the system is .

A. $18K/13$

B. $36K/133$

C. $9K/13$

D. $12K/13$

Answer: A

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9. Three rods of identical cross-sectional area and made from the same metal form the sides of an equilateral triangle ABC The points A and B are maintained at temperature $\sqrt{3}T$ and T respectively In the steady state, the temperature of the point C is T_C Assuming that only heat conduction takes place, the value of T_C/T is equal to .

A. $\frac{1+\sqrt{3}}{2}$

B. $\frac{-1\sqrt{3}}{2}$

C. $\frac{1+\sqrt{2}}{2}$

D. $\frac{1-\sqrt{2}}{2}$

Answer: A

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10. hollow metal with side $0.5m$ and wall thickess $5 \times 10^{-3}m$ is filled with ice It is immersed in water tank maintained at $100^{\circ}C$ Calculate the amount of ice melted in $335sex$ (Conductivity of metal) $= 0.5Wm^{-1}K^{-1}$ Letent heat of fusion of ice $= 335 \times 10^{3}Jkg^{-1}$) .

A. $15kg$

B. $15g$

C. $1.5kg$

D. $1.5g$

Answer: A

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11. 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. $(K_2 l_2 T_1 + K_1 l_1 T_2) /) K_1 l_1 + K_2 l_2)$

B. $(K_2) l_1 T_1 + K_1 l_2 T_2) / (K_2 l_1 + K_1 l_2)$

C. $(K_1 l_2 T_1 + K_2 l_2 T_2) / (K_1 l_2 + K_2 l_1)$

D. $(K_1 l_1 T_1 + K_2 l_2 T_2) / (K_1 l_1 + K_2 l_2)$

Answer: C

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12. The temperature of a furnace is $2227^\circ C$ and the intensity is maximum in its spectrum nearly at $12000A^\circ$ If the intensity in the spectrum of star is maximum nearly at $48000A^\circ$ then the surface temperature of the star is .

A. $8400^\circ C$

B. $6250^\circ C$

C. $7200^\circ C$

D. $5977^\circ C$

Answer: D

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13. Black body at a temperature of $1640K$ has the wavelength corresponding to maximum emission equal to $1.75\mu m$ Assuming the moon to be a perfectly black body the temperature of the moon if the wavelength corresponding to maximum emission is $14.35\mu m$ is .

A. $100K$

B. $150K$

C. $200K$

D. $250K$

Answer: C

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14. A particular star (assuming it as a black body) has a surface temperature of about $5 \times 10^4 K$ The wave length in nano-meters at which its radiation becomes maximum is $(b = 0.0029mk)$.

A. 48

B. 58

C. 60

D. 70

Answer: B

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15. The power radiated by a black body is 'P' and it radiates maximum energy around the wavelength $lmbda_0$ If the temperature of the black body is now changed so that it raddiates maximum energy around a wavelength

$\lambda_0 / 2$ the power radiated becomes .

A. $4P$

B. $16P$

C. $64P$

D. $256P$

Answer: B

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16. There is a temperature difference of $1K$ between two black patches of skin on patient's chest and each patch having area A The radiant heat emitted from them is differ by 2% then temperature of two patches may be .

A. $100K, 101K$

B. $300K, 301K$

C. $200K, 201K$

D. $400K, 401K$

Answer: C

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17. A black body radiates energy at the rate of $E\text{watt}/m^2$ at a high temperature TK when the temperature is reduced to $\left[\frac{T}{2}\right]K$ Then radiant energy is .

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18. The radiant energy from the Sun incident normally at the surface of earth is $20kcal/m^2$ min What would have been the radiant energy incident normally on the earth if the sun had a temperature twice of the present one ? .

A. $40kcal/\left(m^2-\ \min\ \right)$

B. $80kcal/\left(m^2-\ \min\ \right)$

C. $160kCal/\left(m^2-\ \min\ \right)$

D. $320Kcal\left(m^2-\ \min\ \right)$

Answer: D

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19. A star behaves like perfeact Black body emitting radiant energy The ratio of radiant energy emitted per sec by this star to that emitted by an

another star having having `8times the radius of the former but having Kelvin temperature one fourth of the former is .

A. $1:4$

B. $1:8$

C. $4:1$

D. $1:16$

Answer: C

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20. Two spherical bodies have radii $R, 2R$ and emissivities e,2e If the temperature ratio is $2:1$ then the powers will be in the ratio .

A. $1:1$

B. $2:1$

C. $3:1$

D. $4:1$

Answer: B

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21. The temperature of a body is increased by $50\,\%$. The amount of radiation emitted by it would be nearly

A. $50\,\%$

B. $100\,\%$

C. $225\,\%$

D. $406.25\,\%$

Answer: D

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22. A solid sphere is at a temperature $T. K$ The sphere is cut into two halves. The fraction of energy emitted per second by the half sphere th that by complete sphere is .

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. $\frac{3}{4}$

D. $\frac{1}{16}$

Answer: C

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23. A black metal foil is warmed by radiation from a small sphere at temperature T and at a distance d it is found that the power received by the foil is P If both the temperature and the distance are doubled the power received by the foil will be .

A. $1:4$

B. $1:8$

C. $1:16$

D. $1:64$

Answer: A

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24. Power radiated by a black body is P_0 and the wavelength corresponding to maximum energy is around λ_0, On changing the temperature of the black body, it was observed that the power radiated becames $\frac{256}{81}P_0$. The shift in wavelength corresponding to the maximum energy will be

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

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

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

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

Answer: C

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25. A body cools from $70^\circ C$ to $50^\circ C$ in 5minutes Temperature of surroundings is $20^\circ C$ Its temperature after next `10 minutes is .

A. $25^\circ C$

B. $30^\circ C$

C. $35^\circ C$

D. $45^\circ C$

Answer: B

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26. The bodies have thermal capacities in the ratio $3:4$ and the rates of loss of heat in the ratio $3:5$ Their rates of cooling will be in the ratio of .

A. $9:20$

B. $4:5$

C. $5:4$

D. $1:1$

Answer: B

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27. A calorimeter of water equivalent $6g$ has water of mass $64g$ up to a certain volume An other identical calorimeter has liquid of mass 5g and specific heat $0.6calg^{\circ}C$ upto same level If both pf them cool in the same surroundings through same range of temperature and the time taken for the water to cool is $140s$ the time taken for the liquid to cool is .

A. $72s$

B. $140s$

C. $36s$

D. $120s$

Answer: A

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