PHYSICS

BOOKS - MODERN PUBLICATION PHYSICS (KANNADA ENGLISH)

TRANSFERENCE OF HEAT

Multiple Choice Questions Level I

1. A copper rod length 1 am and area of cross - section $0.1\ \mathrm{m}^2$ has its end maintained at

$100^\circ C$ by means of 0.4 KW electric heater. What is temperature of other end in steady state ? $(K = 400W/mK)$:

A. $90^\circ C$

B. $100^\circ C$

C. $70^\circ C$

D. None of the above

Answer: A

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2. Two rods R and Q of same metal and same cross-section have length in the ratio $1:2$ One end of each rod is at $0^\circ C$ and temperatures of other are $30^\circ C$ and $40^\circ C$ respectively. Which of the rod will have higher flow of heat ?

A. Rod P

B. Rod Q

C. Depends upon the shape

D. Both will have same.

Answer: A

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3. Which of the following is best conductor of heat ?

A. Water

B. Alcohol

C. Wood

D. Mercury

Answer: D

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4. In Searle's method for finding conductivity the temperature gradient along the bar is :

A. greater near the hot end

B. greater near the cold end

C. the same at all points

D. increases as we go from hot end to the cold end.

Answer: C

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5. A body in a room cools from $85^\circ C$ to $80^\circ C$ in 9 minutes. The time taken to cool from $80^\circ C$ to $75^\circ C$ is :

A. 9 minutes

B. less than 9 minutes

C. more than 9 minutes

D. ether less or more than five minutes.

Answer: C

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6. The bulbs of two indentical thermometers are coated one with lamp black and the other with silver. Both are exposed to the sun and their seadings are recorded :

A. both indicate sane temperature.

B. the lamp - blace coated thermometer gives higher reading initially but final temeprature is same,

C. the silver coated gives higher reading initially but final temperature is same,

D. both will show different but lower temperature than the actual.

Answer: B

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7. The temperature of filament of bulb is 500 K and amount of heat radiated is E the filament is supposed to be a black body, the amount of heat radiated when the temperature of filament is 1000 K is :

A. 16 E

B. 2 E

C. 4 E

D. 8 E

Answer: A

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8. The radiation emitted by a perfectly black body is proportional to :

A. temperature on ideal gas scale

B. fourth root of temperature on Kelvin's scale

C. fourth power of temperature on Kelvin's scale

D. square of temperature on Kelvin's scale

Answer: C

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9. Four identical pieces of copper are painted with different types of paints. Which one would you expect to lose heat most rapidly if

they are all heated to be same temperature and allowed to cool in vacuum ?

A. painted rough white

B. painted shining white

C. painted rough black

D. painted shining black.

Answer: C

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10. Wien's constant is $2892 \times 10^{-6} mKs$ and value of λ_m from moon is 14.46 micron. What is the surface temperature ?

A. 100 K

B. 200 K

C. 400 K

D. 600 K.

Answer: B

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11. Bottom surface of Kettles are :

A. blackened

B. polished white

C. neither blackened nor polished white

D. left as such.

Answer: B

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12. The thermal radiations are similar to :

A. X-rays

B. cathode rays

C. $\alpha -$ rays

D. sound waves.

Answer: A

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13. A sphere, a cube and a thin circular plate all of same material and same high temperatue are allowed to cool down under similar condition . Then the

A. Sphere

B. Cube

C. Thin plate

D. All cool at same rate.

Answer: A

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14. A black body at a hot temperature of $227^{\circ}C$ radiates heat at a rate of $10\ \text{cal}\,\text{cm}^{-2}\ \text{s}^{-1}$. At a temperature of $727^{\circ}C$ the rate of heat radiated per unit area in cal $cm^{-2}s^{-1}$ will be

A. 200

B. 160

C. 250

D. 400

Answer: A

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15. Coefficient of thermal conductivity K is given by :

A. $\frac{Q.t}{A(T_1 - T_2)d}$

B. $\frac{Q.d}{A(T_1 - T_2)t}$

C. $\frac{A(T_1 - T_2)d}{Q.t}$

D. $\frac{A(T_1 - T_2)t}{Q.d}$

Answer: B

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16. The coefficient of thermal conductivity depends upon :

A. temperature difference between two sides

B. area of the plate

C. nature of the metal

D. thickness of the plate.

Answer: C

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17. Temperature gradient in a rod 0.5 m long is $80^\circ Cm^{-1}$ The temperature of the hotter end is $60^\circ C$. The temperature of cooler end will be :

A. $40^\circ C$

B. $10^{\circ} C$

C. $20^{\circ} C$

D. $12^{\circ} C$.

Answer: D

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18. The thermal conductivity of copper is 4 times that of brass. Two rods of copper and brass having same length and cross-section are joined end to end. Free and of copper is at

$0^\circ C$ and free end of brass is $100^\circ C$. What is the temperature of junction ?

A. $20^\circ C$

B. $40^\circ C$

C. $80^\circ C$

D. $10^\circ C$.

Answer: A

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19. A black body at high temperature T K radiates energy at the rate $\mathrm{E\ W\ /\ m^2}$. When the temperature falls to $\left(\frac{T}{2}\right)$ K, the radiated energy will be :

A. $E/4$

B. $E/8$

C. $2E$

D. $E/16$

Answer: D

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20. A perfect black body emits radiation at temperature $T_1{}^\circ K$. If it is to radiate 16 times this power, its temperature T_2 will be :

A. $T_2 = 16T_1$

B. $T_2 = 8T_1$

C. $T_2 = 4T_1$

D. $T_2 = 2T_1$.

Answer: D

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21. Liquid is filled in a vessel which is kept in a room with, temperature $20^\circ C$. When the temperature of the liquid is $80^\circ C$ then it loses heat at the rate of 60 cal/second. What will be the arte of loss of heat when the temperature of the liquid is $40^\circ C$?

A. 180 cal/s

B. 40 cal/s

C. 50 cal/s

D. 20 cal/s.

Answer: D

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22. Heat is flowing through two cylindrical rods of the same material. The diameters of the rods are in the ratio $1:2$ and the lengths in the ratio $2:1$. If the temperature difference between the ends be the same, then the ratio

of the rate of flow of heat through them will be :

A. $1:8$

B. $1:8$

C. $1:1$

D. $4:1$

Answer: B

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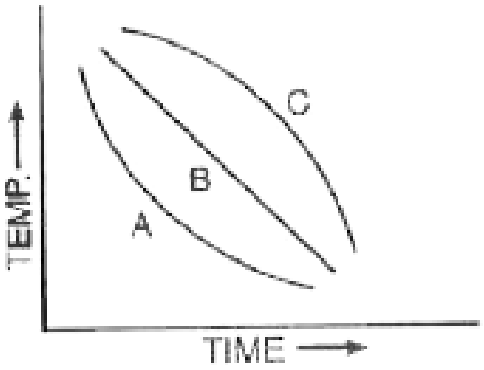
23. A block of steel heated to $100^{\circ}C$ left in a room to cool. Which of the following curves represent the correct behaviour ?



A. Curve A

B. Curve B

C. Curve C

D. None of these.

Answer: A

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24. If the temperature of the hot body is increased by 50% the amount of radiation emitted is increased by nearly :

A. 50%

B. 225%

C. 250%

D. 400%

Answer: D

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25. The wax melts up to the length 15 cm and 30 cm for two identical rods of different metals in Ingen Hausz apparatus. The ratio of thermal conductivities is :

A. $2:3$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: C

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26. The maximum energy in thermal radiation for a source occurs at wavelength $11 \times 10^{-5} cm$. The temperature of the source is n times the temperature of another source of which the wavelength at maximum energy emission is 5.5×10^{-5} cm The value of n is :

A. 2

B. $1/3$

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

D. 1

Answer: C

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27. The ratio of energy of emitted radiation of a black body at $27^\circ C$ and $927^\circ C$ is :

A. $1:4$

B. $1:16$

C. $1:64$

D. $1:256$

Answer: D

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28. How many watts of energy is required to keep a black body in the form of a cube of side

1 cm at 2000 K ? (Temperature of surrounding is $27^{\circ}C$ and $\sigma = 5.67 \times 10^{-8} \mathrm{W\ m^{-2} K^{-4}}$) :

A. 444 W

B. 544 W

C. 844 W

D. None of the above

Answer: B

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29. The temperature at which a black body radiates at the rate of $5.67\mathrm{W\,cm^{-2}}$ is $(\sigma = 5.67 \times 10^{-8} S.I.)$:

A. 100 K

B. 500 K

C. 1000 K

D. 1500 K.

Answer: C

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30. A electric bulb tungsten filament has area $0.29\ \mathrm{cm}^2$ and is buwer being consumed, if emissivity is 0.45 and $s = 5.68 \times 10^{-8} \mathrm{W\ m}^{-4} m^{-2} k^{-4}$?

A. 40 W

B. 25 W

C. 60 W

D. 200 W.

Answer: C

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31. The radiations from the sun have maximum wavelength of 5760Å. The surface temperature of the sun is : $\left(b = 0.288 \times 10^{-2}\text{mK}\right)$:

A. 6000 K

B. 5000 K

C. 4000 K

D. None of the above

Answer: B

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32. If wavelength of maximum intensity of radiations emitted by sun and moon are $0.5 \times 10^{-6} m$ and 10^{-4}m respectively, the ratio of their temperature is :

A. $1/200$

B. $1/100$

C. 100

D. 200.

Answer: D

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33. The temperature of a furnance is $2324^{\circ}C$ and the intensity is maximum in its radiation spectrum at $12 \times 10^{3}\text{Å}$, if the intensity in the spectrum of star is maximum is 4800A, what is the surface tempearture of the star ?

A. 621.95Å

B. $6219.5^\circ C$

C. $621.95^\circ C$

D. None of the above

Answer: B

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34. The filament of a bulb has an area $5 \times 10^{-5} m^2$ and is at 2000 K. If its relative emittance is 0.85 and $\sigma = 5.7 \times 10^{-8}$ MKS

units, what the energy radiated in one minuts

:

A. 2336 J

B. 232.6 J

C. 23.26 J

D. None of the above

Answer: A

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35. A slab consists of two parallel layers of two different materials of same thickness having thermal conductivities K_1 and K_2, the equivalent conductivity of the combination is :

A. $K_1 + K_2$

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

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

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

Answer: B

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36. Two rods of equal length and diameter but of thermal conductivities 1.5 and 3 S.I. units respectivity are joined in series. the thermal conductivity of combination is :

A. 2.5

B. 2

C. 2.25

D. 4.5

Answer: B

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37. Two conductors of identical dimensions of length and area of cross-section are connected in parallel. What will be their equivalent thermal conductivity?

A. 3

B. 2

C. 6

D. 4

Answer: D

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38. Energy is being emitted from the surface of a black body at $127^{\circ}C$ temperature at 1×10^{6} $\mathrm{J\,s^{-1}m^{-2}}$. Temperature of the black body at which the rate of emission is $16 \times 10^{6}\mathrm{J\,s^{-1}m^{-2}}$ will be :

A. $254^{\circ}C$

B. $508^\circ C$

C. $527^\circ C$

D. $272^\circ C$.

Answer: C

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39. Solar radiation emitted by sun resemble that emitted by black body at 6000 K. Maximum intensity is emitted at wavelength 4800Å. If the sun were to be cooled down

from 6000 K to 3000 K, then peak intensity would occur at a wavelength of :

A. 4800Å

B. 9600Å

C. 2400Å

D. 19200Å

Answer: B

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40. In an atomic bomb, the tempearture of 10 million degrees is developed at the moment of explosion. In what region of the spectrum do the wavelength corresponding to maximum energy density lie ?

$\left(b = 0.28 \times 10^{-2} \text{S.I. unit}\right)$

A. ultra-violet

B. visible

C. infra-red rays

D. X-rays.

Answer: D

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41. The wavelength of max. emission for moon is 14 micron. Estimate the temp. of moon if $b = 28.84 \times 10^{-4}$ mK is

A. 150 K

B. 206 K

C. 300 K

D. 500 K.

Answer: B

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42. A small hole is made in a hollow enclosure whose walls are at temp. of 1000 K. The amount of energy coming out of the hole per cm^2 per sec is :

A. 567 ergs

B. 5670 ergs

C. 5670000 ergs

D. 56700000 ergs.

Answer: D

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43. The presence of gravitational firld is required for the heat transfer by :

A. stirring of liquids

B. natural convection

C. conductuion

D. radiation.

Answer: B

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44. Which of the following qualities are best suited for a cooking utensil ?

A. High specific heat and low thermal conductivity

B. High specific heat and high thermal conductivity

C. Low specific heat and low thermal conductivity

D. Low specific heat and high thermal conductivity.

Answer: D

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45. If the temperature of a black body is doubled, the wavelength at which the spectral radiancy has its maximum is :

A. doubled

B. quandrupled

C. halved

D. unchanged.

Answer: C

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46. A black body has maximum wavelength λ_m at 2000 K. Its corresponding wavelength at 3000 K will be :

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

B. $\frac{16}{81}\lambda_m$

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

D. $\frac{81}{16}\lambda_m$

Answer: C

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47. The Wien's displacement law expressed relation between :

A. colour of light and temperature

B. wavelength and temperature

C. radiation energy and wavelength

D. Wavelength corresponding to maximum energy and temperature.

Answer: D

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48. Two spheres made of same material have radii in the ratio $1:2$. Both are at same temperature. Ratio of heat radiation energy emitted per second by them is :

A. $1:2$

B. $1:8$

C. $1:4$

D. $1:16$.

Answer: C

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49. An ideal black body at room temperature is thrown into a furnace. It is observed that :

A. initially, it is the darkest body and at later times, the brightest

B. it is the darkest body at all times

C. It cannot be distinguished at all times

D. initially, it is the darkest body and at later times, it cannot be distinguished.

Answer: A

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50. A slab consists of two parallel layers of two different materials of same thickness having thermal conductivities K_1 and K_2, the equivalent conductivity of the combination is :

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

B. $\sqrt{2}K$

C. $3K$

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

Answer: D

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51. If λ_m denotes the wavelength at which the radiative emission from a black body at a temperature TK is maximum, then :

A. $\lambda_m \propto T$

B. $\lambda_m \propto T^4$

C. $\lambda_m \propto T^{-1}$

D. λ_m does not depend on T.

Answer: C

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52. Which of the following circular rods, (given radius r and length l) each made of the same material and whose ends are maintaind at the same temperature diff. will conduct most heat ?

A. $r = 2r_o l = 2l_o$

B. $r = r_o, l = 2l_o$

C. $r = 2r_o, l = l_o$

D. $r = r_o, l = l_o$

Answer: C

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53. Which of the following processes is reversible ?

A. Transfer of heat by radiation

B. Transfer of heat by conduction

C. Isothermal compression

D. Electrical heating of a nichrome wire.

Answer: C

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54. A hot liquid kept in a breaker cools from $80^{\circ}C$ to $70^{\circ}C$ in two minutes. If the surrounding temperature is $30^{\circ}C$, then the

time of cooling of the same liquid from $60^{\circ}C$ to $50^{\circ}C$ is :

A. 240 s

B. 480 s

C. 360 s

D. 216 s.

Answer: D

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55. A black body at $1227^{\circ}C$ emits radiations with maximum intensity at wavelength of 5000 $\mathring{A}$. If temperature of the body is increased by $1000^{\circ}C$, the maximum intensity will be observed at :

A. $3000\mathring{A}$

B. $4000\mathring{A}$

C. $5000\mathring{A}$

D. $6000\mathring{A}$

Answer: A

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56. 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. 1

B. 3

C. 2

D. 4

Answer: A

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

A. 4

B. 64

C. 32

D. 16

Answer: B

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58. 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 filament

D. heating air around a furnace.

Answer: C

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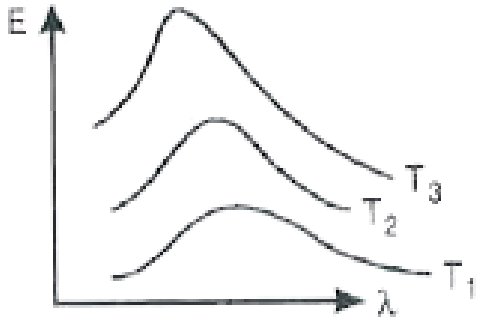
59. Variation of radiant energy emitted by sun, filament of tungsten lamp and welding arc as

a function of its wavelength is shown in fig :



A. Sun- T_1, tungsten filament T_2, welding arc- T_3

B. Sun- T_2, tungsten filament - T_1, welding arc - T_3

C. Sun- T_3, tungsten filament- T_1, welding arc- T_2

D. Sun- T_1, tungsten filament - T_3 welding arc- T_2.

Answer: C

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60. A body of length 1m having cross sectional area $0.75m^2$ conducts heat $6000J/s$. Then find the temperature difference if $K = 200 \ \mathrm{Jm^{-1}K^{-1}}$.

A. $20^{\circ} C$

B. $40^{\circ} C$

C. $80^{\circ} C$

D. $100^{\circ} C$

Answer: B

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61. If the temperature of body is increased by 10% the percentage increase in the emitted radiation will be :

A. $46\ \%$

B. $40\ \%$

C. $30\ \%$

D. $80\ \%$

Answer: A

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62. A black body is at temeprature 300 K. It emits energy at a rate which is proportional to :

A. 300

B. $(300)^3$

C. $(300)^2$

D. $(300)^4$

Answer: D

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63. A body cools from $60^\circ C, 50^\circ C$ in 10 minutes. If the room temperature is $25^\circ C$ and assuming Newton's law of cooling to hold

good, the temperature of the body at the end of the next 10 minutes will be :

A. $40^\circ C$

B. $38.5^\circ C$

C. $45^\circ C$

D. $42.85^\circ C$.

Answer: D

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64. The wavelength of the radiation emitted by a body depends upon

A. the tempearture of its surface

B. the nature of its surface

C. the area of its surface

D. all the above factors

Answer: A

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65. A black body is at $727^{\circ} C$. It emits energy at a rate which is proportinal to :

A. $(1000)^4$

B. $(1000)^2$

C. $(727)^4$

D. $(727)^2$.

Answer: A

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66. A black body at $227^\circ C$ radiates heat at the rate of $7\ \mathrm{cal/cm^2 s}$. At a temperature of $727^\circ C$, the rate of heat radiated in the same units will be :

A. 50

B. 112

C. 80

D. 60

Answer: B

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67. The total radiant energy per unit area, normal to the direction of incidence, received at a distance R from the centre of a star of radiys r, whose outer surface radiates as a black body at a temperature T K is given by

A. $\sigma r^4 T^4 / r^4$

B. $4\pi\sigma r^2 T^4 / R^2$

C. $\sigma r^2 T^4 / R^2$

D. $\sigma r^2 T^4 / 4\pi r^2$

Answer: C

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Multiple Choice Questions Level Ii

1. Two vessels of different materials are similar in size and other respects. The same quantity of ice filled in them gets melted in 40 and 70 minutes respectively. The ration of thermal conductivities for the materials of boxes is :

A. $4:7$

B. $7:4$

C. $4:11$

D. None of these.

Answer: B

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2. Two slabs A and B, each though similar, in all other respects, have different materials. They are placed one above the other in perfect

contact and a steady difference of temperature of $36^{\circ}C$ is maintained across the combination. If the thermal conductivity of A is twice that of B, what is the temperature of interface ?

A. $16^{\circ}C$

B. $12^{\circ}C$

C. $28^{\circ}C$

D. $24^{\circ}C$.

Answer: D

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3. There are two spherical balls A and B of the same material with same surface finish but the radius of A is half than of B. If A and B are heated to the same temperature and allowed to cool then :

A. rate of cooling of both is same

B. rate of cooling of A is four times that of B

C. rate of cooling of A is twice that of B

D. rate of cooling of A is $1/4$ time that of B.

Answer: D

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4. Luminosity of sun is 3.9×10^{26} watts. Mean distance of earth from the sun is $1.496 \times 10^{11} m$. What is the value of solar constant ?

A. $1.388 \times 10^5 W$

B. $1.388 \times 10^{3} \mathrm{W} \mathrm{m}^{-2}$

C. $2.776 \times 10^{6} \mathrm{W} \mathrm{m}^{-2}$

D. $2.776 \times 10^{4} W$.

Answer: B

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5. If the tempearture of black body is raised by 5%, the heat energy radiated would increases by :

A. 5%

B. 20%

C. 21.51%

D. 41.61%

Answer: C

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6. Two identical slabs are welded end to end 20 cals of heat flows through it in 4 min. If the two slabs are now welded by placing them one

above the other, and same heat is flowing through two ends under the same difference of temperature, the time taken is :

A. 1 min

B. 4 min

C. 6 min

D. 16 min

Answer: A

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7. Thermal resistance of two metallic plates of same material and cross -section joined in series are 3 and 4 respectively. What is thermal resistance of the combination ?

A. $3/4$

B. $4/3$

C. 7

D. $1/7$

Answer: C

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8. Ratio of thermal conductivities of two different materials is $4:3$ To have same thermal resistance of the two rods of having equal thickness, what should be the ratio of their lengths ?

A. $3:4$

B. $4:3$

C. $2:3$

D. $4:1$

Answer: B

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9. The ratio of thermal conductivities of two rods is $5:3$. If the thermal resistances of the two rods of same, lengths of the rod is :

A. $\frac{5}{3}$

B. $\frac{3}{5}$

C. $\frac{2}{3}$

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

Answer: A

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10. A wall has two layers A and B, each made of defferent material. A has thickness 10 cm, while B has thickness 20 cm, their coefficients of conductivities are in the ratio of $3:1$. A constant temperature difference of $35^{\circ}C$ exists across the wall. The difference of temperature across the layer A is :

A. $28^{\circ} C$

B. $19^{\circ} C$

C. $5^{\circ} C$

D. $13.5^{\circ} C$

Answer: C

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11. Due to fall in main voltage, the temperature of filament of a bulb falls from 3000 K to 2000

K. What is the percentage fall in power consumption ?

A. 75.25

B. 80.25

C. 85.25

D. None of the above

Answer: B

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12. Two metal rods of same length have same temperature difference between their ends. Their thermal conductivities are K_1 and K_2 and cross-sections A_1 and A_2 respectively. What is the condition for the same rates of flow of heat ?

A. $\frac{K_1}{K_2} = \frac{A_1}{A_2}$

B. $\frac{K_1}{K_2} = \frac{A_2}{A_1}$

C. $K_1^2 A_2^2 = K_2^2 A_1^2$

D. $K_1 A_1^2 = K_2 A_2^2$

Answer: D

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13. The ends of the two rods of conductivities , radii and lengths in the ratio of $1:2$ are maintained at the same temperature difference. If the rate of flow through the bigger rod is $12 \ \mathrm{cal\,s^{-1}}$, in shorter it will be (in $\mathrm{cal\,s^{-1}}$) :

A. 1

B. 2

C. 3

D. 4

Answer: C

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

radius and $1/4th$ the conductivity than that of the first, the rate at which the ice melts in g/sec will be :

A. 3.2

B. 1.6

C. 0.2

D. 0.1

Answer: C

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15. In the steady state of conduction of rod AB of length 100 cm, the temperature at the ends A is $80^\circ C$ and at B the temperature is $0^\circ C$. The temperature of the rod at the distance 60 cm from A is :

A. $16^\circ C$

B. $32^\circ C$

C. $48^\circ C$

D. None of the above

Answer: B

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16. Two spheres of different materials, one with double the radius but $1/4$ th wall thickness than other are filled with ice. If the time taken for complete melting of ice in the bigger sohere is 25 minutes and that in smaller is 16 minutes, the ratio of the thermal conductivities of larger to the smaller is :

A. $5/4$

B. $3/4$

C. $8/25$

D. $2/5$.

Answer: C

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17. A compound slab is composed of two parallel layers of different materials with thickness 3 cm and 2 cm. The temp of outer face of the slab are maintained at $100^{\circ}C$ and

$0^\circ C$ If the conductivities are 0.36 and 0.16 cgs units, then the temp. of junction is :

A. $40^\circ C$

B. $60^\circ C$

C. $100^\circ C$

D. $50^\circ C$

Answer: B

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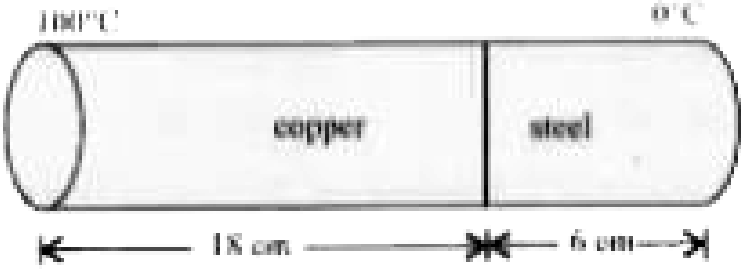
18. The coefficient of the thermal conductivity of copper is 9 times that of steel . In the composite sylindrical bar shown in the figure , what will be the temperature at the junction of copper and steel ?



A. 75°

B. 33°

C. 65°

D. 25°

Answer: A

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19. A solid cube and a solid sphere have equal surface areas. Both are at the same temperature of $120^\circ C$. Then :

A. both of them same temperature of $120^\circ C$. Then :

B. the cube will cool down faster than the sphere

C. the sphere will cool down faster than the cube

D. whichever of the two is heavier will cool down faster

Answer: A

Watch Video Solution

20. A cylindrical rod is having temperature T_1 and T_2 at its ends. The rate of flow of heat is Q_1 cal/sec. If all the linear dimensions are doubled keeping temperatures constant, then rate of flow of heat Q_2 will be :

A. $4Q_1$

B. $Q_1/4$

C. $2Q_1$

D. $Q_1/2.$

Answer: C

Watch Video Solution

21. The rate of cooling at 600 K, if surrounding tempearture is 300 K is R. The rate of cooling at 900 K is :

A. $\frac{16}{3}R$

B. $2R$

C. $3R$

D. $\frac{2}{3}R.$

Answer: A

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22. A cup of tea cools from $65.5^\circ C$ to $62.5^\circ C$ in 1 minute in a room at $22.5^\circ C$ How long will it take to cool from $46.5^\circ C$ to $40.5^\circ C$ C in the same

A. 1

B. 3

C. 2

D. 4

Answer: D

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23. Statement - I : Water kept in an open vessel will evaporate quickly on the surface of moon.

Statement - II : The temperature at the surface of moon is much higher than boiling point of water.

A. Statement - I is true, Statement - II is true and Statement - I is correct

explanation for Statement - II.

B. Statement - I is true, Statement - II is true and Statement - II is not correct explanation of Statement - I.

C. Statement - I is true, Statement - II is false.

D. Statement - I is false, Statement - II is false.

Answer: C

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24. Statement - I : A body which is good radiator is is good absorber of radiation at a given wavelength.

Statement - II : According to Kirchhoff's law, the absorptivity of a body is equal to its emissivity at a given wavelength.

A. Statement - I is true, Statement - II is true and Statement - I is correct explanation for Statement - II.

B. Statement - I is true, Statement - II is true and Statement - II is not correct explanation of Statement - I.

C. Statement - I is true, Statement - II is false.

D. Statement - I is false, Statement - II is false.

Answer: A

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25. Statement - I : It is hotter above the top of a fire than at some distance on the sides.

Statement - II : Airsorrounding the fire conducts more heat upwards.

A. Statement - I is true, Statement - II is true and Statement - I is correct explanation for Statement - II.

B. Statement - I is true, Statement - II is true and Statement - II is not correct explanation of Statement - I.

C. Statement - I is true, Statement - II is false.

D. Statement - I is false, Statement - II is false.

Answer: C

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26. Statement - I : A hallow metallic closed containes maintained at a uniform temperature can act as a source of black body

radiation.

Statement - II All metals act as a black body

A. Statement - I is true, Statement - II is true and Statement - I is correct explanation for Statement - II.

B. Statement - I is true, Statement - II is true and Statement - II is not correct explanation of Statement - I.

C. Statement - I is true, Statement - II is false.

D. Statement - I is false, Statement - II is false.

Answer: C

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27. Statement - I : The absorbtance of a perfact black body is unity.

Statement - II : A perfect black body when heated emits radiations of all possible wavelength at that temperature.

A. Statement - I is true, Statement - II is true and Statement - I is correct explanation for Statement - II.

B. Statement - I is true, Statement - II is true and Statement - II is not correct explanation of Statement - I.

C. Statement - I is true, Statement - II is false.

D. Statement - I is false, Statement - II is false.

Answer: B

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28. Raed the following passage and and answer the following questions.

Stefan's law states that the ernergy emitted per second per unit area of the perfect black body is directly proportional to fourth power of its absolute temperature i.e. $E \propto T^4$ or $E = \sigma T^4$ where σ is called Stefan's constant. If the body is placed in enclosure maintained

at temperature T_0 then $E = \sigma\left(T^4 - T_0^4\right)$. If temperature difference between the body and the surroundings is very small then energy emitted per second per unit area of the body and surrounding i.e $E \propto (T - T_0)$. This is known as Newton's Law of cooling and is a special case of Stefan's Law.

Two bodies P and Q are having equal surface areas and are maintained at temperature $17^\circ C$ and $27^\circ C$ respectively. Then radiant energy emitted per second are in the ratio of :

A. $16 : 81$

B. $8:27$

C. $2:3$

D. $7:8$

Answer: D

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29. A body cools from $50^\circ C$ to $40^\circ C$ in 5 minutes and from $40^\circ C$ to $30^\circ C$ in 8 minutes. Then the temperature of the surrounding is

A. $25^\circ C$

B. $18^\circ C$

C. $15^\circ C$

D. $10^\circ C$

Answer: B

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30. Time taken by the body to cool from $45^\circ C$ to $35^\circ C$ is

A. 5 min

B. 4 min

C. 6 min

D. 8 min

Answer: C

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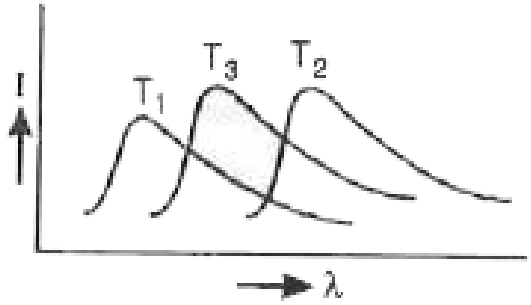
31. The plots of intensity versus wavelength for three black bodies at temperatures T_1, T_2 and T_3 respecttively are shown in fig. Their

temperatures are such that :



A. $T_1 > T_2 > T_3$

B. $T_2 > T_3 > T_1$

C. $T_1 > T_3 > T_2$

D. $T_3 > T_2 > T_1$.

Answer: C

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32. Two spheres of the same material have radii 1 m and 4 m and temperatures 4000 K and 2000 K respectively. The ratio of the energy rediated per second by the first sphere to that by the second is :

A. $1:1$

B. $4:1$

C. $16:1$

D. $1:9$

Answer: A

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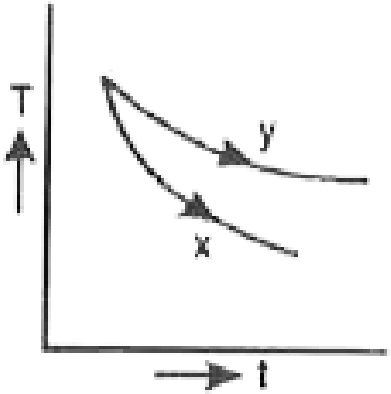
33. The graph shown in the adjacent diagram, represents the variation of temperature T of two bodies x and y having same surface area, with time (t) due to emission of radiation. Find the correct relation between the emissive and

adsoptive powers of the two bodies :



A. $E_x > E_y$ and $a_y < a_y$

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

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34. Three discs A, B and C having radii 2m, 4 m and 6 m respectively are coated with carbon black on their outer surfaces. The wavelengths corresponding to maximum intensity are 300 nm, 400 nm and 500 nm respectively. The power radiated by them are Q_A, Q_B and Q_C respectively :

A. Q_A is maximum

B. Q_C is maximum

C. Q_B is maximum

D. $Q_A = Q_B = Q_C$.

Answer: C

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35. Two identical conducting rods are first connected independently to two vessels, one containing water at $100^\circ C$, and the other containing ice at $0^\circ C$. In the second case, the rods are joined end to end and connected to

the same vessels. Let q_1, q_2 gram/sec be the rate of melting of ice in the two cases respectively. The ratio q_1 / q_2 is :

A. $1/2$

B. $2/1$

C. $4/1$

D. $1/4$.

Answer: C

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36. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is

A. $\frac{E}{C}$

B. E/C^2

C. EC

D. $2\frac{E}{C}$

Answer: D

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37. A body with area A at maintained temperature T and emissivity $e = 0.6$ is kept inside a spherical black body. What will be the maximum energy radiated per second ?

A. $0 \cdot 60\sigma AT^4$

B. $1 \cdot 00\sigma AT^4$

C. $0 \cdot 80\sigma AT^4$

D. $0 \cdot 40\sigma AT^4$.

Answer: A

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38. Ice starts forming in a lake water at $0^{\circ}C$ when the atmospheric temperature is $10^{\circ}C$. If the time taken for 1 cm of ice to be formed is 7 hour, the time taken for the thickness of the ice to change from 1 cm to 2 cm is :

A. 7 h

B. less than 7 h

C. more than 7 h but less than 14 h

D. more than 14 h.

Answer: C

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39. A body is placed in an insulating container at temperature $227^{\circ}C$. In order to keep its temperature $727^{\circ}C$, power of 60 W is required, the power required to keep its temperature $1227^{\circ}C$ will be :

A. 304

B. 321

C. 90

D. 120

Answer: B

Watch Video Solution

40. A cylindrical rod is having temperature T_1 and T_2 at its ends. The rate of flow of heat is Q_1 cal/s. If all the linear dimensions are doubled keeping temperatures constant, the rate of flow of heat Q_2 will be :

A. $4Q_1$

B. $Q_1/4$

C. $2Q_1$

D. $Q_1/2.$

Answer: C

Watch Video Solution

41. The rate of cooling at 600 K, if surrounding tempearture is 300 K is R. The rate of cooling at 900 K is :

A. $4r_0$

B. $16r_0$

C. $16r_0/3$

D. $81r_0/16.$

Answer: D

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42. One end of a copper rod of length $1.0m$ and area of cross-section $10^{-3}m^2$ is immersed in boiling water and the other ens in ice. If the

coefficient of thermal conductivity of copper is 92 cal/m-s- $^{\circ}C$ and the latent heat of ice is 8×10^{4} cal/kg, then the amount of ice which will melt in one munite is :

A. 8×10^{-3} kg

B. 9.2×10^{-3} kg

C. $5.4 \times 10^{-3} kg$

D. 6.9×10^{-3}kg

Answer: D

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43. Consider a compound slab consisting of two different materials having equal thickness and thermal conductivities K and 2 K respectively. The equivalent thermal conductivity of the slab is

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

B. $3K$

C. $\sqrt{2}K$

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

Answer: D

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44. The dimensions of thermal resistance are :

A. $ML^2T^{-2}K^{-2}$

B. $ML^2T^{-3}K$

C. $ML^2T^{-2}K^{-1}$

D. $M^{-1}L^{-2}T^3K.$

Answer: D

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45. There is formation of layer of snow x cm thick on water, when the temperature of air is $-\theta^{\circ}C$ (less than freezing point). The thickness of layer increased from x to in the time t, then the value of t is given by :

A. $\frac{(x-y)(\rho LK)}{2\theta}$

B. $\frac{(x+y)(x-y)\rho L}{k\theta}$

C. $\frac{(x+y)(y-x)\rho L}{2k\theta}$

D. $\frac{(x-y)\rho L}{2k\theta}$

Answer: C

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46. Suppose the sun expands, so that its radius becomes 100 times its present radius and its surface temperature becomes half its present value. The total energy emitted by it will increases by a factor of :

A. 16

B. 625

C. 256

D. 1000

Answer: B

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47. Which of the following circular rods, (given radius r and length l) each made of the same material and whose ends are maintaind at the

same temperature diff. will conduct most heat

?

A. $r = 2r_0, l = 2l_0$

B. $r = r_0, l = 2l_0$

C. $r = 2r_0, l = l_0$

D. $r = r_0, l = l_0.$

Answer: C

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48. A hot liquid kept in a breaker cools from $80^\circ C$ to $70^\circ C$ in two minutes. If the surrounding temperature is $30^\circ C$, then the time of cooling of the same liquid from $60^\circ C$ to $50^\circ C$ is :

A. 240 s

B. 480 s

C. 360 s

D. 216 s.

Answer: D

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49. The two ends of a rod of length L and a uniform cross-sectional area A are kept at two temperatures T_1 and T_2 rod in a steady state is given by :

A. $\frac{dQ}{dt} = \frac{k(T_1 - T_2)}{LA}$

B. $\frac{dQ}{dt} = kLA(T_1 - T_2)$

C. $\frac{dQ}{dt} = \frac{kA(T_1 - T_2)}{L}$

D. $\frac{dQ}{dt} = \frac{kL(T_1 - T_2)}{A}$

Answer: C

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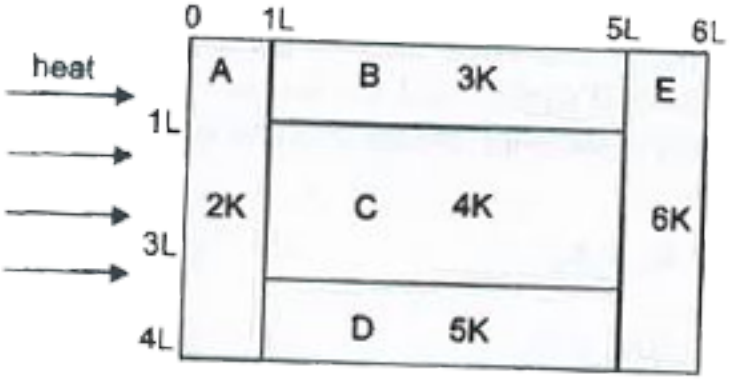
Multiple Choice Questions Level Iii Questions From Aieee Jee Examination

1. 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 is maximum

C. temperature difference across slab E is smallest.

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

Answer: A::C::D

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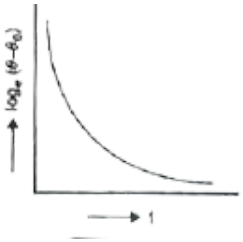
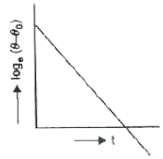
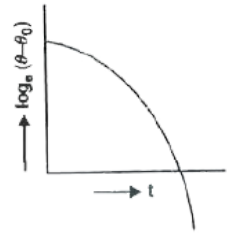
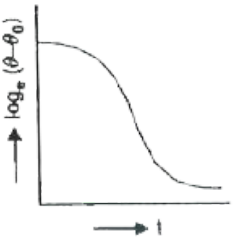
2. A liquid in a beaker has temperature $\phi(t)$ at time t and θ_0 is temperature of surroundings,

then according to Newton's law of cooling the correct graph between $\log_e(\theta - \theta_0)$ and t is

A. 

B. 

C. 

D. 

Answer: B

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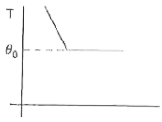
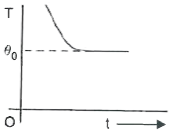
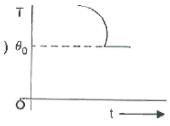
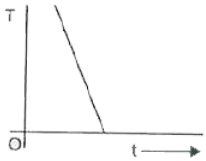
3. If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0 the graph between the temperature T of the metal and time t will be closest to :

A. 

B. 

C. 

D. 

Answer: B

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4. Three rods of Copper, Brass and Steel are welded to - gether to from a Y-shaped

structure. Area of cross-section of each rod = 4 cm^2. End of copper rod is maintained at $100^\circ C$ whereas ends of brass and steel are kept at $0^\circ C$. Lengths of the copper, brass and steel rods are 46, 13 and 12 cm 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 copper rod is :

A. 6.0 cal/s

B. 1.2 cal/s

C. 2.4 cal/s

D. 4.8 cal/s

Answer: D

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5. Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit colume $u = \frac{U}{V} \propto T^4$ and pressure $P = \frac{1}{3}\left(\frac{U}{V}\right)$. If

the shell now undergoes an adiabatic expansion the relation between T and R is :

A. $T \propto e^{-3R}$

B. $T \propto \frac{1}{R}$

C. $T \propto \frac{1}{R^3}$

D. $T \propto e^{-R}$

Answer: B

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Recent Competitive Questions

1. Two slabs are of the thicknesses d_1 and d_2. Their thermal conductivities are K_1 and K_2 respectively They are in series. The free ends of the combination of these two slabs are kept at temperatures θ_1 and θ_2. Assume $\theta_1 > \theta_2$. The temperature θ of their common junction is

A. $\dfrac{K_1\theta_1 + K_2\theta_2}{\theta_1 + \theta_2}$

B. $\dfrac{K_1\theta_1 d_1 + K_2\theta_2 d_2}{K_1 d_2 + K_2 d_1}$

C. $\dfrac{K_1\theta_1 d_2 + K_2\theta_2 d_1}{K_1 d_2 + K_2 d_1}$

D. $\dfrac{K_1\theta_1 + K_2\theta_2}{K_1 + K_2}$

Answer: C

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2. Three identical rods A,B and C are placed end to end. A temperature difference is maintained between the free ends of A and C. The thermal conductivity of B is $thrice$ that of C and $half$ of that of A. The effective thermal conductivity of the system is ..... (K_A is the thermal conductivity of rod A).

A. $\frac{1}{3}K_A$

B. $3K_A$

C. $2K_A$

D. $\frac{2}{3}K_A$.

Answer: A

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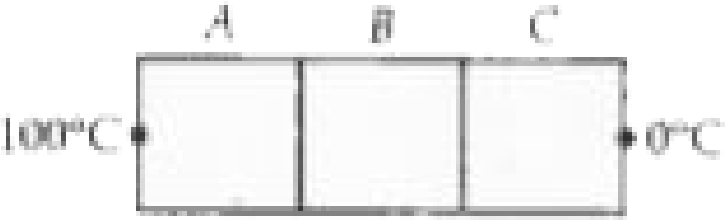
3. A , B and C are the three identical conductors but made from different materials . They are kept in contact as shown . Their

thermal conductivities are K , 2K and $\frac{K}{2}$. The free end of A is at $100^\circ C$ and the free end of C is at $0^\circ C$. During steady state , the temperature of the junction of A and B is nearly .... $^\circ C$.



A. $37^\circ C$

B. $71^\circ C$

C. $29^\circ C$

D. $63^\circ C.$

Answer: B

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4. A solid cylinder of radius R made of a material of thermal conductivity K_1 is surrounded by a cylindrical shell of inner radius R and outer radius $2R$ made of material of thermal conductivity K_2. The two ends of the combined system are maintained at two different temperatures. Then there is no loss of heat across the cylindrical surface

and the system is in steady state. The effective thermal conductivity of the system is

A. $K_1 + K_2$

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

C. $\frac{2K_1 + K_2}{4}$

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

Answer: D

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