PHYSICS

AAKASH INSTITUTE ENGLISH

THERMAL PROPERTIES OF MATTER

Example

1. The triple points of neon and carbon dioxide are 24.57 K and 216.55 K respectively. Express these temperatures on the Celsius and Fahrenheit scales.

2. A surveyor uses a steel measuring tape that is exactly 50.000 m long at a temperature of $20^{\circ} C$ What is its length on a hot summer day when the temperature is $35^{\circ} C$? $\left(\alpha_{\text{steel}} = 1.2 \times 10^{-5} K^{-1}\right)$

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3. A glass flask with volume 200 cm^3 is filled to the brim with mercury at $20^{\circ} C$. How much mercury overflows when the temperature of the system is raised to $100^{\circ} C$? The coefficient of linear expansion of the glass is $0.40 \times 10^{-5} K^{-1}$. Cubical expansion of mercury $= 18 \times 10^{-5} K^{-1}$.

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4. An aluminum cylinder 10 cm long with a cross section area of $20 cm^2$ is used as a spacer between two steel walls. At $17.2^\circ C$ it just slips in between the walls. When it warms to $22.3^\circ C$ calculate the stress in the cylinder and the total force it exerts on each wall, assuming that the walls are perfectly rigid and a constant distance apart.

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5. A woman working in the field drinks her morning coffee out of an aluminium cup. The cup has a mass of 0.120 kg and is initially at $20.0^{\circ} C$ when she pours in 0.300 kg of coffee initially at $70.0^{\circ} C$. What is te final temperature after the coffee and the cup attain thermal equilibrium? (Assume that coffee has the same specific heat as water and that there is no heat exchange with the surroundings).

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6. A steel bar 10.0 cm long is welded end to end to a copper bar 20.0 cm long. Both bars are insulated perfectly on their sides . Each bar has a separate cross-section, 2.00 cm on a side . The free end of the steel bar is maintained at $100^\circ C$ by placing it in contact with steam and free end of the copper bar is maintained at $0^\circ C$ by placing it in contact with ice . find the temperature at the junction of the two bars and the total rate of heat flow . thermal conductivity of steel $= 50.2 W m^{-1} K^{-1}$.thermal conductivity of copper $= 385 W m^{-1} K^{-1}$.

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7. 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.

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8. A body colls in 7 minutes fro $60^\circ C$ to $40^\circ C$. What will be its temperature after the next 7 minutes? The temperature of the surroundings is $10^\circ C$.

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9. A vertical column 50 cm long at $50^{\circ} C$ balances another column of same liquid 60 cm long at $100^{\circ} C$. The coefficient of absolute expansion of the liquid is

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10. Two rods of lengths l_1 and l_2 are made of materials having coefficients of linear expansion α_1 and α_2 respectively. What could be the relation between above values, if the difference in the lengths of the two rods does not depends on temperature variation?

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11. A metal rod (A) of $25cm$ length expands by $0.050cm$ when its temperature is raised from $0^\circ C$ to $100^\circ C$. Another rod (B) of a different metal of length $40cm$ expands by $0.040cm$ for the same rise in temperature. A third rod (C) of $50cm$ length is made up of pieces of rods (A) and (B) placed end to end expands by $0.03cm$ on heating from $0^\circ C$ to $50^\circ C$. Find the lengths of each portion of the composite rod.

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12. Relate the thermal coefficient of linear expansion, α, the the thermal coefficient of area expansion β.

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13. Can we related the thermal coefficient of linear expansion, α, to the thermal coefficient of volume expansion?

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14. There are two Cu spheres having same size. One of them is hollow and the other one is solid. Which will expand more if

(i) they are heated through same temperature range.

(ii) they are supplied with same amount of heat.

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15. A 50 g block of metal is heated to $200^{\circ} C$ and then dropped into a beaker containing 0.5 kg of water initially at $20^{\circ} C$. if the final equilibrium temperature of the mixed system is $22.4^{\circ} C$, find the specific heat capacity of the metal. Given, specific heat capacity of water is 4182 J $kg^{-1}.^{\circ} C^{-1}$.

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16. In an experiment to determine the specific heat of a metal,$a 0.20 kg$ block of the metal at $150.^\circ C$ is dropped in a copper calorimeter (of water equivalent $0.025 kg$ containing $150 cm^3$ of water at $27.^\circ C$. The final temperature is $40.^\circ C$. The specific heat of the metal is.

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17. An 850 W consumer coffee maker can make 10 cups (1.75 litres) of $80^\circ C$ coffee from $20^\circ C$ tap water in 10 minutes. What percentage of the electrical energy consumed actually makes it to the coffee?

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18. A 100 g cube of aluminium is removed from a bath of boiling water and dropped in a bath of room temperature water (2.00 litres at $20.0^{\circ} C$). What is the final temperature of the water assuming heat loss to the surroundings is negligible? The specific heat capacity of aluminium is 897 J/kg. $^{\circ} C$.

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19. In an insulated vessel, 250 g of ice at $0^{\circ} C$ is added to 600 g of water at $18^{\circ} C$

(a) What is the final temperature of the system?

(b) How much ice remains when the system reaches equilibrium?

Useful data:

Specific heat capacity of water: 4190 K/K.kg

Speicific heat capacity of ice: 2100J/K.kg

Latent heat of fusio of ice: $3.34 \times 10^5 J/kg$

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20. Due to a spatial variation in purity, the thermal conductivity of a metal bar (cross sectional area $4 \times 10^{-4} m^2$, length 1m) decreases linearly along its length from 400 $Wm^{-1}K^{-1}$ at one end, to 200

$Wm^{-1}K^{-1}$ at the other. Calculate the rate at which heat flows through the bar if the hot end is maintained at $200^{\circ}C$ and the cold end at $0^{\circ}C$

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21. A point source of heat is placed at the centre of a spherical shell of mean radius 10 cm. the material of the shell has thermal conductivity 9.5 $\times 10^{-2}$kcal/ $m-s^{\circ}C$. Calculate the power of point source of heat, when the temperature difference between the outer and inner surface of the shell is $50^{\circ}C$ in steady state. the thickness of shell is 2 cm.

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22. At what temperature do the Celsius and Fahrenheit readings have the same numerical value ?

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23. At what temperature on the Fahrenheit scale will the reading be double of the reading on the Celsius scale?

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24. How would you suggest measuring the temperature of

(a) The sun

(b) The Earth's upper atmosphere

(c) The moon

(d) The ocean floor, and

(e) Liquid helium ?

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25. Is any one gas better than another for purposes of a standard constant volume gas thermometer?

What properties are desirable in a gas for such purposes?

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26. State some objections to using water-in-glass as a thermometer is mercury-in-glass an improvement

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27. Can you explain why the column of mercury first descends and then rises when a mercury in glass thermometers put in a flame?

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28. Suppose that on a temperature scale X, water boils af -60°X and freezes ar-180.5° X What would a temperature of 350 K be on the X-scale?

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29. The pressures of the gas filled in the bulb of a constant volume gas thermometer are 66 cm and 88 cm of mercury column at $0^{\circ}C$ and $100^{\circ}C$ respectively. When its bulb is immersed in a liquid placed in a vessel, its pressure is 82.5 cm of mercury column. Calculate the temperature of the liquid.

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30. The following observation were recorded on a platinum resistance thermometer. Resistance at melting point of ice is $= 3.70\Omega$, resistance at boiling point of water at normal pressure is $= 4.71\Omega$, and resistance at $t^\circ C = 5.29\Omega$. Calculate

Temperature coefficient of resistance of platinum.

Value of temperature t.

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31. A surveyor uses a steel measuring tape that is exactly 50.000 m long at a temperature of $20^\circ C$ What is its length on a hot summer day when the temperature is $35^\circ C$? $\left(\alpha_{\text{steel}} = 1.2 \times 10^{-5} K^{-1}\right)$

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32. A glass flask with volume 200 cm^3 is filled to the brim with mercury at $20^\circ C$. How much mercury overflows when the temperature of the system is raised to $100^\circ C$? The coefficient of linear expansion of the glass is $0.40 \times 10^{-5} K^{-1}$. Cubical expansion of mercury $= 18 \times 10^{-5} K^{-1}$.

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33. A pendulum clock consists of an iron rod connected to a small, heavy bob. If it is designed to keep correct time at $20^0 C$, how fast or slow will it go in 24 hours at $40^0 C$? Coefficient of linear expansion of iron $= 1.2 \times 10^{-5} C^{-1}$.

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34. An aluminum cylinder 10 cm long with a cross section area of $20 cm^2$ is used as a spacer between two steel walls. At $17.2^\circ C$ it just slips in between the walls. When it warms to $22.3^\circ C$ calculate the stress in the cylinder and the total force it exerts on each wall, assuming that the walls are perfectly rigid and a constant distance apart.

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35. 5 g ice at0^C is mixed with 1 g steam at 100^C.Find the final temperture and compostion of the mixture.

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36. 100 g ice at $0^\circ C$ is mixed with 10 g steam at $100^\circ C$. Find the final temperature and composition .

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37. 30 g ice at $0^{\circ}C$ is mixed with 25 g steam at $100^{\circ}C$. Find the final temperature and composition

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38. Liquids A and B are at 30°C and $20^{\circ}C$. When mixed in equal masses, the temperature of the mixture is found to be 26°C. Find the ratio of their specific heat capacities.

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39. suppose you want to cool 0.25 kg of cola (mostly water), at $25^\circ C$ by adding ice initially at $-20^\circ C$. How much ice should you add so that the final temperature will be $0^\circ C$ with all the ice melt? Neglect the heat capacity of the container. specific heat of ice is$2000 Jkg^{-1}K^{-1}$. [take specific heat of cola $4160 Jkg^{-1}K^{-1}$.]

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40. A steel bar 10.0 cm long is welded end to end to a copper bar 20.0 cm long. Both bars are insulated perfectly on their sides . Each bar has a separate cross-section, 2.00 cm on a side . The free end of the steel bar is maintained at $100^{\circ}C$ by placing it in contact with steam and free end of the copper bar is maintained at $0^{\circ}C$ by placing it in contact with ice . find the temperature at the junction of the two bars and the total rate of heat flow . thermal conductivity of steel $= 50.2Wm^{-1}K^{-1}$.thermal conductivity of copper $= 385Wm^{-1}K^{-1}$.

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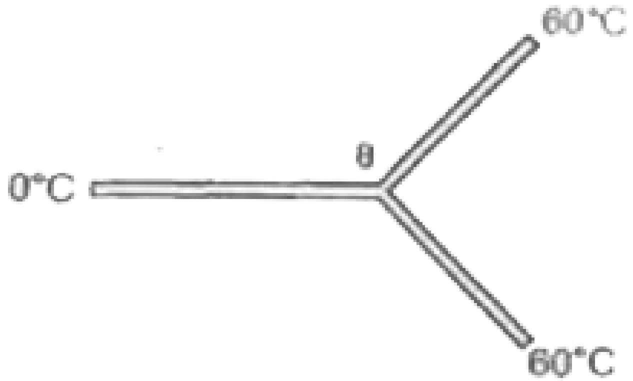
41. Three identical rods have been joined at a junction to make it a Y shape structure .If two free ends are maintained at $60^{\circ}C$ and the thired end is at $0^\circ C$ then what is the juction temperature θ?



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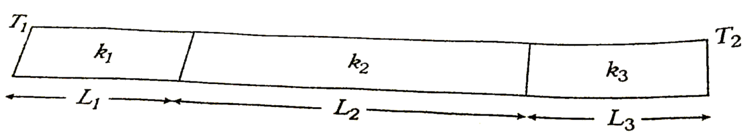
42. Three rods of same cross-section but different length and conductivity are joined in series . If the temperature of the two extreme ends are T_1 and $T_2 (T_1 > T_2)$ find the rate of heat transfer H.



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43. A body cools in 7 minutes from $60^\circ C$ to $40^\circ C$. What will be its temperature after the next 7 minutes? The temperature of the surroundings is $10^\circ C$.

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Try Youself

1. The temperature of a substance increases by $27^\circ C$. On the kelvin scale this increase is equal to

A. 300K

B. 65 K

C. 27 K

D. 7 K

Answer: C

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2. If the boiling point of water is $95^{\circ}F$, what will be reduction at celsius scale?

A. $7^{\circ}C$

B. $65^{\circ} C$

C. $63^{\circ} C$

D. $35^{\circ} C$

Answer: D

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3. When a strip made or iron (α_1) and copper (α_2), $(\alpha_2 > \alpha_1)$ is heated

A. its length does not change

B. it gets twisted

C. it bends with iron on concave side

D. it bends with iron on convex side

Answer: C

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4. The absolute coefficient of expansion of a liquid is 7 times that the volume coefficient of expansion of the vessel. Then the ratio of absolute and apparent expansion of the liquid is

A. $\frac{1}{7}$

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

C. $\frac{6}{7}$

D. $\frac{1}{6}$

Answer: B

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5. The coefficient of volume expansion of a liquid is $4.9 \times 10^{-4} K^{-1}$. Calculate the fractional change in its density when the temperature is raised by $30^{\circ} C$.

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6. Coefficient of areal expansion of a solid is $2 \times 10^{-5} . ^{\circ} C^{-1}$. Calculate its coefficient of linear expansion.

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7. Write the dimensional formul of Thermal stress.

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8. A metal sheet with a circular hole is heated. The hole

A. Gets larger

B. Gets smaller

C. Remains of the same size

D. Gets deformed

Answer: A

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9. A copper block of mass 0.06 kg is heated till its temperature is inreased by $20^\circ C$. Find the heat supplied to the block. [specific heat of copper $= 9 \times 10^{-2} cal g^{-1} .^\circ C^{-1}$]

10. The mechanical equivalent of heat

A. Has the same dimensional formula as heat

B. has the same dimensional formula as work

C. Has the same dimensional formula as energy

D. Is dimensionless

Answer: 4

11. Find the thermal resistance of an aluminium rod of length $20cm$ and area of cross section $1cm^2$. The heat current is along the length of the rod. Thermal conductivity of aluminium $= 200Wm^{-1}K^{-1}$.

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12. The thermal conductivity of a rod depends on

A. Length

B. Mass

C. Area of cross-section

D. Material of the rod

Answer: 4

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13. A body cools down from $45^{\circ}C$ to $40^{\circ}C$ in 5 minutes and to 35° in another 8 minutes. Find the temperature of the surrounding.

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14. Does a body at $20^{\circ}C$ radiate in a room, where the room temperature is $30^{\circ}C$? If yes, why does its temperature not fall further?

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15. Is the specific heat of water greater than that of sand?

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16. Do water and ice have the same specific heats?

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Assignment (Section-A) Objective Type questions (one option is correct)

1. On the celsius scale the absolute zero of temperature is at

A. $0^{\circ} C$

B. $-32^{\circ} C$

C. $100^{\circ} C$

D. $-273.15^{\circ} C$

Answer: D

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2. The absolute zero is the temperature at which

A. water freezes

B. all substances exist in solid

C. molecular motion ceases

D. all of these

Answer: D

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3. The gas thermometers are more sensitive than liquid thermometers because gases

A. Expand more than liquids

B. Are easily obtained

C. Are much lighter

D. Do not eaasily change their states

Answer: A

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4. if temperature of an object is $140^\circ F$, then its temperature in centigrade is

A. $105^\circ C$

B. $32^\circ C$

C. $140^\circ C$

D. $60^\circ C$

Answer: D

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5. A constant volume gas thermometer show pressure reading of 50cm and 99 cm of mercury at $0^\circ C$ and $100^\circ C$ respectively. When the pressure reading is 60 cm of mercury, the temperature is

A. $25^\circ C$

B. $40^\circ C$

C. $15^\circ C$

D. $12.5^\circ C$

Answer: A

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6. On centigrade scale the temperature of a body increases by 30 degrees. The increase in temperature on fahrenheit scale is

A. $50^\circ C$

B. $40^\circ C$

C. $30^\circ C$

D. $54^{\circ} C$

Answer: D

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7. A bar of iron is 10 cm at $20^{\circ} C$. At $19^{\circ} C$ it will be $\left(\alpha_{Fe} = 11 \times 10^{-6} / .^{\circ} C\right)$

A. 11×10^{-6}cm longer

B. $11 \times 10^{-6} cm$ cm shorter

C. $11 \times 10^{-5} cm$ shorter

D. $11 \times 10^{-5} cm$ longer

Answer: C

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8. Coefficient of volume expansion of mercury is $0.18 \times 10^{-3} / {}^{\circ} C$. If the density of mercury at $0^{\circ} C$ is 13.6 g/cc, then its density at $200^{\circ} C$ is

A. 13.11 g/cc

B. 52.11 g/cc

C. 16.11 g/cc

D. 26.11 g/cc

Answer: A

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9. A metre rod of silver at $0^{\circ} C$ is heated to $100^{\circ} C$. It's length is increased by 0.19 cm. coefficient of volume expansion of the silver rod is

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

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

C. $1.9 \times 10^{-5} / .^{\circ} C$

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

Answer: A

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10. The ratio among coefficient of volume expansion, superficial expansion and linear expansion i.e., $\gamma : \beta : \alpha$ is

A. $1:2:3$

B. $3:2:1$

C. $4:3:2$

D. all of these

Answer: A

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11. A solid ball of metal has a concentric spherical cavity within it. If the ball is heated, the volume of the cavity will

A. Increase

B. Decrease

C. Remain same

D. All of these

Answer: A

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12. A metal rod of Young's modules Y and coefficient of thermal expansion α is held at its two ends such that its length remains constant. If its temperature is raised by $t^\circ C$, the linear stress developed in it is

A. $Y\alpha t$

B. $\frac{1}{Y\alpha t}$

C. $\frac{\alpha t}{Y}$

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

Answer: A

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13. When a copper ball is heated, the largest percentage increase will occur in its

A. Diameter

B. Area

C. Volume

D. Density

Answer: C

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14. Two rods of different materials, having coefficients of linear expansion a_1 and a_2 and Young's moduli, Y_1 and Y_2 , respectively, are fixed between two rigid massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of rods. If $\alpha_1/\alpha_2 = 2/3$, then the thermal stresses developed in the two rods are equal, provided Y_1/Y_2 is equal to :

A. $2:3$

B. $1:1$

C. $3:2$

D. $4:9$

Answer: C

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15. A glass flask of volume $200 cm^3$ is just filled with mercury at $20^\circ C$. The amount of mercury that will overflow when the temperature of the system is raised to $100^\circ C$ is $\left(\gamma_{glass} = 1.2 \times 10^{-5} / C^\circ, \gamma_{mercury} = 1.8 \times 10^{-4} / C^\circ\right)$

A. 2.15 cm^3

B. 2.69 cm^3

C. 2.52 cm^3

D. 2.25 cm^3

Answer: B

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16. Solids expand on heating because

A. Kinetic energy of atom increases

B. Potential energy of atom increases

C. Total energy of atom increases

D. The potential energy curve is asymmetric about the equilibrium distance between neighbouring atoms

Answer: D

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17. Which of the following is a unit of specifi heat?

A. $Jkg.^{\circ} C^{-1}$

B. $kJ / kg.^{\circ} C$

C. $kg.^{\circ} C / J$

D. $J/kg.^{\circ}C^{-2}$

Answer: B

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18. 300 grams of water at $25^{\circ}C$ is added to $100g$ of ice at $0^{\circ}C$. The final temperature of the mixture is__________.

A. $-\frac{5}{3}.^{\circ}C$

B. $-\frac{5}{2}.^{\circ}C$

C. $-5^{\circ}C$

D. $0^{\circ}C$

Answer: D

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19. Two spheres made of same substance have diameters in the ratio 1:2. their thermal capacities are in the ratio of

A. $1:2$

B. $1:8$

C. $1:4$

D. $2:1$

Answer: B

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20. 80 g of water at $30^\circ C$ are poured on a large block of ice at $0^\circ C$. The mass of ice that melts is

A. 30 gm

B. 80 gm

C. 1600 gm

D. 150 gm

Answer: A

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21. Work done in converting one gram of ice at $-10^{\circ}C$ into steam at $100^{\circ}C$ is

A. 3.04 kJ

B. 6.05 kJ

C. 0.721 kJ

D. 0.616 kJ

Answer: A

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22. 2gm of steam condenses when passed through 40 gm of water initially at $25^{\circ}C$. The condensation of steam raises the temperature of water to $54.3^{\circ}C$. What is the latent heat of steam

A. 540 cal/g

B. 536 cal/g

C. 270 cal/g

D. 480 cal/g

Answer: A

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23. The temperature of 100 g of water is to be raised from $24^\circ C$ to $90^\circ C$ by adding steam to it. Calculate the mass of the steam required for this purpose.

A. 20g

B. 15g

C. 12g

D. 18g

Answer: C

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24. $10gm$ of ice at $-20^{\circ}C$ is dropped into a calorimeter containing $10gm$ of water at $10^{\circ}C$, the specific heat of water is twice that of ice. When equilibrium is reached the calorimeter will contain:

A. 20 gm of water

B. 20 gm of ice

C. 10 gm ice and 10 gm of water

D. 5 gm ice and 15 gm water

Answer: C

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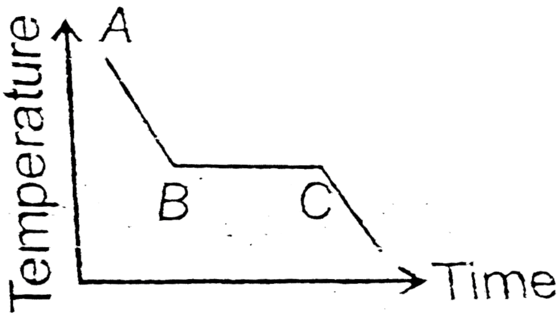
25. The portion of the curve representing the state of matter denotes



A. Change from gaseous state to liquid state

B. The liquid state of matter

C. Gaseous state of matter

D. all of these

Answer: B

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26. Water falls from a height 500 m. what is the rise in temperature of water at bottom if whole energy remains in the water?

A. $0.96^\circ C$

B. $1.02^\circ C$

C. $1.16^\circ C$

D. $0.23^\circ C$

Answer: C

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27. Latent heat of ice 80 cal/gm . A man melts 60 g of ice by chewing in 1 minute . His power is

A. 4800 W

B. 336 W

C. 1.33 W

D. 0.75 W

Answer: B

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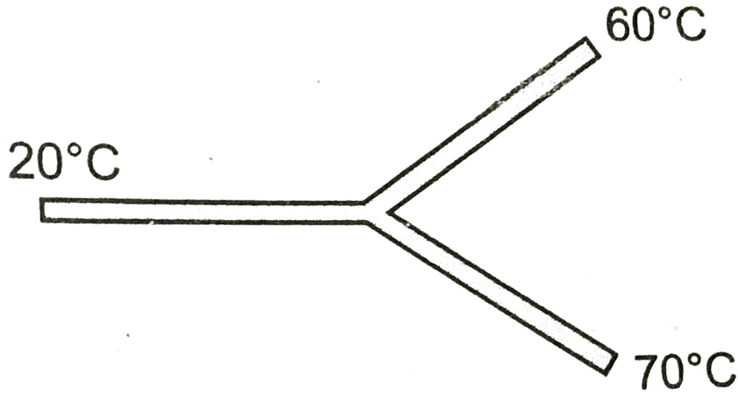
28. There indectical thermal conductors are connected as shown in Fig. 7(CF).17. Considering no heat is lost due to radition, the temperature of the junction is



A. $60^\circ C$

B. $20^\circ C$

C. $50^\circ C$

D. $10^\circ C$

Answer: C

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

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

B. $\sqrt{2}K$

C. $3K$

D. $\left(\frac{4}{3}\right)K$

Answer: D

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30. The outer faces of a rectangular slab made of equal thickness of iron and brass are maintained at $100^\circ C$ and $0^\circ C$ respectively. The temperature at the interface is (Thermal conductivity of iron and brass are 0.2 and 0.3 respectively)

A. $100^\circ C$

B. $40^\circ C$

C. $50^\circ C$

D. $70^{\circ} C$

Answer: B

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31. The dimensions of thermal resistance are

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

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

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

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

Answer: A

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32. The temperature of water at the surface of a deep lake is $2^{\circ}C$. The temperature expected at the bottom is

A. $2^{\circ}C$

B. $3^{\circ}C$

C. $4^{\circ}C$

D. $1^{\circ}C$

Answer: C

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

A. $20^\circ C$

B. $40^\circ C$

C. $80^\circ C$

D. $100^\circ C$

Answer: B

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34. A cylindrical rod having temperature T_1 and T_2 at its end. The rate of flow of heat Q_1 cal/sec. If all the linear dimension are doubled keeping temperature remain const. then rate of flow of heat Q_2 will be : -

A. $4Q_1$

B. $2Q_1$

C. $\frac{Q_1}{4}$

D. $\frac{Q_1}{2}$

Answer: B

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35. A slab consists of two parallel layers of two different materials of same thickness having themal conductivities K1 and K2 . 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. The layers of atmosphere are heated through

A. Convection

B. Conduction

C. Radiation

D. Both (1) and (3)

Answer: D

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37. The temperarture gradient in a rod of 0.5 m long is $80^{\circ} Cm^{-1}$. If the temperature of hotter end of the rod is 30° C, then the temperature of the cooler ends is

A. $40^\circ C$

B. $-10^\circ C$

C. $10^\circ C$

D. $0^\circ C$

Answer: B

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38. The ratio of the thermal conductivities of two different materials is $1:2$. The thermal resistance of the rods of these materials having the same thickness are equal. Find the ratio of the length of rods.

A. $4:5$

B. $9:1$

C. $1:9$

D. $5:4$

Answer: D

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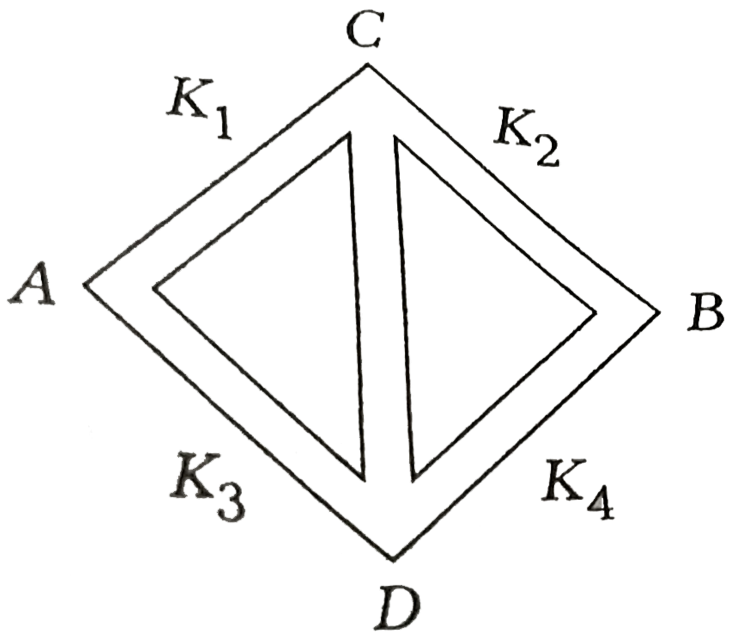
39. Five rods of same dimensions are arranged as shown in figyre. They have thermal conductivities K_1, K_2, K_3, K_4 and K_5. When points A and B are maintained at different temperatures, no heat flows through the central rod if



A. $K_1 = K_4$ and $K_2 = K_3$

B. $K_1K_4 = K_2K_3$

C. $K_1K_2 = K_3K_4$

D. $\frac{K_1}{K_4} = \frac{K_2}{K_3}$

Answer: B

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40. In heat transfer, which method is based on gravitation?

A. Natural convection

B. Conduction

C. Radiation

D. All of these

Answer: A

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41. In which process, the rate of transfer of heat is maximum ?

A. Conduction

B. Convection

C. Radiation

D. In all these, heat is transferred with the same velocity.

Answer: C

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42. Good absorbers of heat are

A. Poor emitters

B. Non-emitters

C. Good emitters

D. Highly polished

Answer: C

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43. A body, which emits radiations of all possible wavelengths, is known as

A. Good conductor

B. Partial radiator

C. Absorber of photons

D. Perfectly black body

Answer: D

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44. A hot and a cold bofy are kept in vacuum seperated from eavh other. Which of the followimg causes decrease in temperature of the hot body?

A. Radiation

B. Convection

C. Conduction

D. Temperature remains same

Answer: A

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45. According to 'Newton's Law of cooling', the rate of cooling of a body is proportional to the

A. Temperature of the body

B. Temperature of the surrounding

C. Fourth power of the temperature of the body

D. Difference of the temperature of the body and the surroudings

Answer: D

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46. A liquid cools down from $70^\circ C$ to $60^\circ C$ in 5 minutes. The time taken to cool it from $60^\circ C$ to $50^\circ C$ will be

A. 5 minutes

B. lessser than 5 minutes

C. greater than 5 minutes

D. Lesser or greater than 5 minutes depending upon the density of the liquid.

Answer: C

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47. If a metallic sphere gets cooled from $62^{\circ}C$ to $50^{\circ}C$ in minutes 10 and in the next 10 minutes gets cooled to $42^{\circ}C$, then the temperature of the surroundings is

A. $30^{\circ}C$

B. $36^{\circ}C$

C. $26^{\circ}C$

D. $20^{\circ}C$

Answer: C

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48. Newton's law of cooling is used in laboratory for the determination of the

A. Specific heat of the gases

B. The latent heat of gases

C. Specific heat of liquid

D. Latent heat of liquids

Answer: C

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49. It takes $10 \min utes$ to cool a liquid from $61^{\circ} C$ to $59^{\circ} C$. If room temperature is $30^{\circ} C$ then find the time taken in cooling from $51^{\circ} C$ to $49^{\circ} C$.

A. 10 min

B. 11 min

C. 13 min

D. 15 min

Answer: D

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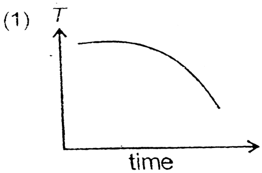
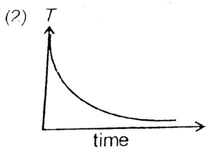
50. A block of metal is heated to a temperature much higher than the room temperature and allowed to cool in a room free from air currents. Which of the following curves correctly represents the cooling? (T : Temperature of block)

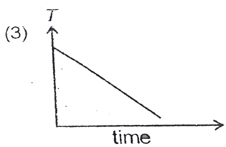
A.

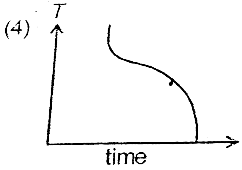


B.



C.



D. 

Answer: B

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Assignment (Section-B) Objective Type questions (one option is correct)

1. A circular hole in an aluminium plat e is 2.54×10^{-2}m in diamter at $0^\circ C$, its diameter when the temperature of the plate is raised to $100^\circ C$ will be? $\left(\alpha = 2.55 \times 10^{-5} / .^\circ C\right)$

A. $2.50 \times 10^{-2} m$

B. $2.546 \times 10^{-2} m$

C. $4.5 \times 10^{-2} m$

D. $2.45 \times 10^{-2} m$

Answer: B

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2. A pendulum clock, made of a material having coefficient of linear expansion $\alpha = 9 \times 10^{-7} / .^{\circ} C$ has a period of 0.500 sec at $20^{\circ} C$. If the clock is used in a climate where temperature averages $30^{\circ} C$, what correction is necessary at the end of 30 days to the time given by clock?

A. $11.66s$

B. $3.88s$

C. $0.100s$

D. $2.0s$

Answer: A

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3. The excess temperature of a body falls from $12^{\circ}C$ to $6^{\circ}C$ in 5 minutes, then the time to fall the excess temperature from $6^\circ C$ to $3^\circ C$ is (assume the newton's cooling is valid)

A. a. 10 minutes

B. b. 7.5 minutes

C. c. 5 minutes

D. d. 2.5 minutes

Answer: C

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4. Emissive power of an ideal black body at $127^\circ C$ is E. the temperature at which it increases to 102% is

A. 400 K

B. 100 K

C. 402 K

D. 502 K

Answer: C

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5. A glass cylinder contains $m_0 = 100g$ of mercury at a temperature of $t_0 = 0^\circ C$. When temperature becomes $t_1 = 20^\circ C$ the cylinder contains $m_1 = 99.7g$ of mercury The coefficient of volume expansion of mercury $\gamma_{He} = 18 \times \left(10^{-5} / ^{\circ} C\right.$

Assume that the temperature of the mercury is equal to that of the cylinder. The coefficient of linear expansion of glass α is

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

B. $= 10^{-3} / .^{\circ} C$

C. $= 10^{-5} / .^{\circ} C$

D. $= 10^{-2} / .^{\circ} C$

Answer: C

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6. A block of ice at $0^\circ C$ whose mass is initially 50.0 kg slides along a horizontal surface, starting at a speed of 5.38 m/s and finally coming tor est after travelling 28.3 meters. The mass of ice melted as a result of the friction between the block and the surface will be

A. 2.16 g

B. 4.0 g

C. 1 g

D. 50 g

Answer: A

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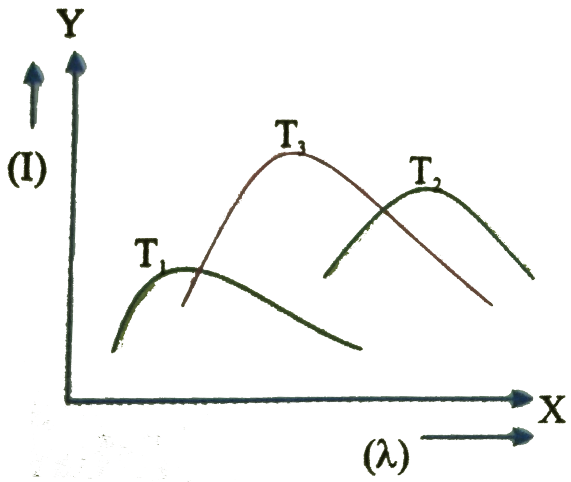
7. The plots of intensity versus wavelength for three black bodies at temperatures T_1, T_2 and T_3 respectively are shown in Their temperatures are shown in How their temperatures are related ?



A. $T_1 > T_2 > T_3$

B. $T_1 > T_3 > T_2$

C. $T_2 > T_3 > T_1$

D. $T_3 > T_2 > T_1$

Answer: B

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8. Equal masses of three liquids A, B and C have temperature $10^\circ C$, $25^\circ C$ and $40^\circ c$ respectively. If A and B are mixed, the mixture has a temperature of $15^\circ C$. If B and C are mixed, the mixture has a temperature of $30^\circ C$, if A and C are mixed will have a temperature of

A. $16^\circ C$

B. $20^\circ C$

C. $25^\circ C$

D. $29^\circ C$

Answer: A

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9. 5 g of water at 30° C and 5 g of ice at $-20^\circ C$ are mixed together in a calorimeter. Find the final temperature of the mixture. Assume water equivalent of calorimeter to be negligible, specific heat of ice and water are 0.5 and $1 cal / g C^{\circ}$, and latent heat of ice is $80 cal / g$.

A. $30^{\circ} C$

B. $0^{\circ} C$

C. $-20^{\circ} C$

D. $10^{\circ} C$

Answer: B

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10. A bullet of mass 10 g moving with a speed of $20 m / s$ hits an ice block of mass 990 g kept on a frictionless floor and gets stuck in it. How much ice will melt if 50% of the lost kinetic energy goes to ice?

(Temperature of ice block $= 0^\circ C$.)

A. 0.030 g

B. 0.30 g

C. 0.003 g

D. 3.0 g

Answer: C

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11. A body cools in 10 minutes from $60^{\circ}C$ to $40^{\circ}C$. What is the temperature of the body after next 20 minutes? The temperatuer fo surroundings is $10^{\circ}C$

A. $14^{\circ}C$

B. $30^{\circ}C$

C. $20.8^{\circ}C$

D. $14.36^{\circ}C$

Answer: C

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12. 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 connected to the same vessels. Let m_1 and m_2 g/s be the rate of melting of ice in the two cases respectively, the ratio $\frac{m_1}{m_2}$ is

A. $1:2$

B. $2:1$

C. $4:1$

D. $1:4$

Answer: C

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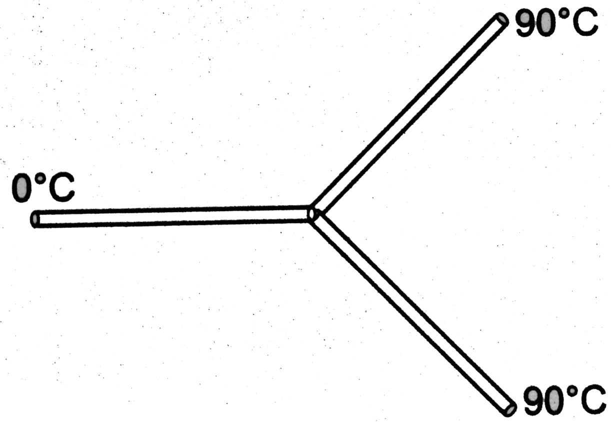
13. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at $0^\circ C$ and $90^\circ C$, respectively. The temperature of junction of the three rods will be

(a) $45^\circ C$ (b) $60^\circ C$

(c) $30^\circ C$ (d) $20^\circ C$.



A. $45^\circ C$

B. 60°

C. $30^\circ C$

D. $20^\circ C$

Answer: B

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14. A liquid (coefficient of cubical expansion γ_1) is contained in a glass vessel of volume V_g (coefficient of cubical expansion γ_g) at a temperature. The volume of liquid at this temperature is V_l. Now the system is heated and it is found that at all temperatures, the volume of vessel, unoccupied by liquid remains always same, then

A. $\frac{V_g}{V_l} = \frac{\gamma_l}{\gamma_g}$

B. $\frac{V_g}{V_l} = \frac{\gamma_g}{\gamma_l}$

C. $V_g - V_l = \gamma_g - \gamma_l$

D. $V_g + V_l = \gamma_g + \gamma_l$

Answer: A

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15. Two metallic rods of length l and 3l have coefficient of linear expansion α and 3α respectively. The coefficient of linear expansion ofr their series combinations, is

A. α

B. 2.5α

C. 4α

D. 2α

Answer: B

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Assignment (Section-C) Objective Type questions (More than one option are correct)

1. 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 1934 K

B. $\lambda_B = 1.5\mu m$

C. The temperature of B is 2901 K

D. The temperature of B is 2901 K

Answer: A::B

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2. Which of the following statement are correct?

A. The value of absolute zero on kelvin scale is zero

B. The value of absolute zero on reaumur scale is -218.5°

C. If the difference of two temperature on celsium scale is 45°, the difference on fahrenheit scale is 81°

D. if the difference of two temperature on celsius scale is 45°, the difference in kelvin scale is 45°

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

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3. Which of the following statements are correct?

A. Rough surfaces are better reflector than smooth surfaces

B. Highly polished mirror like surfaces are very. Good radiators

C. Black surfaces are better absorbers than white ones

D. Black surfaces are better radiators than white ones

Answer: C::D

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4. The ends of a metal rod are kept at temperature θ_1 and θ_2 with $\theta_2 > \theta_1$. At steady state the rate of flow of heat along the rod is directly proportional to

A. the length of the rod

B. the diameter of the rod

C. the cross-sectional area of the rod

D. the temperature difference $(\theta_2 - \theta_1)$ between the ends of the rod

Answer: C::D

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5. The water equivalent of a copper calorimeter is 4.5g. If the specific heat of copper is 0.09 cal $g^{-1}.^{\circ}C^{-1}$. Then

A. mass of the calorimeter is 0.5 kg

B. Thermal capacity of the calorimeter is 4.5 cal $cal^{\circ}C^{-1}$

C. heat requried to raise the temperature of the calorimter by $8^{\circ}C$ will be 36 cal

D. heat required to melt 15 gm of ice placed in the calorimeter in equilibrium with ice, will be 1200 cal.

Answer: B::C::D

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6. The coefficient of linear expansion of a metal rod does not depend uponthe original length of the rod

A. the change in temperature of the rod

B. the specific heat of the metal

C. the nature of the metal

D. NONE

Answer: A::B::C

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7. A spherical black body of radius n radiates power p and its rate of cooling is R. then.

A. $p \propto n$

B. $p \propto n^2$

C. $R \propto n^2$

D. $R \propto \frac{1}{n}$

Answer: B::D

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8. The solar constant for a planet is $\sum$. The surface temperature of the sun is T K. if the sun subtends an angle θ at the planet, then

A. $\sum \propto T^4$

B. $\sum \propto T^2$

C. $\sum \propto \theta^2$

D. $\sum \propto \theta$

Answer: A::C

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9. A heated 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 wavelength $2\lambda_0$

B. The maximum intensity of radiation will be near wavelength $\lambda_0 / 2$

C. The total energy emitted will increase 16 times

D. the total energy emitted will increase 12 times

Answer: B::C

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10. A polished metallic piece and a black painted wooden piece are kept in open in bright sun for a long time.

A. a. The wooden piece will absorb less heat than the metallic piece

B. the wooden piece will hae a lower temperature than the metallic piece

C. If touched, the metallic piece will be felt hotter than the wooden piece

D. When the two pieces are removed from the open to a cold room, the wooden piece will loose heat at a faster rate than the metallic piece.

Answer: C::D

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11. Due to thermal expansion, with rise in temperature

A. a. Metallic scale reading becomes less than the actual value

B. b. Pendulum clock becomes slow

C. c. A floating body sinks a little more

D. d. The weight of a body in a liquid increases

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

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12. Two identical beakers with negligible thermal expansion are filled with water to the same level at $4^{\circ} C$. If one says A is heated while the other says B is cooled, then:

A. water level in A will rise

B. Water level in B will rise

C. Water level in A will fall

D. Water level in B will fall

Answer: A::B

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Assignment (Section-D) Linked Comprehension Type Questions

1. A "flow calorimeter" is used to measure the specific heat of a liquid. Heat is added at a known rate to a stream of the liquid as it passes through the calorimeter at known rate, then a measurement of the resulting temperature difference between the in flow and the out flow points of the liquid stream enables us to compute the specific heat of the liquid. A liquid of density 0.85 g/cm^3 flows through a calorimeter at the rate of 8.0 cm^3/s. heat is added by means of a 250 watt electric heating coil, and a temperature difference of $15^\circ C$ is established in steady state conditions between the in flow and out flow points.

Q. Rate of heat added per second is

A. 4.18 J/s

B. 59.8 cal/s

C. 5 cal/s

D. 90 cal/2

Answer: B

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2. A "flow calorimeter" is used to measure the specific heat of a liquid. Heat is added at a known rate to a stream of the liquid as it passes through the calorimeter at known rate, then a measurement of the resulting temperature difference between the in flow and the out flow points of the liquid stream enables us to compute the specific heat of the liquid. A liquid of density 0.85 g/cm^3 flows through a calorimeter at the rate of 8.0 cm^3/s. heat is added by means of a 250 watt electric heating coil, and a temperature difference of $15^\circ C$ is established in steady state conditions between the in flow and out flow points.

Q. Rate of heat absorption per unit specific heat capacity is

A. 100g-.$^{\circ}C/s$

B. 102g-.$^{\circ}C/s$

C. 50g-.$^{\circ}C/s$

D. $10.2g-.^{\circ}C/s$

Answer: B

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3. A "flow calorimeter" is used to measure the specific heat of a liquid. Heat is added at a known rate to a stream of the liquid as it passes through the calorimeter at known rate, then a measurement of the resulting temperature difference between the in flow and the out flow points of the liquid stream enables us to compute the specific heat of the liquid. A liquid of density 0.85 g/cm^3 flows through a calorimeter at the rate of 8.0 cm^3/s. heat is added by means of a 250 watt electric heating coil, and a temperature difference of $15^\circ C$ is established in steady state conditions between the in flow and out flow points.

Q. Specific heat of the liquid is

A. $0.59 cal/g.^\circ C$

B. $4cal / g.^\circ C$

C. $2cal / g.^\circ C$

D. $9cal / g.^\circ C$

Answer: A

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4. Three liquids A, B and C having same sepcific heats have masses m,2m and 3m. Their temperaures are 'theta',2theta and 3θ respectively. Q. What is the temperature of mixture, when A and B are mixed?

A. a. $\frac{5}{2}\theta$

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

C. c. $\frac{7}{3}\theta$

D. d. $\frac{13}{5}\theta$

Answer: B

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5. Three liquids A, B and C having same sepcific heats have masses m,2m and 3m. Their temperaures are 0,20 and 3θ respectively. ltBrgt Q. What is the temperature of mixture, when A and B mixed?

A. $\frac{5}{2}\theta$

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

C. $\frac{7}{3}\theta$

D. $\frac{13}{5}\theta$

Answer: A

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6. Three liquids A, B and C having same sepcific heats have masses m,2m and 3m. Their temperaures are 0,20 and 3θ respectively. ltBrgt Q. What is the temperature of mixture, when Aand C all are mixed?

A. $\frac{5}{2}\theta$

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

C. $\frac{7}{3}\theta$

D. $\frac{13}{5}\theta$

Answer: C

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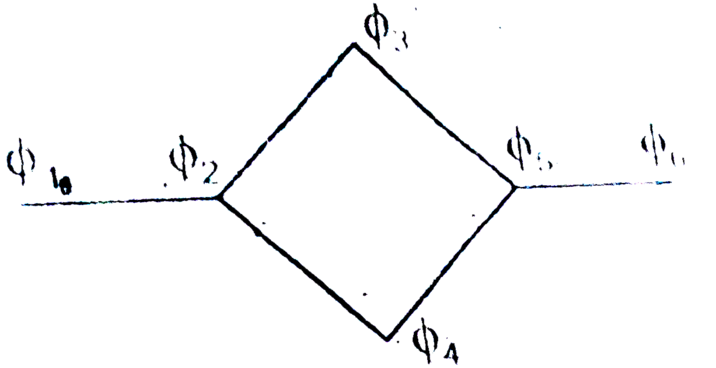
7. Six identical conducting rods are connected as shown in figure. In steady state temperature of point ϕ_1 is fixed at $100^\circ C$ and temperature of ϕ_6 at $-80^\circ C$



Q. What is the temperature of ϕ_2?

A. a. $10^\circ C$

B. b. $40^\circ C$

C. c. $-20^\circ C$

D. d. $-10^\circ C$

Answer: B

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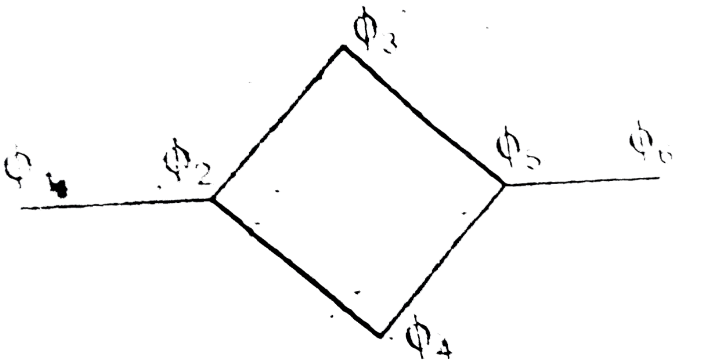
8. Six identical conducting rods are connected as shown in figure. In steady state temperature of point ϕ_1 is fixed at $100^\circ C$ and temperature of ϕ_6 at $-80^\circ C$



Q. What is the temperature of ϕ_3?

A. a. $10^\circ C$

B. b. $40^\circ C$

C. c. $-10^\circ C$

D. d. $-15^\circ C$

Answer: A

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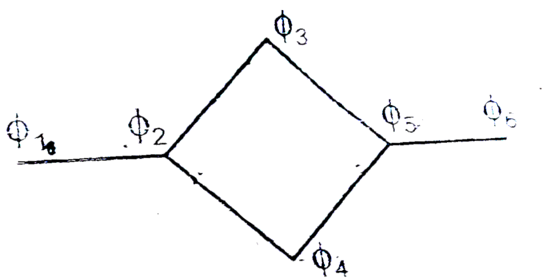
9. Six identical conducting rods are connected as shown in figure. In steady state temperature of point ϕ_1 is fixed at $100^\circ C$ and temperature of ϕ_6 at $-80^\circ C$



Q. What is the temperature of ϕ_5?

A. a. $10^\circ C$

B. b. $30^\circ C$

C. c. $-20^\circ C$

D. d. $-10^\circ C$

Answer: C

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Assignment (Section-E) Assertion & Reason Type Question

1. Statement-1: A black hole is an example of a perfectly black body.

Statement-2: A perfectly black body absorbs every kind of radiation incident on it.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

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

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

Answer: D

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2. Statement-1: When the temperature of a black body is doubled from$t^\circ C$ to $2t^\circ C$, the radiant power becomes 16 times.

Statement-2: The radiant power of a body is proportional to fourth power of absolute temperature.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

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

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

Answer: D

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3. Statement-1: The coefficient of thermal expansion of a body measured in $(.^{\circ} F)^{-1}$ is numerically smaller than that measured in $.^{\circ} C^{-1}$.

Statement-2: Fahrenheit is a smaller unit than centigrade.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

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

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

Answer: A

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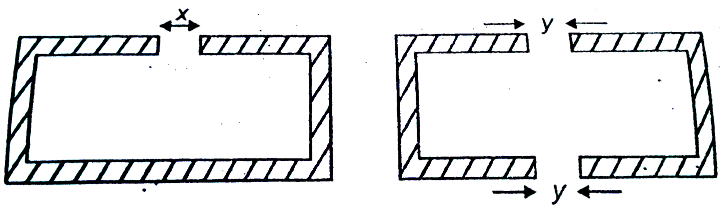
4. Consider the arrangement shown. The arrangement is heated to increase the temperature.

ltBrgt 

Statement-1: On heating, x increases, whereas Y decreases.

Statement-2: The value x is a dimension of the body being heated, whereas y is width of gap.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

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

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

Answer: A

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5. Statement-1: On a cold winter day, an iron railing appears much colder than a wooden fence post.

Statement-2: heat capacity of iron is different from wood.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

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

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

Answer: B

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6. Statement-1: Clinical thermometers are made long and thin.

Staetment-2: Long and thin thermometers can easily be kept in mouth below the tongue.

A. a. $\left(\frac{gm}{r}\right)^{\frac{1}{2}}$

B. b. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. c. mStatement-1 is true, statement-2 is false

D. d. Statement-1 is false, statement-2 is true

Answer: C

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7. Statement-1: Steam burns are more painful than that caused by boiling water at same temperature.

Statement-2: Internal energy of steam at $100^\circ C$ is greater than that of water at $100^\circ C$.

A. a. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. b. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. c. Statement-1 is true, statement-2 is false

D. d. Statement-1 is false, statement-2 is true

Answer: A

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8. Statement-1: Ventilators are provided at the top of the room.

Statement-2: Their purpose is to bring oxygen for breathing.

A. a. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. b. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. c. Statement-1 is true, statement-2 is false

D. d. Statement-1 is false, statement-2 is true

Answer: C

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9. Statement-1: Specific heat capacities of all substance approach zero as $T \rightarrow O$

Statement-2: Molecular motion ceases at very low temperature.

A. a. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. b. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

C. c. Statement-1 is true, statement-2 is false

D. d. Statement-1 is false, statement-2 is true

Answer: A

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10. Statement-1: There are two spheres made of same amount of material, one of them is hollow and other is solid. They are heated to same temperature and left in identical surroundigs. The initial rate of cooling will be greater for hollow sphere. Statement-2: The rate of heat loss depends on surface area and temperature.

A. Statement-1 is true, statement-2 is true, statement-2 is a correct explanation for statement-1

B. Statement-1 is true, statement-2 is true, statement-2 is not a correct explanation for statement-1

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

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

Answer: A

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Assignment (Section-E) Match the columns

1. Match the following

Column-I	Column-II
(A) $e = \int_0^\infty e_\lambda d\lambda$	(p) Wien's displacement law
(B) $\lambda_m T = b$	(q) σT^4
(C) a_λ	(r) Unity for black body
(D) $\frac{e}{a}$ for back body	(s) Absorptive power

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2. Match the following

Column-I	Column-II
(A) Some liquid is filled in a container. On heating container height of liquid in container.	(p) Must increase
(B) When heat is supplied to ice at 0°C. Internal energy of the system.	(q) Must decrease
(C) The rate of heat loss from a body on increasing temperature of surrounding	(r) May increase
(D) On increasing temperature density of water	(s) May decrease
	(t) May be constant

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3. Match the following

Column-I	Column-II
(A) Stefan's constant	(p) [L]
(B) Wien's constant	(q) $[ML^2 T^{-3} \theta^2]$
(C) Emissive power	(r) $[MT^{-3}]$
(D) Thermal resistance	(s) None of these

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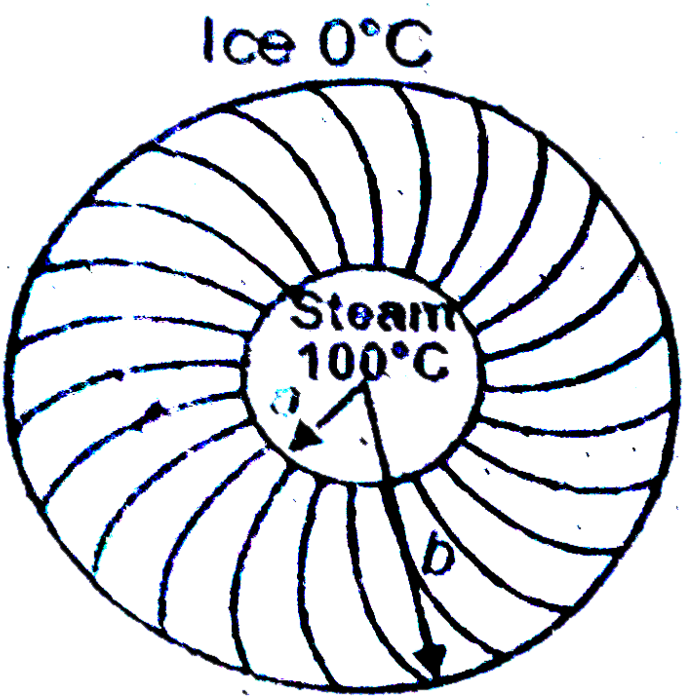
Assignment (Section-E) Integer Answer Type Questions

1. A solid sphere of radius b=4cm has a cavity of radius a=2cm. The cavity is filled with steam at $100^\circ C$. The solid sphere is placed inside the ice at $0^\circ C$.

Thermal conductivity of material of sphere is 0.5 W/m $.^{\circ} C$. If ther ate of flow of heat through the sphere radially is $x\pi J/s$ then find the value of x.



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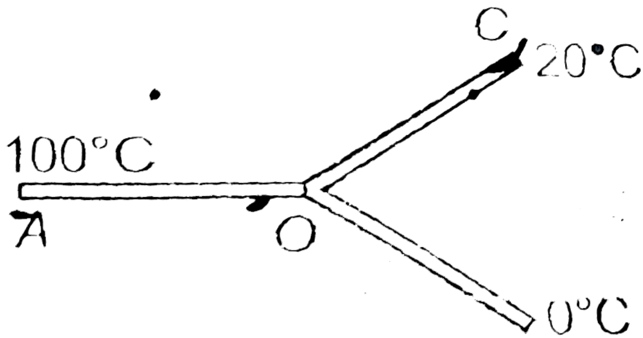
2. Three identical rods are joined at point O as shown in the figure. In the steady state, fid the ratio of thermal current through rod AO and OC.



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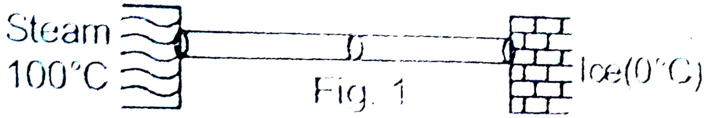
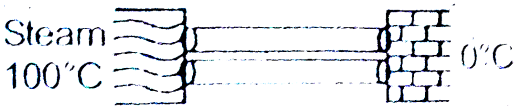
3. Two identical rods are arranged in two different ways as shown in the figure If R_1 is rate at which ice is melting in figure 1 and R_2 is the rate at which ice is melting in figure 2 then $\frac{R_2}{R_1}$ is equal to





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Assignment (Section-H) Multiple True-False Type Questions

1. Statement-1: If the temperature of body and surrounding is same then no heat is radiated by the body.

Statement-2: The rise of $1^\circ C$ is equivalent to $1.8^\circ F$

Statement-3: If heat is given to the system then temperature of the system must rise.

A. TTT

B. TFT

C. FTF

D. FFF

Answer: C

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2. Statement-1: If an annular disk is heated uniformly then outer radius increases but inner radius decreases.

Statement-2: Temperature gradient of a rod is constant in steady state.

Staement-3: Density of metal decreases with increase in temperature.

A. TTT

B. TFT

C. FTT

D. FFF

Answer: C

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Assignment (Section-I) Subjective Type Questions

1. An iron tank tas a capacity of V=50 litres of kerosene at $T_0 = 273K$. What amount of kerosene will flow out of the full tank, if it is brought in a room where the temperature is T=293K? [The density of kerosene $\rho = 0.8 \times 10^3 kg/m^3$, coefficient of volume expansions of kerosene $\gamma_k = 10 \times 10^{-4}$ and coefficient of linear expansio of iron $\alpha_i = 1.2 \times 10^{-5}$, all in SI units].

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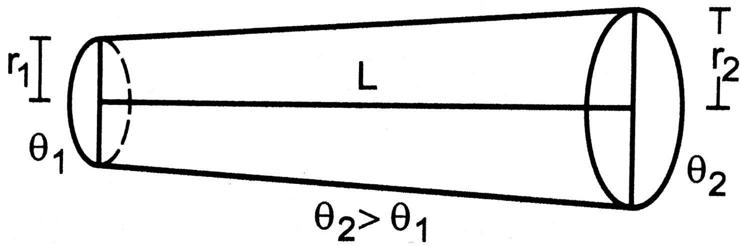
2. Find the rate of heat flow through a cross section of the rod shown in figure $(\theta_2 > \theta_1)$. Thermal conductivity of the material of the rod is K.



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3. A sphere and a cube of same material and same total surface area are placed in the same evacuated space turn by turn after they are heated to the same temperature. Find the ratio of their initial rates of cooling in the enclosure.

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4. Show that the temperature of a planet varies inversely as the square root of its distance from the sum.

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5. A long rod has one end at $0^\circ C$ and other end at a high temperature. The coefficient of thermal conductivity varies with distance from the low temperature end as $K = K_0(1 + ax)$, where $K_0 = 10^2$ SI unit and $a = 1m^{-1}$. At what distance from the first end the temperature will be $100^\circ C$? The area of cross-section is $1cm^2$ and rate of heat conduction is 1 W.

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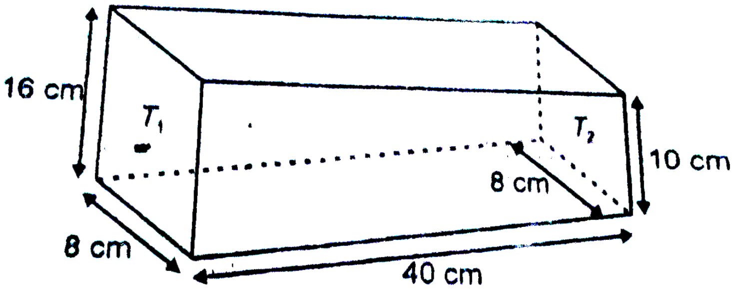
Assignment (Section-J) Akash Challengers Questions

1. A slab of cunductivity k is in the shape of trapezoid as shown I figure. If the two end faces be maintained at temperature $T_1 = 50^\circ C$ and $T_2 = 25^\circ C$, then determine the thermal current through the slab by ignoring any heat loss through the lateral surfaces.



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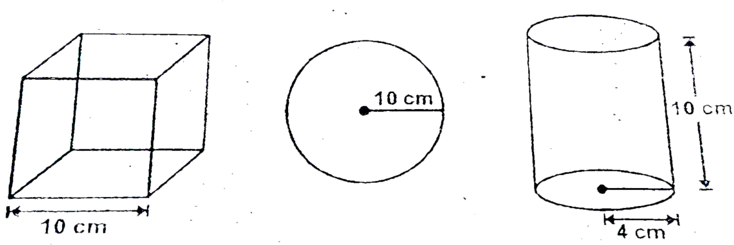
2. A cube, sphere and a cylinder made of same material shown in figure are allowed to cool under identical conditions. Determine which of these will cool at a faster rate?



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3. A rod of length l with thermally insulated lateral surface consists of material whose heat conductivity coefficient varies with temperature as $k = a/T$, where a is a constant. The ends of the rod are kept at temperatures T_1 and T_2. Find the function T(x), where x is the distance from the end whose temperature is T_1.

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4. A metallic cylindrical vessel whose inner and outer radii are r_1 and r_2 is filled with ice at $0^\circ C$. The mass of the ice in the cylinder is m. Circular portions of the cylinder is sealed with completely adiabatic walls. The vessel is kept in air. Temperature of the air is $50^\circ C$. How long will it take for the ice to melt completely. Thermal conductivity of the cylinder is K and its length is l. Latent heat of fusion of L.

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5. A cylindrical block of length 0.4 m and area of cross-section $0.04 m^2$ is placed coaxially on a thin metal disc of mass 0.4 kg and of the same cross - section. The upper face of the cylinder is maintained at a constant temperature of 400 K and the initial temperature of the disc is 300K. if the thermal conductivity of the material of the cylinder is $10\text{watt}/m.K$ and the specific heat of the material of the disc is $600J/kg.K$, how long will it take for the temperature of the disc to increase to 350 K? Assume for purpose of calculation the thermal conductivity of the disc to be very high and the system to be thermally insulated except for the upper face of the cylinder.

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6. A metal ball of mass 1 kg is heated by means of a 20 W heater in a room at $20^{\circ} C$. The temperature of the ball becomes steady at $50^{\circ} C$. Assume newton's law of cooling to hold good in the given situation. The temperature of the ball rises uniformly from $20^{\circ} C$ to $30^{\circ} C$ in 5 minutes. select the correct alternatives

(1) The rate of heat loss by ball to surrounding is 20 W, when it is at 50°

(2) The rate of heat loss by ball to surrounding is $\frac{20}{3} W$, when it is at $30^{\circ} C$

(3) The rate of heat loss by ball to surrounding 20 W, when it is at $30^{\circ} C$

(4). The specific heat capacity of the gas is 500 J/kg K.

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7. A vessel with 100 g of water at a temperature of $0^{\circ} C$ is suspended in the middle of a room. In 15 minutes the temperature of the water rises to $1.8^{\circ} C$. When ice equal in weight of the water is placed in the same vessel, it melts during 10 hours. using appropriate appropriate approximations, estimate the latent heat of fusio of ice in cal/g. if the known alue of latent heat of fusion of ice is 80 cal/g, obtain the difference in the two values in cal/g and report this as your answer.

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Try Yourself

1. A constant volume gas thermometer shows pressure readings of 60 cm and 90 cm of mercury at $0^\circ C$ and $100^\circ C$ respectively. What is the temperature on gas scale, when pressure reading is 70 cm of mercury?

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2. The freezing point of water on a thermometer is marked as 20unit and the boiling point as 120 unit.

Find the value of temperature $80^{\circ} C$ on this thermometer.

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3. When a strip made or iron (α_1) and copper $(\alpha_2), (\alpha_2 > \alpha_1)$ is heated

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4. the volume coefficient of expansion of a liquid is 7 times the volume coefficient of exapansion of the vessel. The ratio of absolute and apparent expansion of the liquid is

A. $\frac{1}{7}$

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

C. $\frac{6}{7}$

D. $\frac{1}{6}$

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5. The coefficient of volume expansion of a liquid is $4.9 \times 10^{-4} K^{-1}$. Calculate the fractional change in its density when the temperature is raised by $30^\circ C$.

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6. Coefficient of areal expansion of a solid is $2 \times 10^{-5} . ^{\circ} C^{-1}$. Calculate its coefficient of linear expansion.

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7. Write the dimensional formul of Thermal stress.

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8. A metal sheet with a circular hole is heated. The hole

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9. A copper block of mass 0.06 kg is heated till its temperature is inreased by $20^\circ C$. Find the heat supplied to the block. [specific heat of copper $= 9 \times 10^{-2} cal g^{-1} .^\circ C^{-1}$]

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10. The mechanical equivalent of heat

(1) has the same dimensional formula as heat

(2) has the same dimensional formula as worked

(3) has the same dimensional formula as energy

(4) is dimensionless

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11. Find the thermal resistance of an aluminium rod of length $20cm$ and area of cross section $1cm^2$. The heat current is along the length of the rod. Thermal conductivity of aluminium $= 200Wm^{-1}K^{-1}$.

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12. If a solid cylinder of area of cross-section A is moving with velocity V in medium of density p then power loss of cylinder is

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13. A body cools down from $45^\circ C$ to $40^\circ C$ in 5 minutes and to 35° in another 8 minutes. Find the temperature of the surrounding.

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14. Does a body at $20^\circ C$ radiate in a room, where the room temperature is $35^\circ C$? If yes, why does not its temperature fall further?

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Exercise

1. A constant volume gas thermometer shows pressure reading of 50 cm and 90 cm of mercury at $0^\circ C$ and $100^\circ C$ respectively. When the pressure reading is 60 cm of mercury, the temperature is:

A. $25^\circ C$

B. $40^\circ C$

C. $15^\circ C$

D. $12.5^\circ C$

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2. On centigrade scale the temperature of a body increases by 30 degrees. The increase in temperature on fahrenheit scale is

A. $50"^\circ C$

B. $40"^\circ C$

C. $30"^\circ C$

D. $54"^\circ C$

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3. A bar of iron is 10 cm at $20^{\circ}C$. At $19^{\circ}C$ it will be

$(\alpha_{Fe} = 11 \times 10^{-6} / .^{\circ} C)$

A. 11×10^{-6} cm longer

B. 11×10^{-6} cm shorter

C. 11×10^{-5} cm shorter

D. 11×10^{-5} cm longer

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4. Coefficient of volume expansion of mercury is

$0.18 \times 10^{-3} / ^{\circ}C$. If the density of mercury at $0^{\circ}C$

is 13.6 g/cc, then its density at $200^{\circ} C$ is

A. 13.11 g/cc

B. 52.11 g/cc

C. 16.11 g/cc

D. 26.11 g/cc

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5. A metre rod of silver at $0^{\circ} C$ is heated to $100^{\circ} C$. It's length is increased by 0.19 cm. coefficient of volume expansion of the silver rod is

A. $5.7 \times 10^{-5} / "^{\circ} C$

B. $0.63 \times 10^{-5} / "^{\circ} C$

C. $1.9 \times 10^{-5} / "^{\circ} C$

D. $16.1 \times x 10^{-5} / "^{\circ} C$

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6. Ratio among linear expansion coefficient (c), area expansion coefficient (B) and volume expansion coefficient (Y) is

A. $1 : 2 : 3$

B. $3:2:1$

C. $4:3:2$

D. All of these

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7. A solid ball of metal has a concentric spherical cavity within it. If the ball is heated, the volume of the cavity will

A. Increase

B. Decrease

C. Remain same

D. All of these

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8. Two rods of different materials, having coefficients of linear expansion a_1 and a_2 and Young's moduli, Y_1 and Y_2, respectively, are fixed between two rigid massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of rods. If $\alpha_1/\alpha_2 = 2/3$, then the thermal stresses developed in the two rods are equal, provided Y_1 / Y_2 is equal to :

A. 2:3

B. 0.04236111111111

C. $3:2$

D. $4:9$

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9. A glass flask of volume $200 cm^3$ is just filled with mercury at $20^\circ C$. The amount of mercury that will overflow when the temperature of the system is raised to $100^\circ C$ is

$(\gamma_{glass} = 1.2 \times 10^{-5} / C^\circ, \gamma_{mercury} = 1.8 \times 10^{-4} / C^\circ)$

A. $2.15 cm^3$ cm

B. $2.69 cm^3$

C. $2 : 52 cm^3$

D. $2.25 cm^3$

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10. Solids expand on heating because

A. Kinetic energy of atom increases

B. Potential energy of atom increases

C. Total energy of atom increases

D. The potential energy curve is asymmetric about the equilibrium distance between neighbouring atoms

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11. 300 grams of water at $25^{\circ} C$ is added to $100 g$ of ice at $0^{\circ} C$. The final temperature of the mixture is________.

A. $-\frac{5}{3}{}^{\circ}C$

B. $-\frac{5}{2}{}^{\circ}C$

C. $-5^{\circ}C$

D. $0^{\circ}C$

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12. Two spheres made of same substance have diameters in the ratio 1:2. their thermal capacities are in the ratio of

A. $1:2$

B. $1:8$

C. $1:4$

D. $2:1$

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13. 80 gm of water at $30^{\circ} C$ is poured on a large block of ice at $0^{\circ} C$. The mass of ice that melts is

A. 30 gm

B. 80 gm

C. 1600 gm

D. 150 gm

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14. Work done in converting one gram of ice at $-10^{\circ}C$ into steam at $100^{\circ}C$ is

A. 3.04 kJ

B. 6.05 kJ

C. 0.721 kJ

D. 0.616 kJ

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15. 2gm of steam condenses when passed through 40 gm of water initially at $25^{\circ}C$. The condensation of steam raises the temperature of water to $54.3^{\circ}C$. What is the latent heat of steam

A. 540 cal/g

B. 536 cal/g

C. 270 cal/g

D. 480 cal/g

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16. The temperature of 100 g of water is to be raised from $24^{\circ}C$ to $90^{\circ}C$ by adding steam to it. Calculate the mass of the steam required for this purpose.

A. 20 g

B. 15 g

C. 12 g

D. 18 g

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17. 10 gm of ice at $-20^{\circ} C$ is kept into a calorimeter containing 10 gm of water at $10^{\circ} C$. The specific heat of water is twice that of ice. When equilibrium is reached, the calorimeter will contain

A. 20 gm of water

B. 20 gm of ice

C. 10gm ice and 10 gm of water

D. 5 gm ice and 15 gm water

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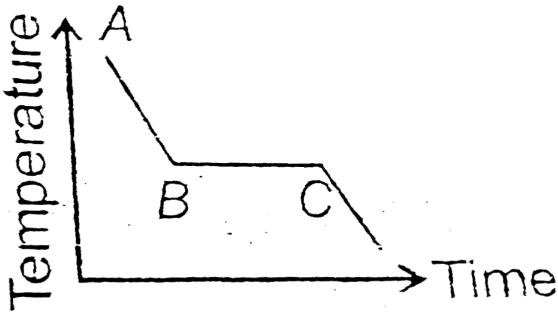
18. The portion of the curve representing the state of matter denotes



A. Change from gaseous state to liquid state

B. The liquid state of matter

C. Gaseous state of matter

D. All of these

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19. Water falls from a height 500 m. what is the rise in temperature of water at bottom if whole energy remains in the water?

A. $0.96"^\circ C$

B. $1.02"^\circ C$

C. $1.16"^\circ C$

D. $0.23"^\circ C$

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20. Latent heat of ice is 80 cal/gm. A man melts 60 gm of ice by chewing in 1 minute. His power is

A. 4800 W

B. 336 W

C. 1.33 W

D. 0.75 W

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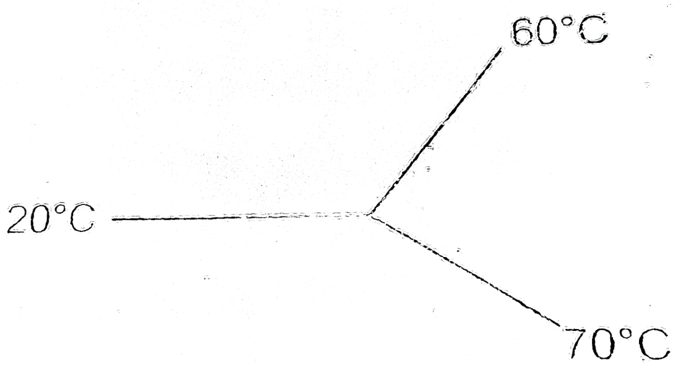
21. Three identical thermal conductors are connected as shown in figure. Consider no heat lost due to radiation, the temperature of the junctions is



A. $60" ^{\circ} C$

B. $20" ^{\circ} C$

C. $50" ^{\circ} C$

D. $10" ^{\circ} C$

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

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

B. $\sqrt{2k}$

C. 3k

D. $\left(\frac{4}{3}\right)k$

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23. The outer faces of a rectangular slab made of equal thickness of iron and brass are maintained at $100^\circ C$ and $0^\circ C$ respectively. The temperature at the interface is (Thermal conductivity of iron and brass are 0.2 and 0.3 respectively)

A. $100^\circ C$

B. $40^\circ C$

C. $50^\circ C$

D. $70^\circ C$

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24. The temperature of water at the surface of a deep lake is $2^{\circ} C$. The temperature expected at the bottom is

A. $2^{\circ} C$

B. $3^{\circ} C$

C. $4^{\circ} C$

D. $1^{\circ} C$

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25. A body of length 1 m having cross-sectional area 0.75 m^2 has heat flow through it at the rate of 6000 J/s. the difference between two ends of conductor if $K = 200 Jm^{-1}K^{-1}$ is

A. $20" ^\circ C$

B. $40" ^\circ C$

C. $80" ^\circ C$

D. $100" ^\circ C$

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26. A slab consists of two parallel layers of two different materials of same thickness having themal conductivities K1 and K2 . 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. $\frac{k_1 + k_2}{2k_1k\_2}$

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27. The layers of atmosphere are heated through

A. Convection

B. Conduction

C. Radiation

D. Both (1) & (3)

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28. The temperarture gradient in a rod of 0.5 m long is $80^{\circ}Cm^{-1}$. If the temperature of hotter end of the

rod is 30° C, then the temperature of the cooler ends is

A. $40^{\circ} C$

B. $10^{\circ} C$

C. $10^{\circ} C$

D. $0^{\circ} C$

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29. The ratio of thermal conductivity of two rods of different material is $5:4$. The two rods of same area of cross - section and same thermal resistance will have the length in the ratio

A. $4:5$

B. $9:1$

C. $1:9$

D. $5:4$

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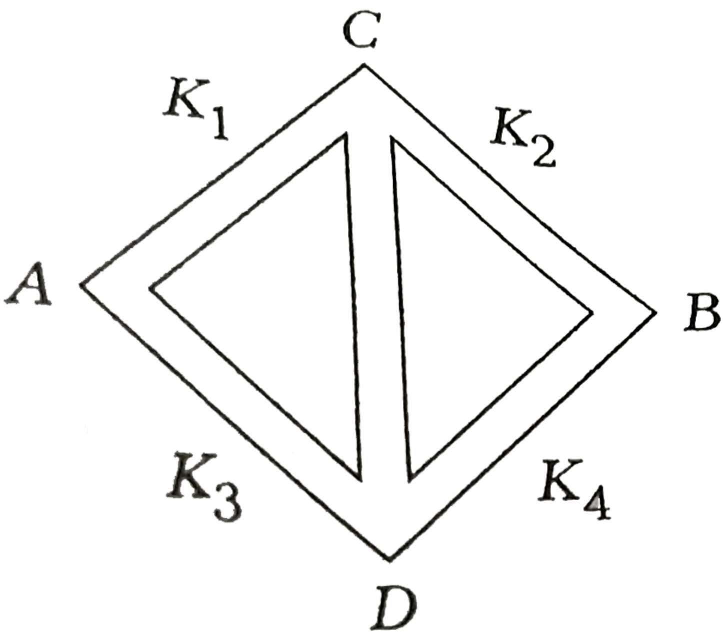
30. Five rods of same dimensions are arranged as shown in figyre. They have thermal conductivities

K_1, K_2, K_3, K_4 and K_5. When points A and B are maintained at different temperatures, no heat flows through the central rod if



A. $k_1 = k_4$ and $k_2 = k_3$

B. $k_1 k_4 = k_2 k_3$

C. $k_1 k_2 = k_3 k_4$

D. $\frac{k_1}{k_4} = \frac{k_2}{k_3}$

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31. In heat transfer, which method is based on gravitation?

A. Natural convection

B. Conduction

C. Radiation

D. All of these

32. In which process, the rate of transfer of heat is maximum ?

A. Conduction

B. Convection

C. Radiation

D. In all these, heat is transferred with the same velocity

33. Good absorbers of heat are

A. Poor emitters

B. Non-emitters

C. Good emitters

D. Highly polished

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34. A body, which emits radiations of all possible wavelengths, is known as

A. Good conductor

B. Partial radiator

C. Absorber of photons

D. Perfectly black body

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35. A hot and a cold bofy are kept in vacuum seperated from eavh other. Which of the followimg causes decrease in temperature of the hot body?

A. Radiation

B. Convection

C. Conduction

D. Temperature remains same

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36. A liquid cools down from $70^\circ C$ to $60^\circ C$ in 5 minutes. The time taken to cool it from $60^\circ C$ to $50^\circ C$ will be

A. 5 minutes

B. Lesser than 5 minutes

C. Greater than 5 minutes

D. Lesser or greater than 5 minutes depending upon the density of the liquid

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37. If a metallic sphere gets cooled from $62^\circ C$ to $50^\circ C$ in minutes 10 and in the next 10 minutes gets cooled to $42^\circ C$, then the temperature of the surroundings is

A. $30" ^\circ C$

B. $36" ^\circ C$

C. $26" ^\circ C$

D. $20" ^\circ C$

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38. Newton's law of cooling is used in laboratory for the determination of the

A. Specific heat of the gases

B. The latent heat of gases

C. Specific heat of liquids

D. Latent heat of liquids

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39. It takes 10 minutes to cool a liquid from $61^\circ C$ to $59^\circ C$. If room temperature is $30^\circ C$ then time taken in cooling from $51^\circ C$ to $49^\circ C$ is

A. 10 min

B. 11 min

C. 13 min

D. 15 min

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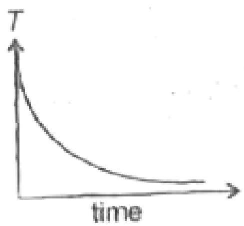
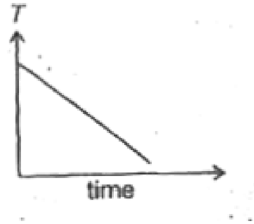
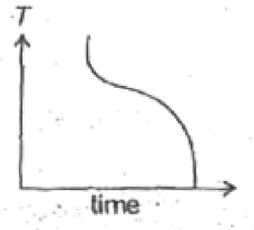
40. A block of metal is heated to a temperature much higher than the room temperature and allowed to cool in a room free from air currents. Which of the following curves correctly represents the cooling? (T : Temperature of block)

A. 

B. 

C. 

D. 

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ASSIGNMENT (SECTION-A)

1. Temperature is a measure of ....

A. Hotness or coldness

B. Heat possessed by a body

C. Potential energy

D. Thermal energy

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2. The pressure of a gas filled in the bulb of a constant volume gas thermometer at temperatures $0^{\circ}C$ and $100^{\circ}C$ are 27.50 cm and 37.50 cm of Hg respectively. At an unknown temperature the pressure is 32.45 cm of Hg. Unknown temperature is -

A. $30^\circ C$

B. $39^\circ C$

C. $48.5^\circ C$

D. $29.6^\circ C$

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3. A graph is plotted by taking pressure along y-axis and centigrade temperature along X-axis for an ideal gas at constant volume. x intercept of the graph is

A. $-273.15^\circ C$

B. $-273.15K$

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

D. $-273K$

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4. A hole is drilled in a copper sheet. The diameter of hole is 4.24 cm at $27.0^{\circ} C$. Diameter of the hole when it is heated to $35^{\circ} C$ is? (α for copper = $1.7 \times 10^{-5} K^{-1}$)

A. Less than 4.24 cm

B. Equal to 4.24 cm

C. More than 4.24 cm

D. Data insufficient

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5. At what temperature the density of water is maximum? State its value.

A. $39.2^{\circ} C$

B. $4^{\circ} F$

C. $0^{\circ} C$

D. 273 K

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6. On heating a uniform metallic cylinder length increases by 3%. The area of cross-section of its base will increase by

A. 1.5%

B. 0.03

C. 0.09

D. 0.06

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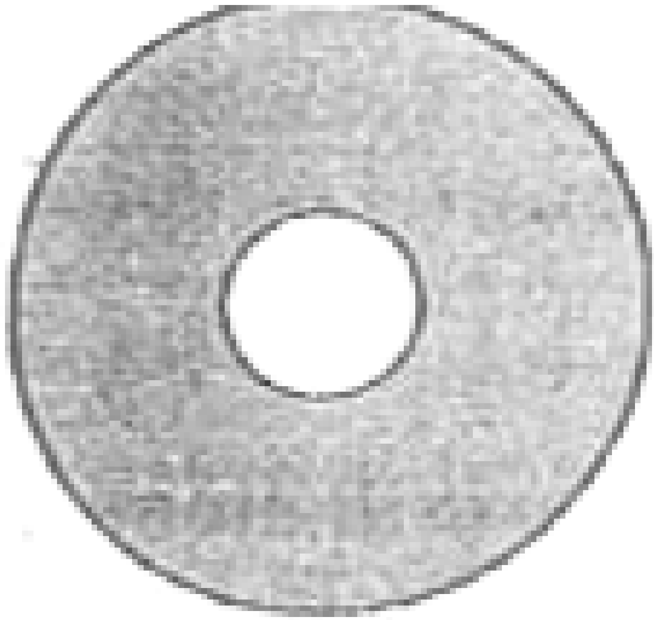
7. A circular metallic disc of radius R has a small circular cavity of radius r as shown in figure. On heating the system



A. R increases and r decreases

B. R decreases and r increases

C. Both R And r increases

D. Both R and r decreases

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8. if in winter season the surface temperature of lake is $1^{\circ}C$, the temperature at the bottom of lake will be

A. $1^{\circ}C$

B. $0^{\circ}C$

C. $4^{\circ} C$

D. All values less than $1^{\circ} C$ are possible

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9. A uniform copper rod of length 50 cm and diameter 3.0 mm is kept on a frictionless horizontal surface at $20^{\circ} C$. The coefficient of linear expansion of copper is $2.0 \times 10^{-5} K^{-1}$ and Young's modulus is $1.2 \times 10^{11} N/m^2$. The copper rod is heated to $100^{\circ} C$, then the tension developed in the copper rod is

A. $12 \times 10^3 N$

B. $36X10^3 N$

C. $18 \times 10^3 N$

D. Zero

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10. A seconds pendulum clock has a steel wire. The clock shows correct time at $25^\circ C$. How much time does the clock lose or gain, in one week, when the temperature is increased to $35^\circ C$?

$(\alpha_{steel} = 1.2 \times 10^{-5} / ^\circ C)$

A. A. 321.5 s

B. B. 3.828 s

C. C. 82.35 s

D. D. 36.28 s

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11. The apparent coefficient of expansion of a liquid when heated in a brass vessel is X and when heated in a tin vessel is Y. If α is the coefficient of linear expansion for brass, the coefficient of linear expansion of tin is

A. $\dfrac{X + Y + 3\alpha}{3}$

B. $\dfrac{X + 3\alpha - Y}{3}$

C. $\dfrac{X + Y - 2\alpha}{3}$

D. $\dfrac{(X + Y - 2\alpha)}{3}$

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12. The coefficient of volume expansion of glycerin is $49 \times 10^{-5} K^{-1}$. What is the fractional change in its density for a $30^{\circ} C$ rise in temperature ?

A. 1.47×10^{-2}

B. 1.47×10^{-3}

C. 1.47×10^{-1}

D. 1.47×10^{-4}

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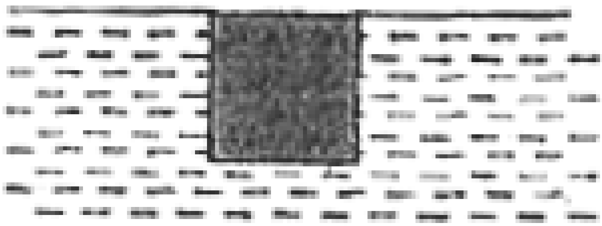
13. A solid cube is first floating in a liquid. The coefficient of linear expansion of cube is α and the coefficient of volume expansion of liquid is γ. On increasing the temperature of (liquid + cube) system, the cube will sink if



A. A. $\gamma = 3\alpha$

B. B. $\gamma > 3\alpha$

C. C. $\gamma < 3\alpha$

D. D. $\gamma = 2\alpha$

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14. A steel tape is callibrated at $20^{\circ}C$. On a cold day when the temperature is $-15^{\circ}C$, what will be the percentage error in the tape ?

A. -0.035%

B. 0.042%

C. 0.012%

D. -0.018%

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15. In engines water is used as coolant, because

A. A. It good conductor of heat energy

B. B. It has low density

C. C. It has high specific heat

D. D. It's bad conductor of heat energy

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16. Which of the following material is used to make calorimeter?

A. A. Glass

B. B. Ebonite

C. C. Metal

D. D. Superconductor

Answer: C

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17. The thermal capacity of 100 g of aluminum (specific heat $=0.2cal/g^{\circ}C$) is

A. $0.002cal/^{\circ}C$

B. $20cal/^{\circ}C$

C. $200cal/^{\circ}C$

D. $100 cal / ^{\circ} C$

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18. Select correct statement related to heat

A. Heat is possessed by a body

B. Hot water contains more heat as compared to cold water

C. Heat is a energy which flows due to temperature difference

D. All of these

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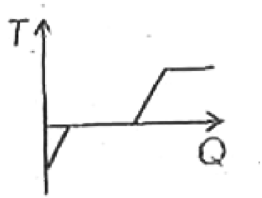
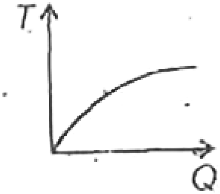
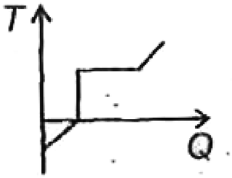
19. A block of ice at $-12^{\circ}C$ is slowly heated and converted into steam at $100^{\circ}C$. Which of the following curves best represents the event ?

A. 

B. 

C. 

D. 

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20. The water equivalent of 20 g of aluminium (specific heat $0.2 \text{ cal} / g - {}^{\circ}C$), is :-

A. 40 g

B. 4 g

C. 8 g

D. 160 g

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21. 100 g of ice (latent heat 80 cal/g, at $0^{\circ} C$) is mixed with 100 g of water (specific heat $1 \ \text{cal} / g - {}^{\circ} C$) at $80^{\circ} C$. The final temperature of the mixture will be :-

A. $0^{\circ} C$

B. $40^{\circ} C$

C. $80^{\circ} C$

D. $< 0^\circ C$

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22. 200 g of ice at $-20^\circ C$ is mixed with 500 g of water $20^\circ C$ in an insulating vessel. Final mass of water in vessel is (specific heat of ice $-0.5 cal g^{-1} \, ^\circ C^{-1}$)

A. 700 g

B. 600 g

C. 400 g

D. 200 g

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23. Which of the following material is most suitable cooking utensil?

A. Low conductivity and low specific heat

B. High conductivity and low specific heat

C. Low conductivity and high specific heat

D. High conductivity and high specific heat

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24. The thermal conductivity of a rod depends on

A. Area of cross-section

B. Length of rod

C. Material of rod

D. All of these

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25. The dimensional forumla for thermal resistance is

A. $\left[M^{-1}L^{-1}T^{-1}K\right]$

B. $\left[M^{2}T^{-2}K^{-1}\right]$

C. $\left[ML^{-3}T^{2}K^{-1}\right]$

D. $\left[M^{-1}L^{-2}T^{3}K\right]$

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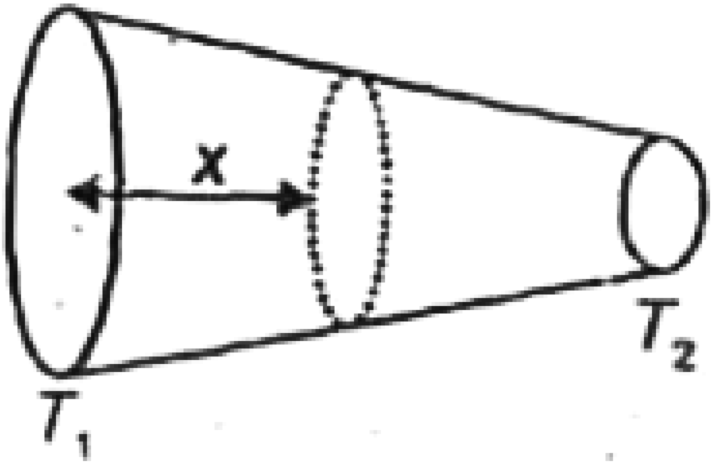
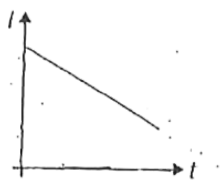
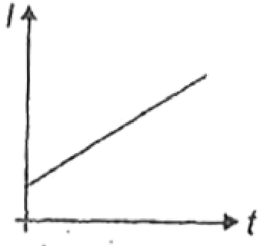
26. Two ends of a rod of non uniform area of cross section are maintained at temperature $T_1$and T_2 $(T_1 > T_2)$ as shown in the figure

If I is heat current through the cross-section of conductor at distance x from its left face, then the variation of l with x is best represented by



A. 

B. 

C. 

D. 

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27. Four rods, of different radii r and length l, are used to connect two reservoirs of heat at different temperatures. The rod that will conduct the heat fastest will be

A. r=1 cm, l=1 m

B. r=2 cm,l=2 m

C. r=1 cm,l=1/2 m

D. r=2 cm,l=1/2 m

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28. Two walls of thickness d_1 and d_2 and thermal conductivites K_1 and K_2 are in contact. In the steady state, if the temperature at the outer surfaces are T_1 and T_2 the temperature at the common wall is

A. $\frac{K_1T_1 + K_2T_2}{d_1 + d_2}$

B. $\dfrac{K_1T_1d_2 + K_2T_2d_1}{K_1d_2 + K_2d_1}$

C. $\dfrac{(K_1d_1 + K_2d_2)T_1T_2}{T_1 + T_2}$

D. $\dfrac{K_1d_1T_1 + K_2d_2T_2}{K_1d_1 + K_2d_2}$

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29. A 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 a material of thermal conductivity K_2 . The two ends of the combined system are maintained at two different temperatures. 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. $\frac{K_1 + 3K_2}{4}$

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

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

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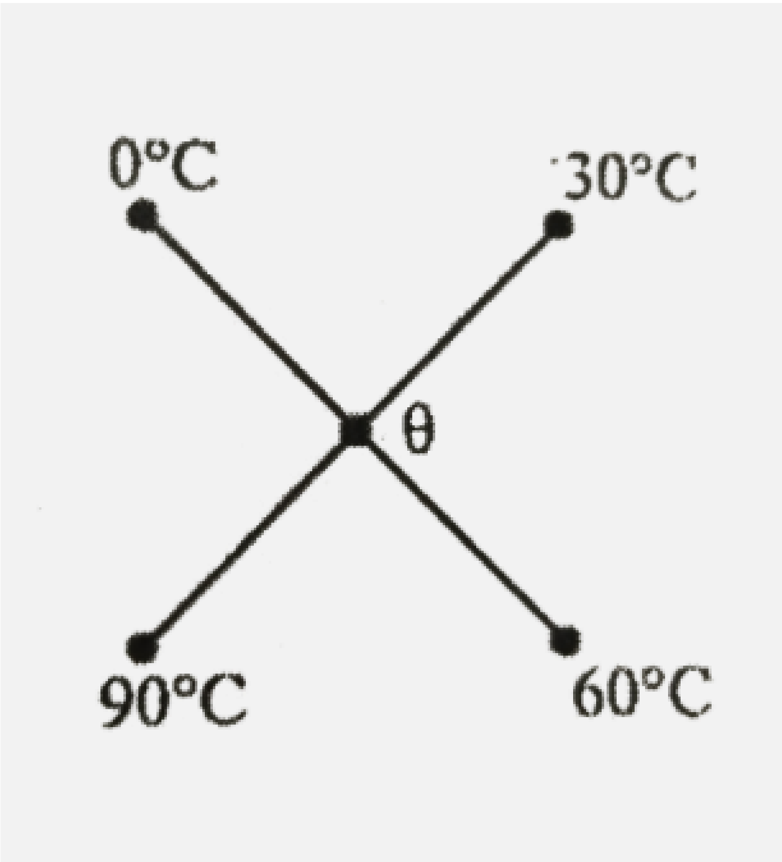
30. Four rods of same material and having the same cross section and length have been joined, as shown. The temperature of the junction of four rods will be :



A. $20^{\circ} C$

B. $30^\circ C$

C. $45^\circ C$

D. $60^\circ C$

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31. Why it is more hotter for same distance over the top of a candle than it in the side of its flame

A. Conduction of heat in air is upward

B. Heat is maximum radiated in upward direction

C. Radiation and conduction both contribute in transferring heat upwards

D. Convection takes more heat in upward direction

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32. In gravity free space heat transfer is not possible by

A. Conduction

B. Convention

C. Radiation

D. Both (1) & (3)

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33. Which factor does not affect convection?

A. Temperature difference

B. The rate of movement of carrying medium

C. The volumetric specific heat of carrying medium

D. The thermal conductivity of carrying medium

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34. A polished plate with rough black spot is heated to a high temperature and then taken to a dark room, then

A. Spot will appear brighter than the plate

B. Spot will appear darker than the plate

C. Both will appear equally brighter

D. Both will not be visible

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35. Select the incorrect statement

A. A body radiates at all temperatures except OK

B. A good reflector is a bad radiator

C. A colder body can radiate heat to the hotter surroundings

D. A body does not radiate when its temperature is below $0^{\circ} C$

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36. "A good absorber is a good emitter" is explained by

A. Stefan's law

B. Wien's law

C. Newton law of cooling

D. Kirchhoff's law

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37. The rate of radiation of energy from a hot object is maximum, if its surface is

A. White and smooth

B. Black and rough

C. Black and smooth

D. White and rough

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38. Two balls of same material and same surface finish have their diameters in the ratio 1:2. They are heated to the same temperature and are left in a room to cool by radiation, then the initial rate of loss of heat

A. Will be same for the balls

B. For larger ball is half that of other ball

C. For larger ball is twice that of other ball

D. For larger ball is four times that of the other ball

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39. A black body, which is at a high temperature TK thermal radiation emitted at the rate of E W/m^2. If the temperature falls to T/4 K, the thermal radiation emitted in W/m^2 will be

A. E

B. E/4

C. E/64

D. E/256

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40. A sphere, a cube and a thin circular plate, all made of the same mass and finish are heated to a temperature of $200^\circ C$. Which of these objects will cool slowest, when left in air at room temperature?

A. The sphere

B. The cube

C. The circular plate

D. All will cool at same rate

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41. If a body cools down from $80^\circ C$to $60^\circ C$ in 10 min when the temperature of the surrounding of the is $30^\circ C$. Then, the temperature of the body after next 10 min will be

A. $30^\circ C$

B. $48^\circ C$

C. 50°

D. $52^\circ C$

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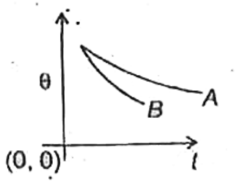
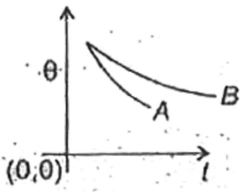
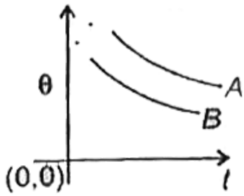
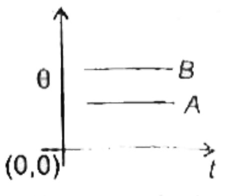
42. Two bodies A and B of same mass, area and surface finish with specific heats S_A and S_B $(S_A > S_B)$ are allowed to cool for given temperature range. Temperature varies with time as

A. 

B. 

C. 

D. 

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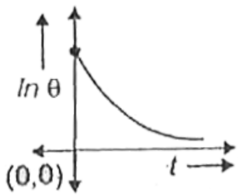
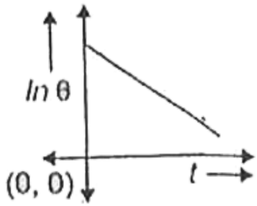
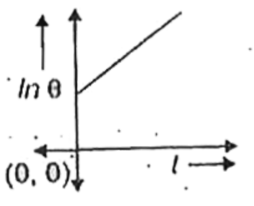
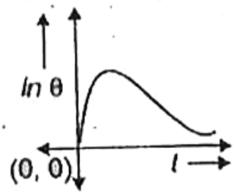
43. Instantaneous temperature difference between cooling body and the surroundings obeying Newton's law of cooling is θ. Which of the following represents the variation of In θ with time t?

A. 

B. 

C. 

D. 

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44. Two metal spheres have radii rand 2r and they emit thermal radiation with maximum intensities at wavelengths λ and 2λ. respectively. The respective ratio of the radiant energy emitted by them per second will be

A. $4:1$

B. $1:4$

C. $16:1$

D. $8:1$

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45. If temperature of sun is decreased by 1 % then the value of solar constant will change by

A. 0.02

B. -0.04

C. -0.02

D. 0.04

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46. The value of solar constant is

A. 2 kcal $m^{-2} \min ute^{-1}$

B. 20 kcal $m^{-2} \min ute^{-1}$

C. $2kWm^{-2}$

D. $200Wm^{-2}$

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ASSIGNMENT (SECTION-B)

1. A uniform thermometre scale is at steady state with its 0 cm mark at $20^{\circ}C$ and 100 cm mark at $100^{\circ}C$. Temperature of the 60 cm mark is-

A. A. $48^{\circ}C$

B. B. $68^{\circ}C$

C. C. $52^{\circ}C$

D. D. $58^{\circ}C$

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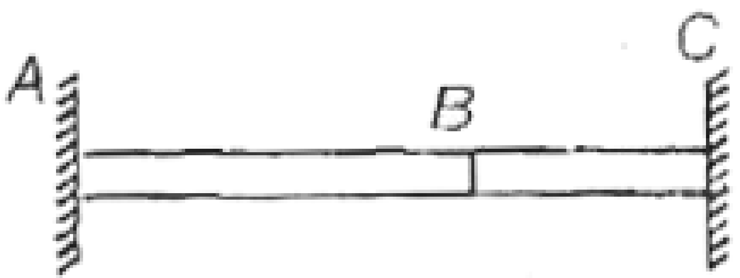
2. Two uniform rods AB and BC have Young's moduli $1.2 \times 10^{11} N/m^2$ and $1.5 \times 10^{11} N/m^2$ respectively. If coefficient of linear expansion of AB is $1.5 \times 10^{-5} /" ^\circ C$ and both have equal area of cross section, then coefficient of linear expansion of BC, for which there is no shift of the junction at all temperatures, is



A. $1.5 \times 10^{-5} / ^\circ C$

B. $1.2 \times 10^{-5} / {}^{\circ}C$

C. $0.6 \times 10^{-5} / {}^{\circ}C$

D. $0.75 \times 10^{-5} / {}^{\circ}C$

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3. Coefficient of linear expansion of a vessel completely filled with Hg is $1 \times 10^{-5} /" {}^{\circ}C$. If there is no overflow of Hg on heating the vessel, then coefficient of cubical expansion of Hg is

A. $4 \times 10^{-5} / {}^{\circ}C$

B. $> 3 \times 10^{-5} / {}^{\circ}C$

C. $\leq 3 \times 10^{-5} / {}^{\circ}C$

D. Data is insufficient

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4. A metallic tape gives correct value at $25^{\circ}C$.A piece of wood is being measured by this metallic tape at $10^{\circ}C$. The reading is 30 cm on the tape, the real length of wooden piece must be

A. $30cm$

B. $> 30cm$

C. $< 30cm$

D. Data is not sufficient

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5. In a thermostat two metal strips are used, which have different

A. Length

B. Area of cross-section

C. Mass

D. Coefficient of linear expansion

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6. The coefficient of linear expansion of a crystalline substance in one direction is $2 \times 10^{-4} /"^\circ C$ and in every direction perpendicular to it is $3 \times 10^{-4} /"^\circ C$. The coefficient of cubical expansion of crystal is equal to

A. $5 \times 10^{-4} /^\circ C$

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

C. $8 \times 10^{-4} / {}^\circ C$

D. $7 \times 10^{-4} / {}^\circ C$

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7. If C_p and C_v denote the specific heats (per unit mass) of an ideal gas of molecular weight M.-

Where R is the molar gas constant

A. $C_P - C_V = RlM^2$

B. $C_P - C_V = R$

C. $C_P - C_V = RlM$

D. $C_P - C_V = MR$

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8. The molar specific heat at constant pressure of an ideal gas is $\left(\frac{7}{2}\right)R$. The ratio of specific heat at constant pressure to that at constant volume is:-

A. $\frac{9}{7}$

B. $\frac{7}{5}$

C. $\frac{8}{7}$

D. $\frac{5}{7}$

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9. A bullet of mass 10 g moving with a speed of $20m/s$ hits an ice block of mass 990 g kept on a frictionless floor and gets stuck in it. How much ice will melt if 50% of the lost kinetic energy goes to ice?

(Temperature of ice block $= 0^\circ C$.)

A. 0.001 g

B. 0.002 g

C. 0.003

D. 0.004 g

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10. 50 g ice at $0^{\circ}C$ is dropped into a calorimeter containing 100 g water at $30^{\circ}C$. If thermal . capacity of calorimeter is zero then amount of ice left in the mixture at equilibrium is

A. A. 12.5 g

B. B. 25 g

C. C. 20 g

D. D. 10 g

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11. Heat is being supplied at a constant rate to the sphere of ice which is melting at the rate of 0.1 gm/s. It melts completely in 100 s. The rate of rise of temperature thereafter will be

A. $0.4^\circ C / s$

B. $2.1^\circ C / s$

C. $3.2^\circ C / s$

D. $0.8^{\circ}C/s$

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12. In a calorimeter of water equivalent 20 g, water of mass 1.1 kg is taken at 288 K temperature. If steam at temperature 373 K is passed through it and temperature of water increases by $6.5^{\circ}C$ then the mass of steam condensed is

A. 17.5 g

B. 11.7 g

C. 15.7 g

D. 18.2 g

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13. Heat energy at constant rate is given to two substances P and Q. If variation of temperature (T) of substances with time (t) is as shown in figure, then select the correct statement

A. A. Specific heat of P is greater than Q

B. B. Specific heat of Q is greater than P

C. C. Both have same specific heat

D. D. Data is insufficient to predict it

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

(σ stands for stefan's constant)

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

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

C. $\frac{Q}{4\pi R^2 \sigma}$

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

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15. Gravitational force is required for:

A. Stirring of liquid

B. Convection

C. Conduction

D. Radiation

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16. Which of the following processes is reversible

A. Transfer of heat by conduction

B. Transfer of heat by radiation

C. Isothermal compression

D. Electrical heating of a nichrome wire

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17. Solar constant (S) depends upon the temperature of the Sun

A. $S \propto T$

B. $S \propto T^2$

C. $S \propto T^3$

D. $S \propto T^4$

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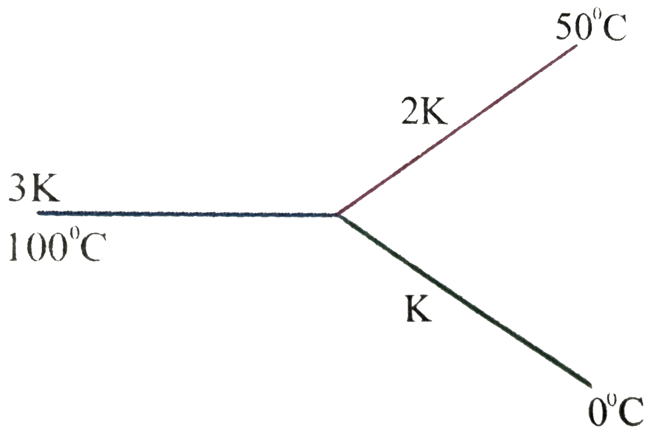
18. Three rods of same dimensions have thermal conductivity $3K, 2K$ and K They are arranged as shown in Then the temperature of the junction in steady state is



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A. $75^\circ C$

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

C. $40^\circ C$

D. $\frac{100}{3}, {}^\circ C$

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19. If wavelength of maximum intensity of radiation emitted by sun and moon are 0.5×10^{-6} m and 10^{-4} m respectively. Calculate the ratio of their temperatures

A. $\frac{1}{10}$

B. $\frac{1}{5}$

C. 100

D. 200

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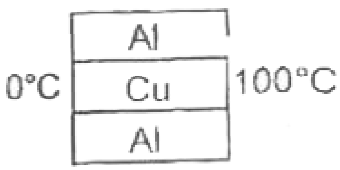
20. The three rods shown in figure have identical dimensions. Heat flows from the hot end at a rate of 40 W in the arrangement (a). Find the rates of heat flow when the rods are joined as in arrangement (b).

(Assume $k_{Al} = 200 \frac{W}{m^\circ C}$ and $K_{Cu} = 400 \frac{W}{m^\circ C}$

(a)



(b)

A. 75 W

B. 200 W

C. 400 W

D. 4 W

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21. Two bodies A and B of equal masses, area and emissivity cooling under Newton's law of cooling from same temperature are represented by the graph: If θ is the instantaneous temperature of the body and θ_0, is the temperature of surroundings, then relationship between their specific heats is

A. $S_A = S_B$

B. $S_A > S_B$

C. $S_A < S_B$

D. None of these

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22. Two spheres of same material and radius r and 2r are heated to same temperature and are kept in identical surroundings, ratio of their rate of loss of heat is

A. $1:2$

B. $1:4$

C. $1:6$

D. $1:8$

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23. Assume that Solar constant is $1.4kW/m^2$, radius of sun is 7×10^5 km and the distance of earth from centre of sun is 1.5×10^8 km. Stefan's constant is $5.67 \times 10^{-8} Wm^2K^{-4}$ find the approximate temperature of sun

A. 5800 K

B. 16000 K

C. 15500 K

D. 8000 K

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24. If a graph is plotted by taking spectral emissive power along y-axis and wavelength along X-axis then the area below the graph above wavelength axis is

A. A. Emissivity

B. B. Total intensity of radiation

C. C. Diffusivity

D. D. Solar constant

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25. A spherical black body with radius 12 cm radiates 450 w power at 500 K. If the radius is halved and the temperature doubled, the power radiated in watts would be

A. 225

B. 450

C. 900

D. 1800

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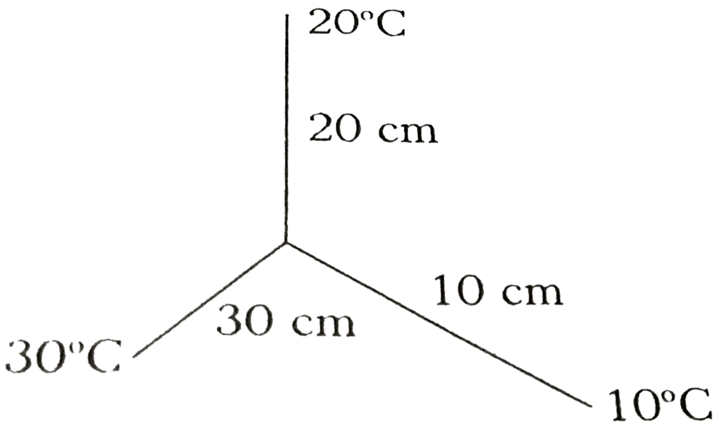
26. Three rods made of the same material and having same cross-section area but different length 10 cm, 20 cm and 30 cm are joined as shown. The temperature of the junction is



A. $19.2^\circ C$

B. $16.4^\circ C$

C. $11.5^\circ C$

D. $22^\circ C$

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27. If transmission power of a surface is $\frac{1}{6}$ and reflective power is $\frac{1}{3}$, then its absorptive power will be

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

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

C. $\frac{1}{6}$

D. $\frac{1}{12}$

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28. A solid cylinder of length L and radius r is heat upto same temperature as that of a cube of edge length a. If both have same material, volume and allowed to cool under similar conditions, then ratio of amount of radiations radiated will be (Neglect radiation emitted from flat surfaces of the cylinder)

A. $\frac{a}{3r}$

B. $\frac{2a}{rL}$

C. $\frac{a^2}{rL}$

D. $\frac{\pi a^2}{2rL}$

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29. A very thin metallic shell of radius r is heated to temperature T and then allowed to cool. The rate of cooling of shell is proportional to

A. rT

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

C. r^2

D. r^0

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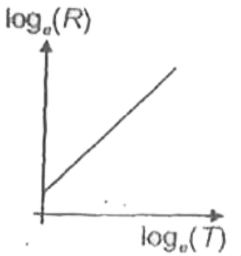
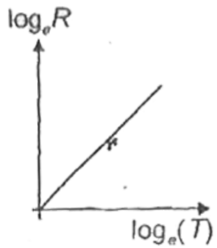
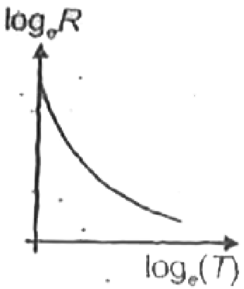
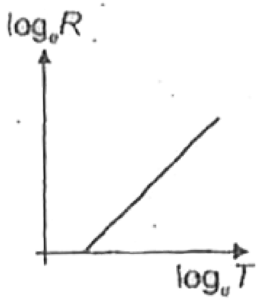
30. If an object at absolute temperature (T) radiates energy at rate R, then select correct graph showing the variation of $\log_e$ R with $\log_e$ (T).

A. 

B. 

C. 

D. 

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31. Two diagonally opposite corners of a square made of a four thin rods of same material, same dimensions are at temperature $40^\circ C$ and $10^\circ C$. If only heat conduction takes place, then the temperature difference between other two corners will be

A. $0^{\circ} C$

B. $10^{\circ} C$

C. $25^{\circ} C$

D. $15^{\circ} C$

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32. Bottom of a lake is at $0^{\circ} C$ and atmospheric temperature is $-20^{\circ} C$. If 1 cm ice is formed on the surface in 24 h, then time taken to form next 1 cm of ice is

A. 24 h

B. 72 h

C. 48 h

D. 96 h

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ASSIGNMENT (SECTION-C)

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

A. 225

B. 450

C. 1000

D. 1800

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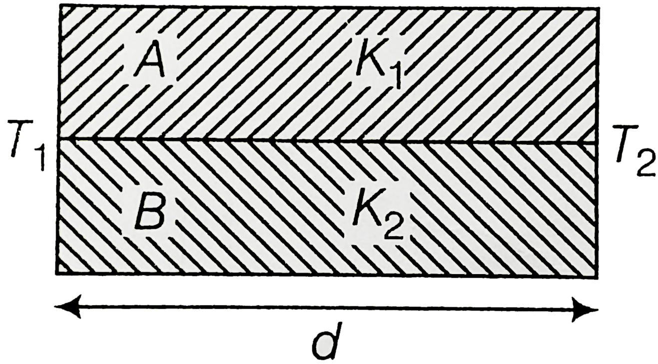
2. Two rods A and B of different materials are welded together as shown in figure Their thermal condutivities are k_1 and k_2.The thermal conductivity of the composite rod will be



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

B. $\frac{3(K_1 + K_2)}{2}$

C. $K_1 + K_2$

D. $2(K_1 + K_2)$

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3. Two identical bodies are made of a material for which the heat capacity increases with temperature. One of these is at $100^\circ C$, while the other one is at 0°. If the two bodies are brought into contact, then assuming no heat loss, the final common temperature is

A. $50^\circ C$

B. More than $50^\circ C$

C. Less than $50^\circ C$ but greater than $0^\circ C$

D. `0^(@)C~

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4. A body cools from a temperature 3T to 2T in 10 minutes. The room temperature is T. Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 10 minutes will be

A. $\frac{7}{4}T$

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

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

D. T

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5. Coefficent of liner espansion of bress and steel rods and α_1 and α_2 Lengths of brass and steel roda are l_1 and l_2 respectively, If $(l_2 - l_1)$ is maintained same at all temperatures, which one of the following relations holds good ?

A. $\alpha_1 l_1 = \alpha_2 l_2$

B. $\alpha_1 l_2 = \alpha_2 l_1$

C. $\alpha_1 l_2^2 = \alpha_2 l_1^2$

D. $\alpha_1^2 l_2 = \alpha_2^2 l_1$

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6. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat heat during its fall. The value of h is (Latent heat of ice is 3.4×10^5 J/kg and g = 10N/kg)

A. 68 km

B. 34 km

C. 544 km

D. 136 km

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7. A black body is at a temperature of 5760K. The energy of radiation emitted by the body at wavelength 250 nm is U_1, at wavelength 500 nm is U_2 and that at 1000 nm is U_3. Wien's constant, b = 2.88 xx 10^(6)` nmK. Which of the following is correct?

A. $U_2 > U_1$

B. $U_1 = 0$

C. $U_3 = 0$

D. $U_1 > U_2$

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8. The value of coefficient of volume expansion of glycerin is $5 \times 10^{-4} K^{-1}$. The fractional change in the density of glycerin for a rise of $40^{\circ} C$ in its temperature is

A. 0.010

B. 0.015

C. 0.020

D. 0.025

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9. The two ends of a metal rod are maintained at temperatures 100°C and 110°C. The rate of heat flow in the rod is found to be 4 Js^{-1}. If the ends are maintained at temperature 200°C and 210°C, the rate of heat flow will be

A. 4.0 J/s

B. 44.0 J/s

C. 16.8 J/s

D. 8.0 J/s

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10. on observing light form three different stars P, Q and R, it was found that intensity of violet colour is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red colour is maximum in the spectrum of Q. If T_p, T_Q and T_R are the respective absolute temperatures of P, Q and R, then it can be concluded from the above observation that

A. $T_P < T_Q < T_R$

B. $T_P > T_Q > T_R$

C. $T_P > T_R > T_Q$

D. $T_P < T_R < T_Q$

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

A. 24 g

B. 31.5 g

C. 42.5 g

D. 22.5 g

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12. Certain quantity of water cools from $70^\circ C$ to $60^\circ C$ in the first 5 min and to $54^\circ C$ in the next 5 min. The temperature of the surrounding is

A. $45^\circ C$

B. $20^\circ C$

C. $42^\circ C$

D. $10^{\circ} C$

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13. A piece of iron is heated in a flame. If first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using

A. When's displacement law

B. Kiechoff's law

C. Newton's law of cooling

D. Stefan's law

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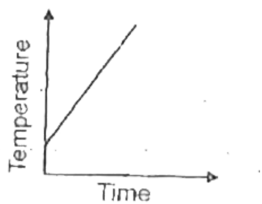
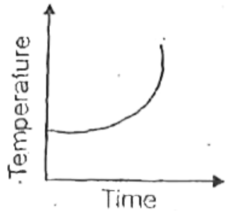
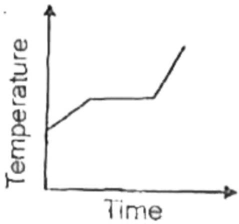
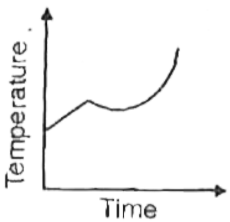
14. Liquid oxygen at 50K is heated at 300K at constant pressure of 1at. The rate of heating is constant. Which one of the following graphs represents the variation of temperature with time?

A. 

B. 

C. 

D. 

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

(σ stands for stefan's constant)

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

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

C. $\frac{Q}{4\pi R^2 \sigma}$

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

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16. A slab of stone of area 0.36 m2 and thickness 0.1m

is exposed on the lower surface to steam at $100^{\circ} C$. A block of ice at $0^{\circ}C$ rests on the upper surface of the slab. In one hour 4.8 kg of ice is melted. The thermal conductivity of slab is-

A. $1.24 J/m/s/^{\circ}C$

B. $1.29 J/m/s/^{\circ}C$

C. $2.05 J/m/s/^{\circ}C$

D. $1.02 J/m/s/^{\circ}C$

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17. When $1kg$ of ice at $0^\circ C$ melts to water at $0^\circ C$, the resulting change in its entropy, taking latent heat of ice to be $80cal/.^\circ C$, is

A. 293 cal/k

B. 273 cal/k

C. $8 \times 10^4 cal/k$

D. 80 cal/k

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18. A cylendrical metallic rod in thermal contact with two ends reservoirs of heat at its two ends conducts an amount of heat Q in time t. The metallic rod is melted and the material is formed into a rod of half the radius of the original rod. What is the amount of heat conducted by the new rod when placed in thermal contact with the two reservoirs in time t?

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

B. $\frac{Q}{16}$

C. 2Q

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

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

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

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

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

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

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20. The two ends of a rod of length L and a uniform cross -secontional area A are kept at two temperatures T_1 and $T_2 (T_1 > T_2)$. The rate of heat tranfer, $\frac{dQ}{dt}$, through the 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. $\frac{dQ}{dt} = \frac{kL(T_1 - T_2)}{A}$

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21. A black body at $227^{\circ}C$ radiates heat at the rate of 7 cal $cm^{-2}s^{-1}$. 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

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22. On a new scale of tmperature (which is linear) and called the W scale, the freezing and voilling points of water are $39^{\circ} W$ and $239^{\circ} W$, respectively, What will be the temperature on the new scale, corresponding to a temperature of $39^{\circ} C$ on the Celsius scale ?

A. $139^{\circ} W$

B. $78^{\circ} W$

C. $117^{\circ} W$

D. $200^{\circ} W$

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23. Assuming the sun to have a spherical outer surface of radius r, radiating like a black body at temperature $t^\circ C$, the power received by a unit surface, (normal to the incident rays) at distance R from the centre of the Sun is:-

Where σ is the Stefan's Constant.

A. $\dfrac{r^2\sigma(t+273)^4}{R^2}$

B. $\dfrac{4\pi r^2\sigma t^4}{R^2}$

C. $\dfrac{r^2\sigma(t+273)^4}{4\pi R^2}$

D. $\dfrac{16\pi r^2\sigma t^4}{R^2}$

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24. A black body is at 727° C. It emits energy at a rate which is proportional to:

A. $(727)^4$

B. $(727)^2$

C. $(1000)^4$

D. $(1000)^2$

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

A. 4000 A

B. 5000 A

C. 6000 A

D. 3000 A

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

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

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

C. $r = r_0, l = l_0$

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

Watch Video Solution

27. Coefficent of liner espansion of bress and steel rods and α_1 and α_2 Lengths of brass and steel roda are l_1 and l_2 respectively, If $(l_2 - l_1)$ is maintained same at all temperatures, which one of the following relations holds good ?

A. $\alpha_1^2 l_1 = {\alpha_2}^2 l_2$

B. $\alpha_1 l_2 = \alpha_2 l_1$

C. $\alpha_1 l_1 = \alpha_2 l_2$

D. $\alpha_1 l_2^2 = \alpha_2 {l_1}^2$

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

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

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

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

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

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29. if 1 g of system is mixed with 1 g of ice, then the resultant temperature of the mixture is

A. $100^\circ C$

B. $230^\circ C$

C. $270^\circ C$

D. $50^\circ C$

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30. Heat is flowing through two cylindrical rods of the same material. The diamters of the rods are in the ratio $1:2$ and the length in the ratio $2:1$. If the temperature difference between the ends is same then ratio of the rate of flow of heat through them will be

A. $2:1$

B. $8:1$

C. $1:1$

D. $1:8$

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31. A cylindrical rod having temperature T_1 and T_2 at its end. The rate of flow of heat Q_1 cal/sec. If all the linear dimension are doubled keeping temperature remain const. then rate of flow of heat Q_2 will be : -

A. $4Q_1$

B. $2Q_1$

C. $\frac{Q_1}{4}$

D. $\frac{Q_1}{2}$

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32. Two metal rods 1 and 2 of same lengths have same temperature difference between their ends. Their thermal conductivities are K_1 and K_2 and cross sectional areas A_1 and A_2 respectively. If the rate of heat conduction in 1 is four times that in 2, then

A. $K_1A_1 = K_2A_2$

B. $K_1A_1 = 4K_2A_2$

C. $K_1A_1 = 2K_2A_2$

D. $4K_1A_1 = K_2A_2$

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33. Consider two rods of same length and different specific heats (S_1, S_2), conductivities (K_1, K_2) and area of cross-sections (A_1, A_2) and both having temperature T_1 and T_2 at their ends. If rate of loss of heat due to conduction is equal, then :-

A. $K_1A_1 = K_2A_2$

B. $\frac{K_1A_1}{S_1} = \frac{K_2A_2}{S_2}$

C. $K_2A_1 = K_1A_2$

D. $\frac{K_2A_1}{S_2} = \frac{K_1A_2}{S_1}$

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34. Unit of Stefan's constant is : -

A. $wa < -m^2 - k^4$

B. $wa < -m^2 / k^4$

C. $wa < /m^2 - k^4$

D. $wa < /m^2 k^4$

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

A. 2/3 k

B. $\sqrt{2}k$

C. 3 k

D. 4/3 k

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36. Gravitational force is required for:

A. Stirring of liquid

B. Convection

C. Conduction

D. Radiation

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37. A black body is at temperature of $500K$. It emits energy at rate which is proportional to

A. $(500)^3$

B. $(500)^4$

C. 500

D. $(500)^2$

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38. Which of the following is close to an ideal black body ?

A. Black lamp

B. Cavity maintained at constant temperature

C. Platinum black

D. A lump of charcoal heated to high temperature

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39. For a black body at temperature $727^\circ C$. If the temperature of the black body is changed to $1227^\circ C$, then its radiating power will be

A. 304 W

B. $\frac{320}{3}W$

C. 240 W

D. 120 W

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40. A beaker full of hot water is kept in a room. If 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 $65^\circ C$ to 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. $t_1 < t_2 = t_3$

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41. Wien's displacment law expresses relation between

A. Wavelength corresponding to maximum intensity and temperature

B. Radiation energy and wavelength

C. Temperature and wavelength

D. Colour of light and temperature

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42. We consider the radiation emitted by the human body. Which of the following statements is true

A. The radiation emitted is in the infra-red region

B. The radiation is emitted only during the day

C. The radiation is emitted during the summers and absorbed during the winters

D. The radiation emitted lies in the ultraviolet region and hence is not visible

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43. If λ_m denotes the wavelength at which the radiative emission from a black body at a temperature T K is maximum, then

A. $\lambda_m \propto T^4$

B. λ_m is independent of T

C. $\lambda_m \propto T$

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

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

-

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

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

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

D. $\frac{61}{16}\lambda_m$

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45. 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. $320kcal/m^2 \text{ min}$

B. $40kcal/m^2 \text{ min}$

C. $160kcal/m^2 \text{ min}$

D. $80kcal/m^2 \text{ min}$

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ASSIGNMENT (SECTION-D)

1. A: Density of water is maximum at $4^{\circ} C$.

R : Water has both positive and negative temperature coefficients of volumetric expansions depending on the temperature range.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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2. Assertion : A solid and hollow sphere of same diameter and same material when heated through the same temperature will expand by the same amount.

Reason : The change in volume us independent of the original mass but depends on original volume.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)
C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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3. Statement-1: Fahrenheit is the smallest unit measuring temperature

Statement-2: Fahrenheit was the first temperature scale used for measuring temperature

A. If both Assertion & Reason are true and the reason is the correct explanation of the

assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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4. A: Material used for making cooking utensils is the one having high specific heat and high conductivity.

R: Low conductivity means high specific heat.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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5. A: The value of the absorbitivity and the emissivity has the same value for a single body at a particular temperature.

R: Value of absorbivity is 1 for a black body.

A. If both Assertion & Reason are true and the reason is the correct explanation of the

assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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6. A: The reflectance of a black body is zero.

R: Black body absorbs all radiations incident on it.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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7. A: Evaporation of water is fast on the surface of moon as compared to earth.

R: On the surface of moon temperature is much greater than the surface of earth.

A. If both Assertion & Reason are true and the reason is the correct explanation of the

assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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8. A: The internal energy of a solid substance increases during melting.

R: Latent heat is required to melt a solid substance.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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9. A: Transmission cables are not tightly fixed on the poles.

R: During winters the length of cables decreases due to decrease in temperature, which can damage poles

A. If both Assertion & Reason are true and the reason is the correct explanation of the

assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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10. A: The thermal conductivity of a body depends on its material and dimensions.

R: Thermal conductivity is proportional to length and inversely proportional to area cross-section of body.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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11. A: Eskimos make double wall houses of ice blocks.

R: The air trapped between double walls prevents the conduction of heat energy from inside the house to outside it.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

12. The melting of ice in water decreases with increase in pressure.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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13. A: Natural convection is not possible in an orbiting satellite.

R: Natural convection is not possible in gravity free space.

A. If both Assertion & Reason are true and the reason is the correct explanation of the

assertion, then mark (1)

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2)

C. If Assertion is true statement but Reason is false, then mark (3).

D. If both Assertion and Reason are false statements, then mark (4).

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