PHYSICS

BOOKS - RESNICK AND HALLIDAY PHYSICS (HINGLISH)

HEAT-MEASUREMENT AND TRANSFER

Solved Problem 19 01

1. How much heat must be absorbed by ice of mass m= 720g at $-10^{\circ}C$ to take it to the liquid state at $15^{\circ}C$?

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Solved Problem 19 02

1. What fraction of water supercooled down to the temperature $t = -20^\circ C$ under standard pressure turns into ice when the system passes into the equilibrium state ? At what temperature of the supercooled water does it turn into ice completely ?

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2. A copper slug whose mass m_c is 75 g is heated in a laboratory oven to a temperature T of $312^\circ C$. The slug is then dropped into a glass beaker containing a mass $m_w = 220g$ of water. The heat capacity C_b of the beaker is 45 cal /K. The initial temperature T_i of the water and the beaker is $12^\circ C$. Assuming that the slug, beaker, and water are an isolated system and the water does not vaporize, find the final temperature T_f of the system at thermal equilibrium.

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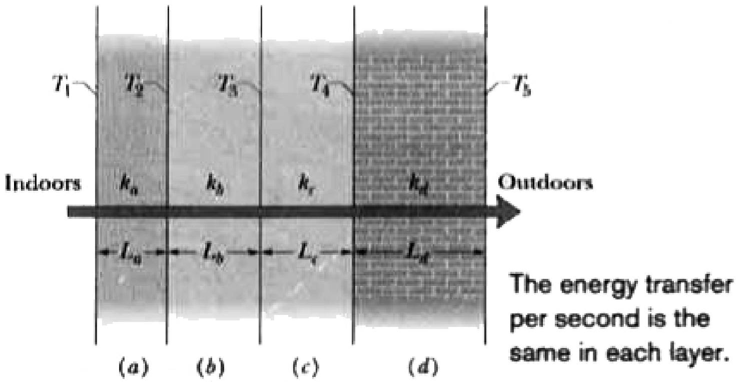
Solved Problem 19 03

1. Figure shows the cross section of a wall made of white pine of thickness L_a and brick of thickness $L_d = \; = 2.0 L_a$, sandwiching two layers of unknonw material with identical thicknesses and thermal conductivities. The thermal conductivity of the pine is k_a and that of the brick is $k_d (= 5.0 k_a)$. The face area A of the wall is unknown. Thermal conduction through the wall has reached the steady state, the only known interface temperatures are $T_1 = 25^\circ C, T_2 = 20^\circ C$, and $T_5 = -10^\circ C$. What is interface temperature T_4 ?



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Solved Problem 19 04

1. A copper cube with sides o flength 20 mm had its surface blackened. The cube is heated up to 500K and placed inside a room at a constant temperature of 300K. Calculate the initial rate of temperature fall of the cube, assuming it as a perfect black-body. (Stefan's constant $= 5.7 \times 10^{-8} W / m(2) / K^4$ specific heat capacity of aluminium $= 400 J / kg / K$, density of aluminium $= 7800 kg / m^3$) where A is the surface area of the cube, T_1 is the temperature of the body, and T_2 is the temperature of the enclosure.

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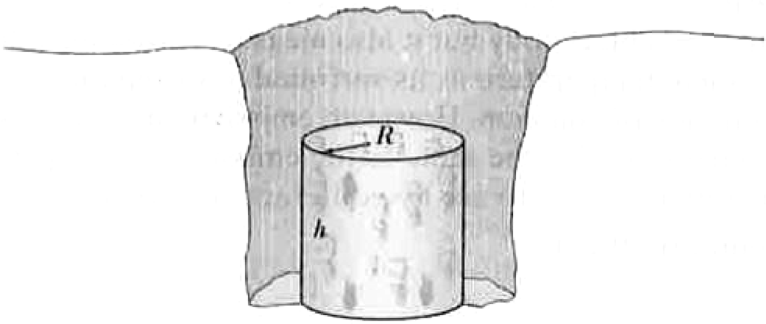
Solved Problem 19 05

1. Unlike most other plants, a special type of cabbage called skunk cabbage can regulate its internal temperature (set at T = $22^\circ C$)by altering the rate at which it produces energy. If it becomes covered with snow, it can increase that its thermal radiation metls the snow in order to re-expose the plant to sunlight. Let's model a skunk cabbage with a cylinder of height h = 5.0 cm and radius R = 1.5 cm and assume it is surrounded by a snow wall at temperature $T_{\text{env}} = -3.0^{\circ}C$ (Figure) . If the emissivity ε is 0.80, what is the net rate of energy exchange via thermal radiation between the plant's curved side and the snow ?



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Solved Problem 19 06

1. A space station is covered by an envelope which is a blackened shell. The temperature of the envelope is T = 500 K that is constant due to the operation of applicances of the station. Determine the temperature of the shell if the station is enveloped by a thin spherical black screen of nearly the same radius as the radius of the shell. Assume that there are no radiations on this space station.

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Solved Problem 19 07

1. What is the approximate radius of the central bright differaction spot of light of wavelength $\lambda = 0.5 \mu m$, if focal length of the lens is 20 cm and radius of aperture of the lens is 5 cm ?

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Solved Problem 19 08

1. An object at temperature $70^\circ C$ is placed in a surrounding medium of temperature $30^\circ C$. Its temperature decreases by $10^\circ C$ in first 5 min. Find the time interval from starting in which its temperature reduces to

$40^\circ C$. Assume Newton's law to be valid.

$t = 0 \quad T = 70^\circ C \quad T_{\text{env}} = 30^\circ C$

$t = 5 \quad T = 60^\circ C \quad T_{\text{env}} = 30^\circ C$

time = t T = 40° $\quad T_{\text{env}} = 30^\circ C$

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Checkpoint 1

1. A certain amount of heat Q will warm 1 g of material A by $3^\circ C$ and 1 g of material B by $4^\circ C$. Which material has the greater specific heat ?

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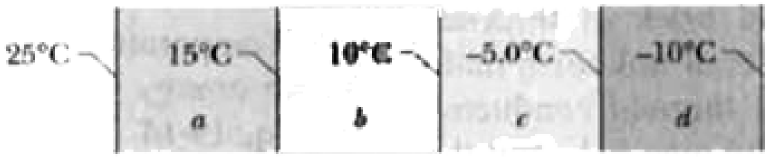
Checkpoint 2

1. The figure shows the face and interface temperatures of a composite slab consisting of four materials, of identical thickness, through which the heat transfer is steady. Rank the materials according to their thermal conductivities, greatest first.



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Problems

1. An 8.00 g ice cube at its melting point is added to $130 cm^3$ of tea (water) initially at $90.0^\circ C$ in a well-insulated container. When equilibriu is reached, what has been the decrease in the tea's temperature ?

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2. A certain substance has a mass per mole of 50.0 $g/$ mol. When 325 J is added as heat to a 30.0 g sample, the sample's temperature rises from

25.0° to 45.0° C. What are the (a) specific heat and (b) molar specific heat of this substance ? (c) How many moles are in the sample ?

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3. One way to keep the contents of a garage from becoming too cold on a night when a severe subfreezing temperature is forecast is to put a tub of water subfreezing temperature is forecast is to put a tub of water in the garage. If the mass of the water is 135 kg and its initial temperature is $20^\circ C$, (a) how much energy must the water transfer to its surrounding in order to freeze competely and (b) what is the lowest possible temperature of the water and its surrounding until that happens?

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4. Nonmetric version : (a) How long does a 2.0×10^5 Btu / h water heater take to raise the temperature of 65 gal of water from 70°F to $100^\circ F$? Metric version : (b) How long does a 59 kW water heater take to raise the temperature of 246L of water from 21° to 38°C ?

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5. A small electric immersion heater is used to heat 170g of water for a cup of instant coffee. The heater is labeled "180 watts" (it converts electrical enery to thermal energy at this rate). Calculate the time required to bring all this water from $23.0^{\circ} C$ to $100^{\circ} C$, ignoring any heat losses.

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6. A 3.0 cm slabe has formed on an outdoor tank of water . The air is at $-14^{\circ} C$. Find the rate of ice formation (centimeters per hour). The ice has thermal conductivity 0.0040 cal $/ s. cm. ^{\circ} C$ and density $0.92 g / cm^{3}$

.Assume there is no energy transfer through the walls or bottom.

Figure 19-15 Problem 7

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7. The specific heat of a substance varies with temperature according to the function c = 0.20 $+$ 0.14 T$+ 0.023T^{\circ}$, with T in $^{\circ}C$ and c in $Cal / g. K$, Find the energy required to raise the temperature of 1.0g of this substance from $5.0^{\circ}C$ to $15^{\circ}C$.

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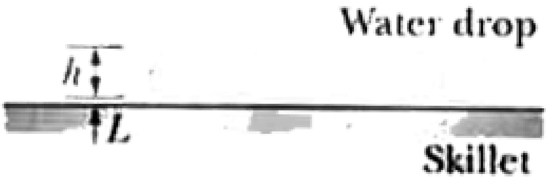
8. Leidenfrost effect. A water drop will last about 1 s on a hot skillet with a temperature between $100^{\circ}C$ and about $200^{\circ 0}$. However, if the skillet is much hotter, the drop can last several minutes, an effect named after an early investigator. The longer lifetime is due to the support of a thin layer of air and water vapor that separates the drop from the metal (by distance L in Figure) . Let L = 0.0800 mm, and assume that the drop is flate with height h = 1.50 mm and bottom face area $A = 5.00 \times 10^{-6} m^2$. Also assume that the skilled has a constant temperature $T_s = 300^{\circ}C$ and the drop has a temperature of $100^{\circ}C$.Water has density $\rho = 1000 kg / m^3$, and the supporting layer has thermal conductivity $k = 0.026 W / m. K$. (a) At what rate is energy conducted from the skillet to the drop through the drop's bottom surface? (b) If conduction is the primary way energy moves from the skilled to the drop, how long will the drop last ?



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9. Ethyl alcohol has a boiling point of $78.0^{\circ}C$, a freezing point of $-114^{\circ}C$, a heat of vaporization of 879 kJ $/kg$, a heat of fusion of 109kJ $/$ kg , and a specific heat of 2.43 kJ $/kg.K$. How much energy must be removed from 0.720kg of ethyl alcohol that is initially a gas at $78.0^{\circ}C$ so that it becomes a solid at $-114^{\circ}C$?

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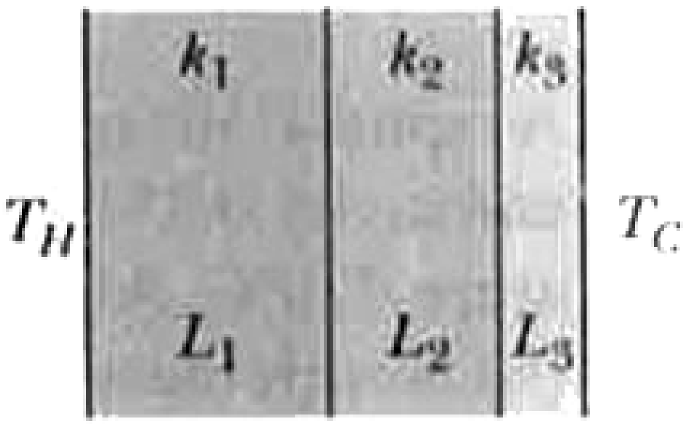
10. Figure shows the cross section of a wall made of three layers. The layer thicknesses are L_1, $L_2 = 0.750L_1$, and $L_3 = 0.350L_1$. The thermal conductivities are k_1, $k_2 = 0.900k_1$, and $k_3 = 0.800k_1$. The temperature at the left side and right side of the wall are $T_H = 30.0^\circ C$ and $T_C = -15.0^\circ C$, respectively. Thermal conduction is steady . (a) What is the temperature difference ΔT_2 across layer 2 (between the left and right sides of the layer) ? If k_2 were, instead, equal to 1.1k_1, (b) would the reate at which energy is conducted through the wall be greater than, less than, or the same as proviously, and (c) what would be the value of ΔT_2 ?



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11. Consider the slabe shown in Figure. Suppose that L = 15.0 cm , A $= 105cm^2$, and the material is copper. If $T_H = 125^\circ C, T_C = 10.0^\circ C$, and a steady state is reached, find the conduction rate through the slabe.

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12. What mass of steam at $100^\circ C$ must be mixed with 250g of ice at its melting point, in a thermally insulated container, to produce liquid water at $50^\circ C$?

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13. Evaporative cooling of beverages. A cold beverage can be kept cold even on a warm day if it is slipped into a porous ceramic container that has been soaked in water. Assume that energy lost to evaporation matched the net energy gained via the radiation exchange through the top and side surfaces. The container and beverage have temperature $T = 10^\circ C$, the environment has temperature $T_{\text{env}} = 32^\circ C$, and the container is a cylinder with radius $r = 2.2cm$ and height 10cm. Approximate the emissivity as $\varepsilon = 1$, and neglect other energy exchanges .At what rate dm / dt is the container losing water mass ?

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14. A solid cylinder of radius $r_1 = 2.5cm$, length $h_1 = 5.5$ cm, emissivity 0.85, and temperature $30^\circ C$ is suspended in an environment of temperature $50^\circ C$. (a) What is the cylinder's net thermal radiation transfer rate P_1 ? (b) If the cylinder is stretched until its radius is $r_2 = 0.50cm$, its net thermal radiation transfer rate becomes P_2. What is the ratio P_2 / P_1 ?

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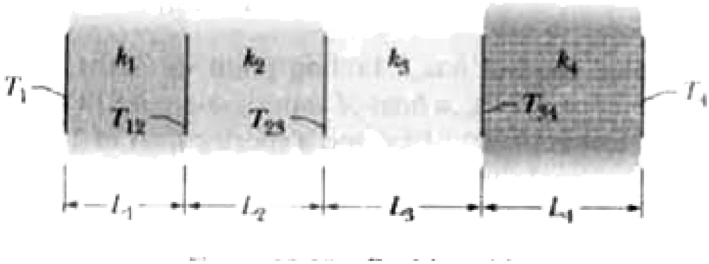
15. Figure shows (in cross section) a wall consisting of four layers, with thermal conductivities $k_1 = 0.060W / m. K, k_3 = 0.040W / m. K,$ and $k_4 = 0.12W / m. K(k_2$ is not known). The layer thickness are $L_1 = 1.2cm, L_3 = 5.6cm,$ and $L_4 = 4.0cm$ $(L_2$ is not known) . The known temperatures are $T_1 = 30^\circ C, T_{12} = 25^\circ C$, and $T_4 = -10^\circ C$.

Energy transfer through the wall is steady. What is interface temperature T_{34} ?



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16. A sphere of radius 0.350m, temperature $27.0^\circ C$, and emissivity 0.850 is located in an environment of temperature $77.0^\circ C$. At what rate does the sphere (a) emit and (b) absorb thermal radiation ? (c) What is the sphere's net change in energy in 3.50 min ?

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17. If you were to walk brieftly in space without a spacesuit while far from the Sun (as an astronaut does in the movie 2001, A Space Odyssey), you would feel the cold of space- while you radiated energy, you would absorb almost non from your environment . (a) At what rate would you lose energy ? (b) How much energy would you lose in 44s ? Assume that your emissivity is 0.90, and estimate other data needed in the calculations.

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18. Ice has formed on a shallow pond, and a steady state has been reached, with the air above the ice at $-5.0^{\circ} C$ and the bottom of the pond at $4.0^{\circ} C$. If the total depth of ice $+$ water is 2.0m, how thick is the ice ? (Assume that the thermal conductivity of ice and water are 0.40 and 0.12 $cal / m. {}^{\circ} C. s$, respectively.)

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19. Penguin huddling.To withstand the harsh weather of the Antartic, emperor penguins huddle in groups (Figure). Assume that a penguins is a circular cylinder with a top surface area a = $0.26m^2$,and height h = 90 cm. Let P_r be the rate at which an individual penduin radiates energy to the environment (through the top and the sides), thus NP_r is the rate at which N identical, well separated penguins radiate. if the penduins radiate. If the penguis huddle closely to form a huddled cylinder with top surface area Na and height h, the cylinder radiates at the rate P_h. If N = 1000, (a) what is the value of the fraction P_h/NP_r and (b) by what percentage does huddling reduces the total radiation loss ?

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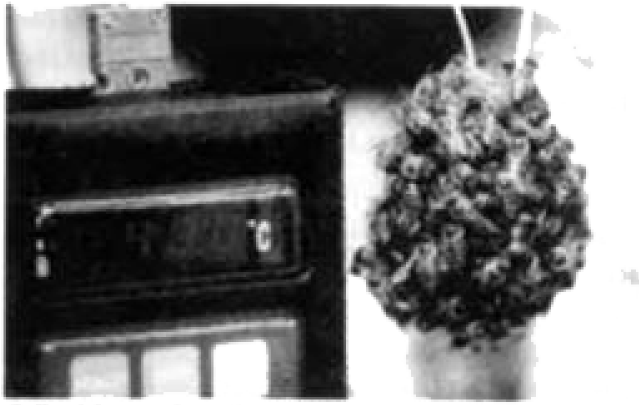
20. The giant hornet Vespa mandarinia japonica preys on Japanes bees.However, if one of the hornets attempts to invade a beehive, several hundred of the bees quickly form a compact ball around the hornet to stop it. They do not sting, bits, crush , or suffocate it. Rather they overheat it by quickly raising their body temperatures from the normal $35^\circ C$ to 47° or $48^\circ C$, which is lethal to the hornet but not to bees (Figure). Assume the following : 500 bees from a ball of radius R = 1.8 cm for a time t = 18 min, the primary loss of energy by the ball is by thermal radiation, the ball's surface has emissivity $\varepsilon = 0.80$, and the ball has a uniform temperature . On average, how much additional energy must each bee produce during the 18 min to maintain $47^\circ C$?



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21. Calculate the minimum amount of energy, in joules, required to completely melt 85.0g of silver initially at $15.0^\circ C$.

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22. What mass of butter, which has a usable energy content of $6.0KCal/g(=6000cal/g)$, would be equivalent to the change in gravitational potential energy of a 78.0 kg man who ascends from sea level to the top of Mt. Everset, at elevation 8.84 km? Assume that the average g for the ascent is $9.80m/s^2$.

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23. (a) Two 40g ice cubes are droped into 200g of water in a thermally insulated container. If the water is initially at $25^\circ C$, and the ice comes directly from a freezer at $-15^\circ C$, what is the final temperature at thermal equilibrium? (b) What is the final temperature if only one ice cube is used ?

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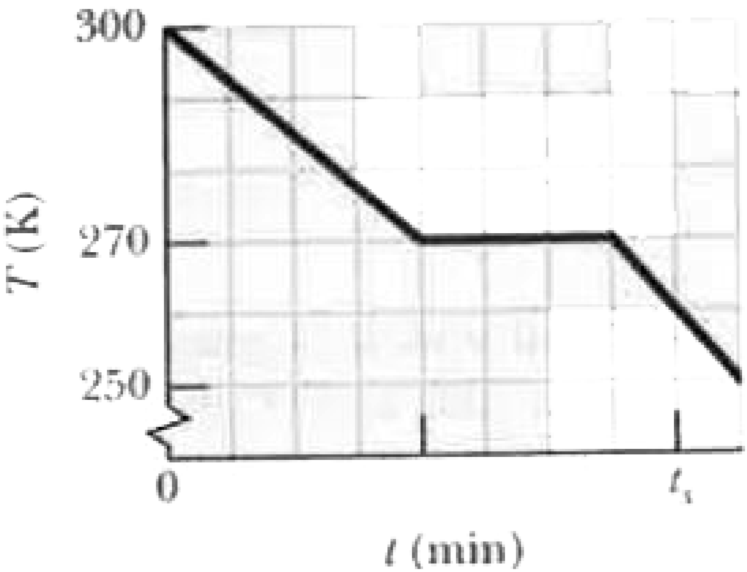
24. A 0.600kg sample is placed in a cooling apparatus that removes energy as heat at a constant rate. Figure gives the temperature T of the sample versus time t, the horizontal scale is set by $t_s = 80.0$ min. The sample freezes during the energy removal. The specific heat of the sample in its initial liquid phase is 3000$J/kg.K$. What are (a) the sample's heat of fusion and (b) its specific heat in the frozen phase ?



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25. A cylindrical copper rod of length 0.60m and cross-sectional area 6.0 cm^2 is insulated along its side. The ends are held at a temperature difference of $100^\circ C$ by having one end in a water -ice mixture and the other in a mixture of boiling water and steam. At what reate (a) is energy conducted by the rod and (b) does the ice melt ?

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26. In a solar water heater, energy from the Sun is gathered by water that circulates through tubes in a rooftop collector. The solar radiation enters the collector through a transparent cover and warms the water in the tubes, this water is pumped into a holding tank. Assume that the efficiency of the overally system is 25% (that is, 80% of the incident solar energy is lost from the system). What collector area is necessary to raise the temperature of 200L of water in the tank from $20^{\circ} C$ to 40° in 1.0 h when the intensity of incident sunlight is 750 W $/ m^2$?

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27. A person makes a quantity of iced tea by mixing 250g of hot tea (essentially wwater) with an equal mass of ice at its melting point.Assume the mixture has negligible energy exchange with its environment. If the tea's initial temperature is $T_i = 90^{\circ} C$, when thermal equilibrium is reached what are (a) the mixture's temperature T_f and (b) the remaining mass m_f of ice ? If $T_i = 70^{\circ} C$, when thermal equilibrium is reached what are (c) T_f and (d) m_f ?

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28. A 150 g copper bowl contains 260 g of water, both at $20.0^{\circ} C$ A very hot 300 g copper cylinder is dropped into the water, causing the water to boil, with 5.00 g being converted to steam. The final temperature of the system is $100^{\circ} C$. Neglect energy transfers with the environment. (a) How much energy (in calories) is transferred to the water as heat ? (b) How much to the bowl ? (c) What is the original temperature of the cylinder ?

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29. The temperature of a body falls from $40^{\circ} C$ to $36^{\circ} C$ in 5 minutes when placed in a surrounding of constant temperature $16^{\circ} C$. Find the time taken for the temperature of the body to become $32^{\circ} C$.

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30. The earth receives solar radiation at a rate of $8.2 J cm^{-2} \min^{-1}$. Assuming that the sun radiates like a blackbody, Calculate the surface temperature of the sun. The angle subtended by the sun on the earth is $0.55^{\circ} C$ and the stefan constant $\sigma = 5.67 \times 10^{-s} W m^{-2} K^{-4}$.

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31. A hot body placed in air is cooled down according to Newton's law of cooling, the rate of decrease of temperature being k times the temperature difference from the surrounding. Starting from $t = 0$, find the time in which the body will loss half the maximum heat it can lose.

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32. (a) Calculate the rate at which body heat is conducted through the clothing of a skier in a steady-state process, given the following data: the body surface area is $1.8 m^2$, and the clothing is 1.0 cm thick, the skin surface temperature is $33^{\circ} C$ and the outer surface of the clothing is at

$1.0^{\circ} C$, the thermal conductivity of the clothing is $0.040 W / m. K.$ (b) If , after a fall, the skier's clothes became soaked with water of thermal conductivity $0.60 W / m. K$, by how much is the rate of conduction multiplied ?

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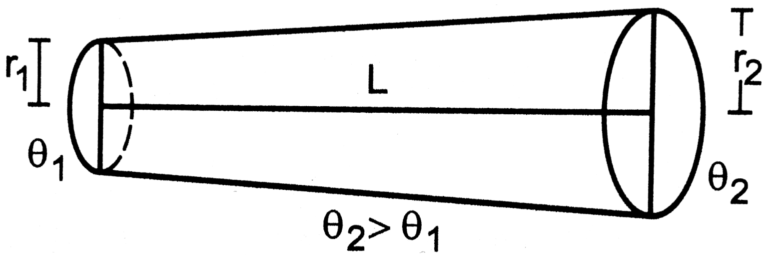
33. Find the rate of heat flow through a cross section of the rod shown in figure $(\theta_2 > \theta_1)$. Thermal conductivity of the material of the rod is K.



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34. A calorimeter containes $50 g$ of water at $50^{\circ} C$. The temperature falls to $45^{\circ} C$ in 10 minutes. When the calorimeter contains $100 g$ of water at

$50^\circ C$ it takes 18 minutes for the temperature to become $45^\circ C$. Find the water equivalent of the calorimeter.

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35. A metal ball of mass $1kg$ is heated by means of a $20W$ heater in a room at $20^\circ C$. The temperature of the ball becomes steady at $50^\circ C$. (a) Find the rate of loss of heat to the surrounding when the ball is at $50^\circ C$. (b) Assuming Newton's law of cooling, calculate the rate of loss of heat to the surrounding when the ball is at $30^\circ C$. (c) Assume that the temperature of the ball rises uniformly from $20^\circ C$ to $30^\circ C$ in 5 minutes. Find the total loss of heat to the surrounding during this period. (d) Calculate the specific heat capacity of the metal.

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Practice Questions

1. A heat of transformation of a substance is

A. the energy absorbed as heat during a phase transformation

B. the energy per unit mass absorbed as heat during a phase transformation.

C. the same as the heat capacity

D. the same as the specific heat.

Answer: B

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2. Heat is

A. energy transferred by virtue of a temperature difference.

B. energy transferred by macroscopic work.

C. energy content of an object.

D. a temperature difference.

Answer: A

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3. An insulated contianer, filled with water, contains a thermometer and a paddle wheel. The paddle wheel can be rotated by an external source. This apparatus can be used to determine.

A. specific heat of water.

B. relation between kinetic energy and absolute temperature.

C. thermal conductivity of water.

D. mechanical equivalent of heat.

Answer: D

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4. For constant volume processes the heat capacity of gas A is greater than the heat capacity of gas B. We conclude that when they both absorb the same energy as heat at constant volume

A. the temperature of A increase more than the temperature of B.

B. the temperature of B increases more than the temperature of A.

C. the internal energy of A increases more than the internal energy of B.

D. the internal energy of B increases more than the internal energy of A.

Answer: B

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5. The same energy Q enters five different substances as heat. Which of these has the greatest specific heat ?

A. The temperature of 3g of substance A increases by 10 K.

B. The temperature of 4g of substance B increases by 4K.

C. The temperature of 6g of substance C increases by 15K.

D. The temperature of 8g of substance D increases by 5K.

Answer: B

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6. Take the mechanical equivalent of heat as 4J/cal. A 10-gram bullet moving at 2000 m/s plunges into 1 kg of paraffin wax (specific heat 0.7 cal $/(g^\circ C)$. The wax was initially at $20^\circ C$. Assuming that all the bullet's energy heats the wax, its final temperature is

A. $20.14^\circ C$

B. $23.5^\circ C$

C. $20.006^\circ C$

D. $27.1^\circ C$

Answer: D

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7. The specific heat of lead is $0.030 cal/(g^{\circ}C)$. 300 g of lead shot at $100^{\circ}C$ is mixed with 100g of water at $70^{\circ}C$ in an insulated container. The final temperature of the mixture is

A. $100^{\circ}C$

B. $85.5^{\circ}C$

C. $79.5^{\circ}C$

D. $72.5^{\circ}C$

Answer: D

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8. The heat of fusion of water is $79.5 \text{ cal } / \text{ g}$. This means 79.5 cal of energy are required to

A. raise the temperature of 1g of water by 1K.

B. turn 1 g of water to steam.

C. raise the temperature of 1 g of ice by 1K.

D. melt 1 g of ice.

Answer: D

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9. The formation of ice from water is accompained by

A. absorption of energy as heat.

B. temperature increase.

C. decrease in volume.

D. an evolution of heat.

Answer: A

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10. How many calories are required to change one gram of $0^\circ C$ ice to $100^\circ C$ steam ? The latent heat of fusion is 80 cal / g and the latent heat of vaporization is 540 cal / g. The specific heat of water is $1.00 cal /$ (g K)

.

A. 100 cal

B. 540 cal

C. 620 cal

D. 720 cal

Answer: D

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11. Ten grams of ice at - $20^{\circ} C$ is to be changed to steam at $130^{\circ} C$. The specific heat of both ice and steam is 0.5 cal $/(g^{\circ} C)$. The specific heat of water is 1.00 cal $/(gK)$. The heat of fusion is 80 cal $/$ g and the heat of vaporization is 540 cal $/$ g. The entire process requires.

A. 750cal

B. 1250cal

C. 6950 cal

D. 7450 cal

Answer: D

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12. Steam at $100^{\circ} C$ enters a radiator and leaves as water (at $80^{\circ} C$). Take the heat of vaporization to be 540 cal $/$ g .Of the total energy given off as heat, what percent arises from the cooling of the water?

A. 1

B. 0.54

C. 0.26

D. 0.036

Answer: D

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13. Fifty grams of ice at $0^{\circ} C$ is places in a thermos bottle containing one hundred grams of water at $6^{\circ} C$. How many grams of ice will melt? The heat of fusion of water is 333 kJ / kg and the specific heat of water is 4190J / (kg K).

A. 7.5g

B. 2.0g

C. 8.3g

D. 17g

Answer: A

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14. A slab of material has area A, thickness L, and thermal conducitivy k. One of its surface (P) is maintained at temperature T_1 and the other surface (Q) is maintained at a lower temperature T_2. The rate of heat flow from P to Q is :

A. $\frac{kA(T_1 - T_2)}{L^2}$

B. $\frac{kL(T_1 - T_2)}{A}$

C. $\frac{kL(T_1 - T_2)}{L}$

D. $\frac{k(T_1 - T_2)}{(LA)}$

Answer: C

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15. A metallic rod is continuously heated at its two ends, the flow of heat through the rod does not depend upon –

A. temperature difference between opposite faces of the slab.

B. specific heat of the slab.

C. slabe thickness

D. cross-sectional area of the slab.

Answer: B

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16. The rate of heat flow through a slab is P_{cond}. If the slab thickness is doubled, its cross-sectional area is halved, and the temperature difference across it is doubled, then the rate of heat flow becomes

A. $2P_{\text{cond}}$

B. $\frac{P_{\text{cond}}}{2}$

C. P_{cond}

D. $\frac{P_{\text{cond}}}{8}$

Answer: B

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17. An iron slove, used for heating a room by radiation , is more efficient if

A. its inner surface is highly polished.

B. its inner surface is covered with aluminium paint

C. its outer surface is covered with aluminium paint.

D. its outer surface is rought and black.

Answer: D

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18. An electric stove burner of diameter 20cm is at a temperature of $250^{\circ}C$. If $\sigma = 5.67 \times 10^{-8} W/m^2.K^4$, at what rate is the burner radiating energy ? Assume the emissivity $\varepsilon = 0.6$.

A. 4W

B. 80 W

C. 320 W

D. 1600 W

Answer: B

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19. A homeowner purchases insulation for her attic rated at R-15. She wants the attic insulated to R-30. If the insulation she purchased is 10cm thick, what thickness does she need to use ?

A. 10cm

B. 15 cm

C. 20 cm

D. 30 cm

Answer: C

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20. A 2.00 kg metal object requires $5.02 \times 10^3 J$ of heat to raise its temperature from $20.0^\circ C$ to $40.0^\circ C$. What is the specific heat capacity of the metal ?

A. $63.0 J/(kg. ^\circ C)$

B. $126 J/(kg. ^\circ C)$

C. $251 J/(kg. ^\circ C)$

D. $502 J/(kg. ^\circ C)$

Answer: B

Watch Video Solution

21. A 0.20 kg lead ball is heated to $90.0^\circ C$ and dropped into an ideal calorimeter containing 0.50 kg of water initially at $20.0^\circ C$. What is the final equilibrium temperature of the lead ball ? The specific heat capacity of lead is $128J/(kg.^\circ C)$, and the specific heat of water is $4186J/(kg.^\circ C)$.

A. $4.8^\circ C$

B. $20.8^\circ C$

C. $22.4^\circ C$

D. $27.8^\circ C$

Answer: B

Watch Video Solution

22. A gold sphere has a radius of 1.000 cm at $25.0^\circ C$. If 7650 J of heat is added to the sphere, what will the final volume of the sphere be ? Gold has a density of 19.300 kg $/m^3$ at $25.0^\circ C$, a specific heat capacity of $129J/(kg.\ ^\circ C)$, and a coefficient of volume expansion of $42.0 \times 10^{-6/^\circ C}$.

A. $2.88 \times 10^{-6} m^3$

B. $3.01 \times 10^{-6} m^3$

C. $4.32 \times 10^{-6} m^3$

D. $3.91 \times 10^{-6} m^3$

Answer: C

Watch Video Solution

23. Heat is added to a substance, but its temperature does not rise. Which one of the following statements provides the best explanation for this observation ?

A. The substance must be a gas.

B. The substance must be a non-perfect solid.

C. The substance undergoes a change of phase.

D. The substance has unusual thermal properties.

Answer: C

Watch Video Solution

24. Which would cause a more serious burn 30g of steam or 30g of liquid water, both at $100^\circ C$, and why is this so ?

A. Water, because it is denser than steam.

B. Steam, because of its specific heat capacity.

C. Steam, because o fits latent heat of vaporization.

D. Water, because its specific heat its greater than that of steam.

Answer: C

Watch Video Solution

25. Determine the leatent heat of vaporization of unknonw substance X in kcal / g if 3.0g of boiling liquid X are completely vaporized in 1.5 hours by an input of 10 kcal / h into the system by an energy source.

A. 5 kcal / g

B. 1.5 kcal / g

C. 27 kcal / g

D. 30 kcal / g

Answer: A

Watch Video Solution

26. Which one of the following statements best explains why convection does not occur in solids?

A. Molecules in a solid are more closely spaced than in a gas.

B. The molecules in a solid are not free to move throughout the volume of the solid.

C. Molecules in a solid vibrate at a lower frequency than those in a liquid.

D. Solids are more compressible than liquids.

Answer: B

Watch Video Solution

27. Suppose you are sitting next to a fireplace in which there is a fire burning. One end of a metal poker has been left in the fire. Which one of the following statements concerning this situation is true?

A. You can feel the heat of the fire primarily because of convection.

B. The end of the poker that is not in the fire is warmed through conduction.

C. Heat escapes through the chimney primarily through through conduction.

D. You can feel the heat of the fire primarily because of conduction.

Answer: B

Watch Video Solution

28. The ends of a cylinder steel rod are maintained at two different temperatures. The rod conducts heat from one end to the other at a rate of 10 cal / s. At what rate would a steel rod twice as long and twice the diameter conduct heat between the same two temperatures?

A. 5 cal / s

B. 10 cal / s

C. 20 cal / s

D. 40 cal / s

Answer: C

Watch Video Solution

29. A cabin has a 0.159 m thick wooden floor [k = 0.14] $W/(m. ^{\circ}C)]$ with an area of $13.4m^2$. A roaring fire keeps the interior of the cabin at a comfortable $18.0^{\circ}C$ while the air temperature in the crawl space below the cabin is $-20.6^{\circ}C$. What is the rate of heat conduction through the wooden floor ?

A. 31 J $/$s

B. 459 J $/$ s

C. 138 J $/$ s

D. 245 J $/$s

Answer: B

Watch Video Solution

30. Which object will emit more electromagnetic radiation than it absorbs from its surroundings?

A. $600^{\circ} C$ lead sphere in a $700^{\circ} C$ overn.

B. A girl scout sitting close to a campfire.

C. An ice cube in beaker of water at $50^{\circ} C$

D. A $200^{\circ} C$ copper coin in a beaker of water at $98^{\circ} C$.

Answer: D

Watch Video Solution

31. Two identical solid spheres have the same temperature.One of the spheres is cut into two identical pieces.These two hemispheres are then separated. The intact sphere radiates an energy Q during a given time interval. During the same interval, the two hemispheres radiate a total energy Q'. What is the ratio Q' / Q?

A. 2.0

B. 4.0

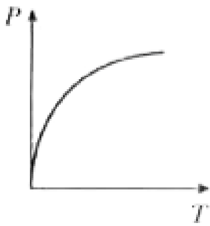
C. 0.50

D. 1.5

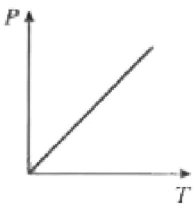
Answer: D

Watch Video Solution

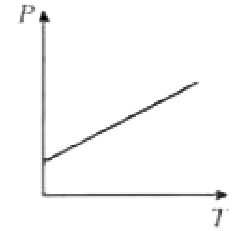
32. Which one of the following graphs shows the rate at which heat is emitted from a hot body as a function of its Kelvin temperature T' ?

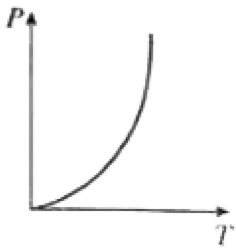


A.



B.

C. 

D. 

Answer: D

Watch Video Solution

33. Assuming a filament in a 100W light bulb acts like a perfect blackbody, what is the temperature of the hottest portion of the filament if it has a surface area of $6.3 \times 10^{-5} m^2$? The Stefan-Boltzmann constant is $5.67 \times 10^{-8} W / (m^2 . K^2)$.

A. 130K

B. 2300K

C. 1100K

D. 5800K

Answer: B

Watch Video Solution

34. Object A has an emissivity of 0.95, and its temperature is $25^\circ C$ .At what temperature (in degrees Celsius) does object B, whose emissivity is 0.60, emit radiation at the same rate as object A if both objects have the same surface area ?

A. $28^\circ C$

B. $40^\circ C$

C. $61^\circ C$

D. $73^\circ C$

Answer: C

Watch Video Solution

Watch Video Solution

35. Assume that the sun is a sphere of radius $6.96 \times 10^8 m$ and that its surface temperature is $5.8 \times 10^3 K$. If the Sun radiates at a rate of 3.90×10^{26}W and is a perfect emitter, at what rate is energy emitted per square meter at the Sun's surface ?

A. $5.6 \times 10^7 W/m^2$

B. $6.4 \times 10^7 W/m^2$

C. $5.6 \times 10^{17} W/m^2$

D. $12.8 \times 10^7 W/m^2$

Answer: B

Watch Video Solution

36. A 1.5 kg steel sphere will not fit through a circular hole in a 0.85 kg aluminium plate, because the radius of the sphere is 0.10% larger than the radius of the hole. If both the sphere and the plate are always kept at the same temperature, how much heat must be put into the two so the ball just passes through the hole ?

A. $6.2 \times 10^4 J$

B. $1.3 \times 10^5 J$

C. $7.0 \times 10^4 J$

D. $2.4 \times 10^5 J$

Answer: B

Watch Video Solution

37. A 10.0 kg block of ice has a temperature of $-10.0^\circ C$. The pressure is one atmosphere. The block absorbs $4.11 \times 10^6 J$ of heat. What is the final temperature of the liquid water ?

A. $0.58^\circ C$

B. $4.6^\circ C$

C. $9.2^{\circ} C$

D. $13^{\circ} C$

Answer: D

Watch Video Solution

38. One end of a brass bar is maintained at $306^{\circ} C$, while the other end is kept at a constant, but lower, temperature. The cross-sectional area of the bar is $2.6 \times 10^{-4} m^{2}$. Because of insulation, there is negligible heat loss through the sides of the bar . Heat flows through the bar, however, at the rate 3.6 J / s . What is the temperature of the bar at a point 0.15m from the hot end ?

A. $301^{\circ} C$

B. $297^{\circ} C$

C. $287^{\circ} C$

D. $265^{\circ} C$

Answer: C

Watch Video Solution

39. Liquid helium is stored at its boiling-point temperature of 4.2 K in a spherical container (r = 0.30m). The container is a perfect blackbody radiator. The container is surrounded by a spherical shield whose temperature is 77K. A vacuum exists in the space between the container and the shield. The latent heat of vaporization for helium is $2.1 \times 10^4 J / kg$. What mass of liquid helium boils away through a venting valve in one hour?

A. 0.39kg

B. 0.57kg

C. 0.81kg

D. 1.1kg

Answer: A

Watch Video Solution

40. A small sphere (emissivity $= 0.9, radius = r_1$) is located at the centre of a spherical asbestos shell (thickness $= 5.0$ cm , outer radius $= r_2$) The thickness of the shell is small compared to the inner and outer radii of the shell. The temperature of the small sphere is 800 K while the temperature of the inner surface of the shell is 600 K The temperature of small sphere is maintained constant. Assuming that $\frac{r_2}{r_1} = 10.0$ and ignoring any air inside the shell, find the temperature (in k) of the outer surface of the shell Take : $K_{asbes \to r} = 0.085 W/m^{\circ}$ C $\sigma = \frac{17}{3} \times 10^{-8} W/m^2 k^4$

A. $642.9^{\circ} C$

B. $557.7^{\circ} C$

C. $689.3^{\circ} C$

D. $519.4^{\circ} C$

Answer: B

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Watch Video Solution

41. A solid sphere has a temperature of 773K. The sphere is melted down the recast into a cube that has the same emissivity and emits the same radiant power as the sphere. What is the cube's temperature ?

A. 959K

B. 816K

C. 732K

D. 623K

Answer: C

Watch Video Solution

42. The ends of a thin bar are maintained at different temperatures. The temperature of the cooler end is $11^\circ C$, while the temperature at a point 0.13m from the cooler end is $23^\circ C$ and the temperature of the warmer end is $48^{\circ} C$. Assuming that heat flows only along the length of the bar (the sides are insulated), find the length of the bar.

A. 0.50m

B. 0.40m

C. 0.23m

D. 0.64m

Answer: B

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43. A piece of glass has a temperature of $83.0^{\circ} C$. Liquid that has a temperature of $43.0^{\circ} C$ is poured over the glass, completely covering it, and the temperature at equilibrium is $53.0^{\circ} C$. The mass of the glass and the liquid is the same. Ignoring the container that holds the glass and liquid and assuming that the heat lost to or gained from the surroundings is negligible , determine the specific heat capacity of the liquid.

A. $280J/(kg.\ ^{\circ}C)$

B. $1300J/(kg.\ ^{\circ}C)$

C. $2500J/(kg.\ ^{\circ}C)$

D. $3400J/kg(kg.\ ^{\circ}C)$

Answer: C

Watch Video Solution

44. A thermos contains 150cm^3 of coffee at $85^{\circ}C$. To cool the coffee, you drop two 11-g ice cubes into the thermos. The ice cubes are initially at $0^{\circ}C$ and melt completely. What is the final temperature of the coffee ? Treat the coffee as if it were water.

A. $59^{\circ}C$

B. $77^{\circ}C$

C. $64^{\circ}C$

D. $73^{\circ}C$

Answer: C

Watch Video Solution

45. A mass m of steam at $100^{\circ}C$ is to passed into a vessel containing 10g of ice and 100g of water at $0^{\circ}C$ so that all the ice is melted and the temperature is raised to $5^{\circ}C$ neglecting heat absorbed by the vessel, we get

A. m = 2.1 g

B. m = 4.2 g

C. m = 6.3g

D. m = 8.4g

Answer: A

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

A. Pt

B. $\frac{Pt}{M}$

C. PtM

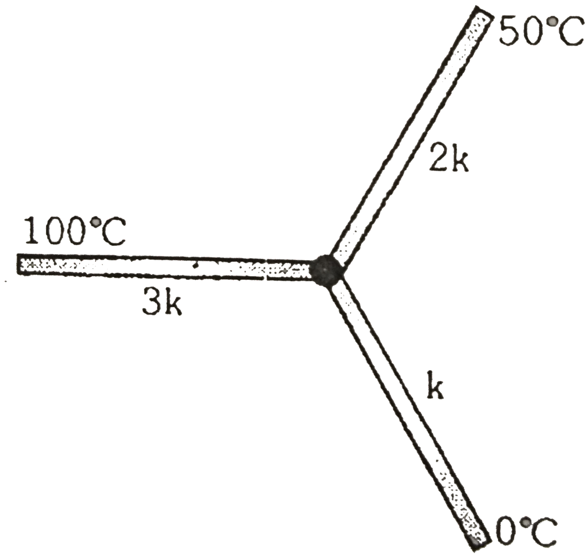
D. $\frac{PM}{t}$

Answer: B

Watch Video Solution

47. Three rods of the same dimensions have thermal conductivities 3k , 2k and k . They are arranged as shown, with their ends at $100^{\circ}C$, $50^{\circ}C$ and

$0^{\circ} C$. The temperature of their junction is :-



A. $75^{\circ} C$

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

C. $40^{\circ} C$

D. $100 / 3^{\circ} C$

Answer: B

Watch Video Solution

48. A hot liquid is kept in a big room. The logarithm of the numerical value of the temperature difference between the liquid and the room is plotted against time.The plot will be very nearly

A. a straight line

B. a circular arc

C. a parabola

D. an ellipse.

Answer: A

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49. Choose the correct relation, when the temperature of an isolated black body falls from T_1 to T_2 in time $'t'$ and assume $'c'$ to be a constant.

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

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

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

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

Answer: D

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

A. $4/3$

B. $16/9$

C. $64/27$

D. $256/81$

Answer: D

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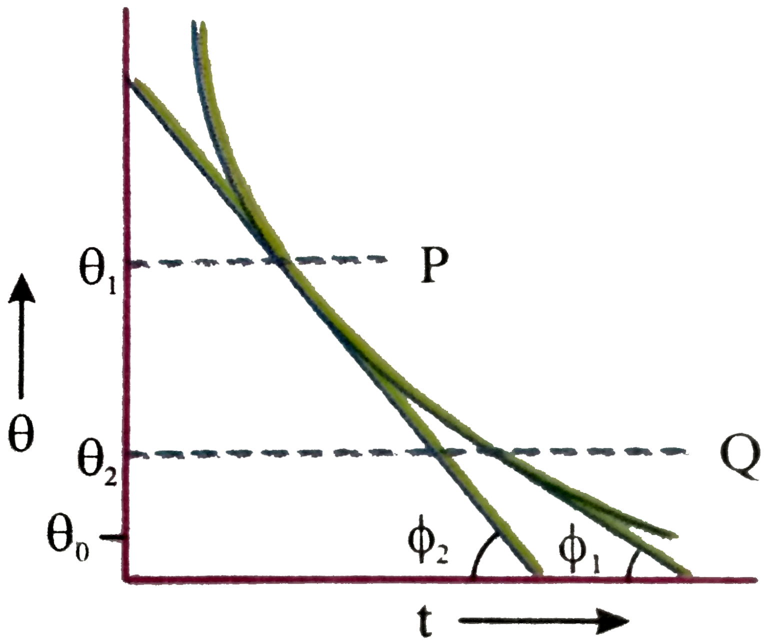
51. A body cools in a surrounding which is at a constant temperature of θ_0 Assume that it obeys Newton's law of cooling Its temperature θ is plotted against time t Tangents are drawn to the curve at the points $P(\theta = \theta_1)$ and $Q(\theta = \theta_2)$ These tangents meet the time axis at angle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



A. $\frac{\tan \phi_2}{\tan \phi_1} = \frac{T_1 - T_0}{T_2 - T_0}$

B. $\frac{\tan \phi_2}{\tan \phi_1} = \frac{T_2 - T_0}{T_1 - T_0}$

C. $\frac{\tan \phi_1}{\tan \phi_2} = \frac{T_1}{T_2}$

D. $\frac{\tan \phi_1}{\tan \phi_2} = \frac{T_2}{T_1}$

Answer: B

Watch Video Solution

52. In solar radiation, the intensity of radiation is maximum around the wavelength λ_m. If R is the radius of the sun and c is the velocity of light, the mass lost by the sum per unit time is proportional to

A. $\frac{R^2}{\lambda^4 c^2}$

B. $\frac{R^2}{\lambda^2 c^2}$

C. $\frac{R^3}{\lambda^4 c^3}$

D. $\frac{R^3}{\lambda^4 c^2}$

Answer: A

Watch Video Solution

53. When a body is placed in surroundings at a constant temperature of $20^\circ C$ and heated by a 10W heater, its temperature remains constant at $40^\circ C$. If the temperature of the body is now raised from $20^\circ C$ to $80^\circ C$ in 5 min at a uniform rate, the total heat it will lose to the surroundings will be

A. 3000 J

B. 3600J

C. 4500J

D. 5400J

Answer: C

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

A. $\frac{4\pi kR^2T}{p}$

B. $\frac{4\pi kR^2}{Tp}$

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

D. $\frac{4\pi R^2P}{kT}$

Answer: A

Watch Video Solution

55. There are three thermometers one in contact with the skin of the man other in between the vest and the shirt and third in between the shirt and coat. The readings of the thermomenters are $30^\circ C$,$25^\circ C$ and $22^\circ C$, respectively. If the vest and the shirt are of the same thickness, the ratio of their thermal conductivities is

A. $9 : 25$

B. $25 : 9$

C. $5 : 3$

D. $3 : 5$

Answer: D

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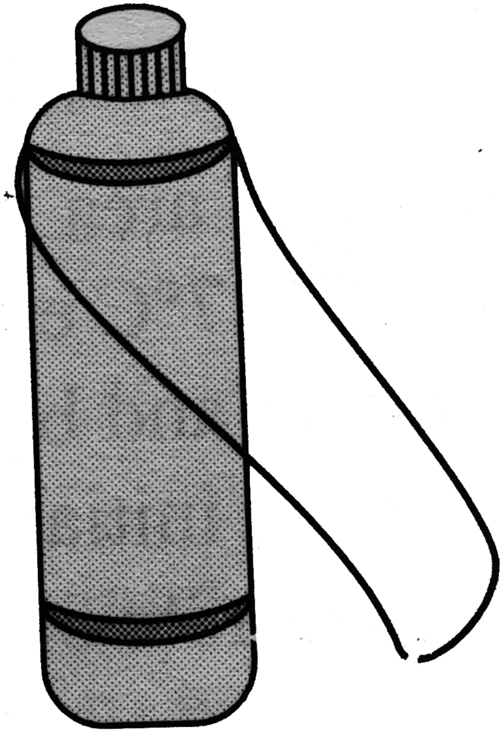

56.

The only possibility of heat flow in a thermos flask is through its cork which is $75 cm^2$ in area and 5 cm thick its thermal conductivity is $0.0075 cal / cm - s - ^\circ C$. The outside temperature is $40^\circ C$ and latent heat of ice is $80 cal / g$. Time taken by 500 g of ice at $0^\circ C$ in the flask to melt into water at $0^\circ C$ is `

A. 2.47h

B. 4.27h

C. 7.41h

D. 4.72h

Answer: A

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57. A black body at 200 K is found to emit maximum energy at a wavelength of $14\mu m$. When its temperature is raised to 1000 K, the wavelength at which maximum energy is emitted is

A. $14\mu m$

B. $7\mu m$

C. $2.8\mu m$

D. $7.4\mu m$

Answer: C

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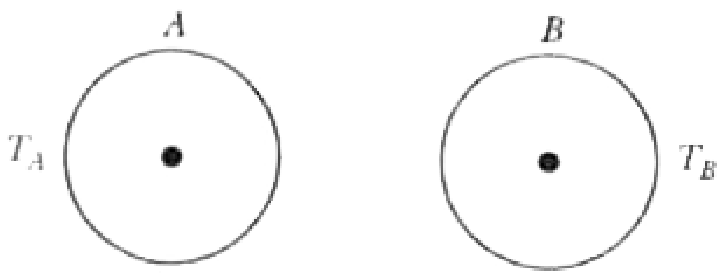
58. A and B are two isolated spheres kept in close proximity so that they can exchange energy by radiation as shown in the following figure. The two spheres ,have identical physical dimension, but the surface of A behaves like a perfectly black body while the surface of B reflects 20% of all the radiations it receives. They are isolated from all other sources of radiation.



A. If they are in thermal equilibrium and exchange equal amounts of radiation per second, then they will be at same absoulte temperature, $T_A = T_B$.

B. If they are in thermal equilibrium and exchange equal amounts of radiation per second, the $T_A = (0.8)^{1/4} T_B$.

C. If they ar enot in thermal equilibrium and are each at t =0 at the same temperature $T_A = T_B = T$, then the sphere A will loss thermal energy and B gain thermal energy.

D. If they are not in thermal equilibrium and are each at t=0 at the same temperature $T_A = T_B = T$, then the sphere A will gain thermal energy and B lose thermal energy.

Answer: A

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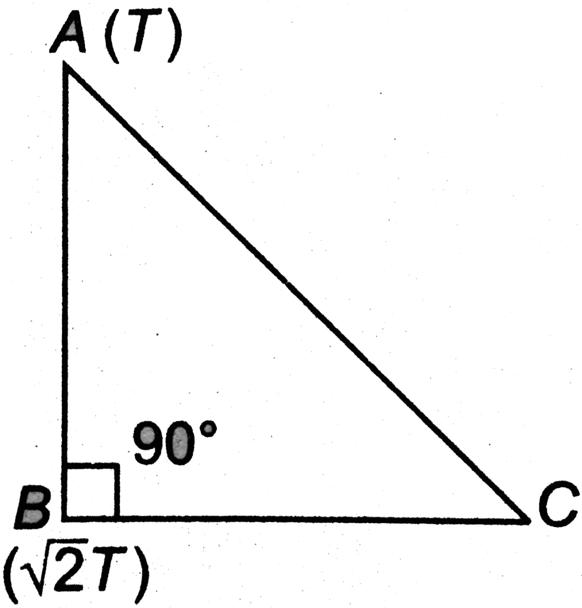
59. Three rods of identical cross-sectional area and made from the same metal form the sides of an isosceles triangle ABC right angled at B as shown in the figure. The points A and B are maintained at temperature T and $(\sqrt{2})T$ respectively in the steady state. Assuming that only heat conduction takes place, temperature of point C will be



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

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

C. $\frac{T}{3\sqrt{2}-1}$

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

Answer: A

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60. 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.

A. $\sqrt{\frac{3\pi}{8}} : 1$

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

C. $\frac{\pi}{\sqrt{6}} : 1$

D. $\frac{\pi}{\sqrt{3}} : 1$

Answer: A

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Practice Questions More Than One Correct Choice Type

1. A solid sphere and a hollow sphere of the same material and of equal radii are heated to the same temperature.

A. both will emit equal amount of radiation per unit time in the beginning

B. both will absorb equal amount of radiation from the surrounding in the beginning

C. the initial rate of cooling (dT/dt) will be the same for the two spheres.

D. the two spheres will have equal temperatures at any instant.

Answer: A,B

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2. The heat capacity of a body depends on

A. the heat given.

B. the temperature raised.

C. the mass of the body.

D. the material of the body.

Answer: C,D

Watch Video Solution

3. A black body does not .

A. emit radiation

B. absorb radiation.

C. reflect radiation

D. refract radiation

Answer: C,D

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

A. A only emits radiation, while B only absorbs it until both attain temperature T.

B. A lose more heat by radiation than it absorbs while B absorbs more radiation than it emits until they attain temperature T.

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

D. Each object continues to emit and absorb radiation even after attaining temperature T.

Answer: B,D

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5. Choose the correct statements from the following :

A. Good reflector are good emitters of thermal radiation.

B. Burns caused by water at $100^\circ C$ are more severe than those caused by steam at $100^\circ C$.

C. If the Earth did not have atmosphere, it would become intolerably cold.

D. It is impossible to construct a heat engine of a 100% efficiency.

Answer: C,D

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6. 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 11604 K

D. the temperature of B is 2901 K.

Answer: A,B

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7. A piece of charcoal and a piece of shining steel of the same surface area are kept for a long time in an open lawn in bright sun.

A. The steel will absorb more heat than the charcoal.

B. The temperature of the steel will be higher than that of the charcoal.

C. If both are picked up by bare hands, the steel will be felt hotter than the charcoal.

D. If the two are picked up from the lawn and kept in a cold chamber, the charcoal will lose heat at a faster rate than the steel.

Answer: C,D

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

A. A, the surface area of the body

B. S, the specific heat of the body

C. $1/m$, where m is the mass of the body .

D. e, the emissivity of the body.

Answer: A,B,C

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Practice Questions Linked Comprehension

1. A 0.0500 kg lead bullet of volume $5.00 \times 10^{-6} m^3$ at $20.0^\circ C$ hits a block that is made of an ideal thermal insulator and comes to rest at its center. At that time, the temperature of the bullet is $327^\circ C$. Use the following information for lead :

Coefficient of linear expansion : $\alpha = 2.0 \times 10^{-5} / {}^\circ C$

Specific heat capacity : $c = 128 J / (kg. {}^\circ C)$

Latent heat of fusion : $L_1 = 23300 J / kg$

Melting point : $T_{\text{melt}} = 327^\circ C$

How much heat was needed to raise the bullet to its final temperature ?

A. 963 J

B. 1960J

C. 3640J

D. 3880 J

Answer: B

Watch Video Solution

2. A 0.0500 kg lead bullet of volume $5.00 \times 10^{-6} m^3$ at $20.0^\circ C$ hits a block that is made of an ideal thermal insulator and comes to rest at its center. At that time, the temperature of the bullet is $327^\circ C$. Use the following information for lead :

Coefficient of linear expansion : $\alpha = 2.0 \times 10^{-5} / ^\circ C$

Specific heat capacity : $c = 128 J / (kg. ^\circ C)$

Latent heat of fusion : $L_1 = 23300 J / kg$

Melting point : $T_{\text{melt}} = 327^\circ C$

What is the volume of the bullet when it comes to rest ?

A. $5.00 \times 10^{-6} m^3$

B. $5.01 \times 10^{-6} m^3$

C. $5.09 \times 10^{-6} m^3$

D. $5.07 \times 10^{-6} m^3$

Answer: C

Watch Video Solution

3. A 0.0500 kg lead bullet of volume $5.00 \times 10^{-6} m^3$ at $20.0^\circ C$ hits a block that is made of an ideal thermal insulator and comes to rest at its center. At that time, the temperature of the bullet is $327^\circ C$. Use the following information for lead :

Coefficient of linear expansion : $\alpha = 2.0 \times 10^{-5} / ^\circ C$

Specific heat capacity : $c = 128 J / (kg. ^\circ C)$

Latent heat of fusion : $L_1 = 23300 J / kg$

Melting point : $T_{\text{melt}} = 327^\circ C$

What additional heat would be needed to melt the bullet ?

A. 420J

B. 837 J

C. 628 J

D. 1160 J

Answer: D

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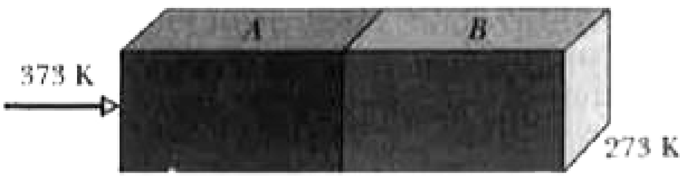
4. Two bars, A and B, each of length 2.0 m and cross-sectional area $10m^2$, are placed and to end as shown in the figure.

The thermal conductivities of the bars are $k_A = 339(J/s.\ m.\ K)$ and $k_B = 837J/(s.\ m.\ K)$, respectively. The left end of bar A is maintained at 373 K while the right end of B is maintained at 273 K



Which one of the following statements is true concerning the above situation ?

A. For a given time l, the amount of heat transferred through bar A is the same as that through B.

B. For a given time l, the amount of heat transferred through bar A is smaller than that through B.

C. For a given time t, the amount of heat transferred through bar A is less than that through B.

D. The time for a quantity of heat Q to pass through bar A is less than that for B.

Answer: A

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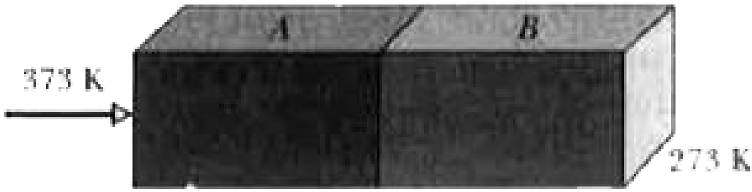
5. Two bars, A and B, each of length 2.0 m and cross-sectional area $10m^2$, are placed and to end as shown in the figure.

The thermal conductivities of the bars are $k_A = 339(J/s.m.K)$ and $k_B = 837J/(s.m.K)$, respectively. The left end of bar A is maintained at 373 K while the right end of B is maintained at 273 K



Wha tis the temperature at the interface between A and B?

A. 332K

B. 302 K

C. 323K

D. 313K

Answer: B

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6. Match the laws given in Column I to the respective correct statement given in Column II.

Column I	Column II
(a)Wien's displacement law explains	(p)why days are hot and night
(b)Planck's law explains	(q)why a blackened platinum
(c)Kirchhoff's law explains	$(r)$the distribution of energy i
(d)Newton's law of cooling explains that	$(s)$the rate of cooling of body i

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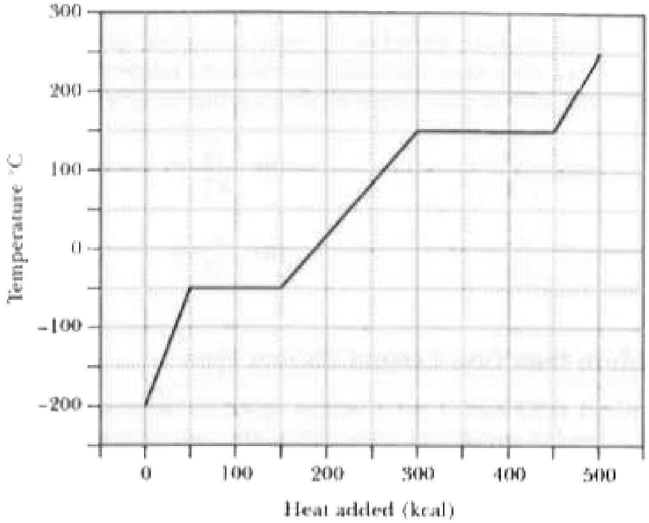
7. In the question, there is a table having 3 columns and 4 rosw. Based on the table, there are 3 questions. Each question has 4 options (a), (b) , (c) an (d), ONLY ONE of these four options is correct.

Heat is added to a 1.0 kg solid sample of a material at $-200^{\circ} C$ .The figure shows the temperature of the material as a function of the heat added.



In the given table, Columns I, II and III have parts of the statements.

Column I	Column II	Column III
(I) The specific heat capacity of this substance	(i) in its liquid state	(J) 100 cal/g.
(II) The latent heat of	(ii) in its solid state	(K) 150 cal/g.
(III) The specific heat capacity of this substance	(iii) vaporization of this material	(L) 0.75 cal/g/°C.
(IV) The latent heat of	(iv) fusion of this material	(M) 0.33 cal/g/°C.

Which one of the following combination about the heat capacity of the substance is correct ?

A. (I) (ii) (M)

B. (II) (i) (M)

C. (IV) (ii) (J)

D. (III) (iv) (L)

Answer: A

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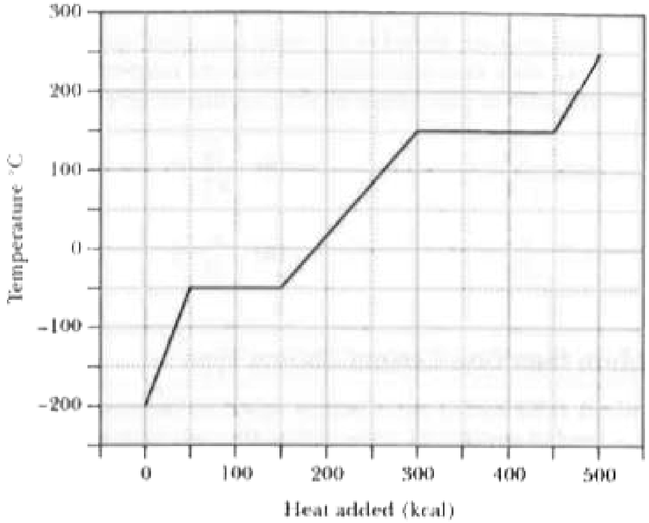
8. In the question, there is a table having 3 columns and 4 rosw. Based on the table, there are 3 questions. Each question has 4 options (a), (b) , (c) an (d), ONLY ONE of these four options is correct.

Heat is added to a 1.0 kg solid sample of a material at $-200^\circ C$ .The figure shows the temperature of the material as a function of the heat added.



In the given table, Columns I, II and III have parts of the statements.

Column I	Column II	Column III
(I) The specific heat capacity of this substance	**(i)** in its liquid state	**(J)** 100 cal/g.
(II) The latent heat of	**(ii)** in its solid state	**(K)** 150 cal/g.
(III) The specific heat capacity of this substance	**(iii)** vaporization of this material	**(L)** 0.75 cal/g/°C.
(IV) The latent heat of	**(iv)** fusion of this material	**(M)** 0.33 cal/g/°C.

Which one of the following combination is correct about change of state of substance from solid to liquid ?

A. (IV) (iii) (K)

B. (I) (ii) (L)

C. (III) (i) (M)

D. (II) (iv) (J)

Answer: D

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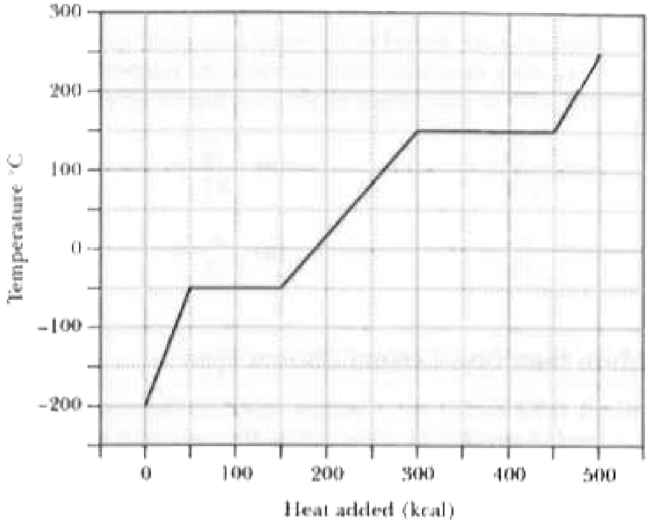
9. In the question, there is a table having 3 columns and 4 rosw. Based on the table, there are 3 questions. Each question has 4 options (a), (b) , (c) an (d), ONLY ONE of these four options is correct.

Heat is added to a 1.0 kg solid sample of a material at $-200^\circ C$ .The figure shows the temperature of the material as a function of the heat added.



In the given table, Columns I, II and III have parts of the statements.

Column I	Column II	Column III
(I) The specific heat capacity of this substance	(i) in its liquid state	(J) 100 cal/g.
(II) The latent heat of	(ii) in its solid state	(K) 150 cal/g.
(III) The specific heat capacity of this substance	(iii) vaporization of this material	(L) 0.75 cal/g/°C.
(IV) The latent heat of	(iv) fusion of this material	(M) 0.33 cal/g/°C.

Which one of the following combination is correct about change of state of substance from liquid to gas ?

A. (II) (iv) (J)

B. (IV) (iii) (K)

C. (I) (i) (L)

D. (III) (ii) (M)

Answer: B

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Practice Questions Integer Type

1. To help keep his warm on cold days, a farmer stores 840 kg of solar-heated water $(L_F = 3.35 \times 10^5 J/kg)$ in barrels . For how many hours would a 2.0 kW electric space heater have to operate to provide the same amount of heat as the water does when it cools from 10.0 to $0.0^\circ C$ and completely freezes ?

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2. A commonly used method of fastening one part to another part is called " shrink fitting." A steel rod has a diameter of 2.0026cm, and a flat plate contains a hole whose diameter is 2.0000cm. The rod is cooled so that it just fits into the hole. When the rod warms up, the enormous thermal stress exerted by the plate holds the rod securely to the plate. By how many Celsius degrees should the rod be cooled?

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3. A steel ruler is calibrated to read true at $20.0^{\circ} c$. A draftsman uses the ruler at $40.0^{\circ} C$ to draw a line on a $40.0^{\circ} C$ copper plate. As indicated on the warm ruler, the length of the line is 0.50m. To what temperature should the plate be cooled , such that the length of the line truly becomes 0.50 m?

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4. In a house the temperature at the surface of a window is $25^{\circ} C$ The temperatuere outside at the window surface is $5.0^{\circ} C$ .Heat is lost through the window via conduction, and the heat lost per second has a certain value. The temperature outside begins to fall, while the conditions inside the house remain the same. As a result, the heat lost per second increases. What is the temperature at the outside window surface when the heat lost per second doubles ?

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5. A body cools down from $60^{\circ} C$ to $55^{\circ} C$ in 30 s. Using newton's law of cooling calculate the time taken by same body to cool down from $55^{\circ} C$ to $50^{\circ} C$. Assume that the temperature of surrounding is $45^{\circ} C$.

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