PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

HEAT AND THERMAL EXPANSION

Illustrative Example

1. What will be the following temperatures on the kelvin scale: a. 37°, b. $80^\circ F$, c. $-196^\circ C$?

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2. Typical temperatures in the interior of the earth and sum are about $4 \times 10^3 .^\circ C$ and $1.5 \times 10^7 .^\circ C$ respectively.a. What are these temperature in Kelvins? B. What percentage error is made in each case if a person fogets to change $.^\circ C$ to K?

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3. In an aluminium there is a hole of diameter 2 m and is horozontally mounted on a stand. Onto this hole an iron sphere of diameter 2.004 m is resting. Initial temperature of this system is $25^\circ C$. Find at what temperature the iron sphere will fall down through the hole in sheet. The coefficient of linear expansion for aluminium and iron are 2.4×10^{-5} and 1.2×10^{-5} respectively.

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4. 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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5. Two straight thin bars, one of brass and the other of steel are joined togethre side by side by short steel cross-pieces at $0^{\circ}C$, one cm long the centre lines of the bars being one cm apart. When heated to $100^{\circ}C$, the composite bar becomes bent into the arc of a circle. calculate the radius of this circle.

α for brass $= 19 \times 10^{-6}$ per $.^{\circ} C$

and α for steel $= 11 \times 10^{-6}$ per $.^{\circ} C$

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6. A clock with a metallic pendulum gains 5 s each day at a temperature of $15^{\circ}C$ and loses 10 s each day at a

temperature of $30^\circ C$. Find the coefficient of thermal expansion of the pendulum metal.

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7. What should be the length of steel and copper rods at $0^\circ C$ that the length of steel rod is 5 cm longer than copper at all termperature? Given $\alpha_{Cu} = 1.7 \times 10^5.^\circ C^{-1}$ and $\alpha_{steel} = 1.1 \times 10^5.^\circ C^{-1}$.

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8. A steel wire of corss sectional area $0.5mm^2$ is held between two rigid clamps so that it is just taut at $20^\circ C$. Find the tension in the wire at $0^\circ C$. Given that Young's

Modulus of steel is $Y_{st} = 2.1 \times 10^{12}$ dynes/cm^2 and coefficient of linear expansion of steel is $\alpha_{st} = 1.1 \times 10^{-5}.^{\circ} C^{-1}$

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9. Three rods A,B and C having indentical shape and size, are hingerd together at ends to form an equilateral triangle. Rods A and B are made of same material having coefficient of linea thermal expansion α_1 while that of material of rod C is α_2. By how many kelvin should the system of rods be heated to increase the angle opposite to rod C by $\Delta\theta$.

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10. A pendulum clock and a digitical clock both are synchronized to beep correct time at temperature $20^\circ C$ in the mornign on 1st March, 2003. At 12:00 noon temperature increases to $40^\circ C$ and remains constant for three months. Now on Ist June, 2003 at 12:00 noon temperature drops to $10^\circ C$ and remains constant for a very long duration. Find the date and time on which both the clocks will again be synchronized for a moment.

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11. At room temperature $(25^\circ C)$ the length of a steel rod is measured using a brass centimetre scale. The measured length is 20 cm. If the scale is calibrated to read accurately

at temperature $0^{\circ}C$, find the actual length of steel rod at room temperature.

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12. A rod AB of length l is pivoted at an end A and freely rotated in a horizontal plane at an angular speed ω about a vertical axis passing through A. If coefficient of linear expansion of material of rod is α, find the percentage change in its angular velocity if temperature of system is incresed by ΔT

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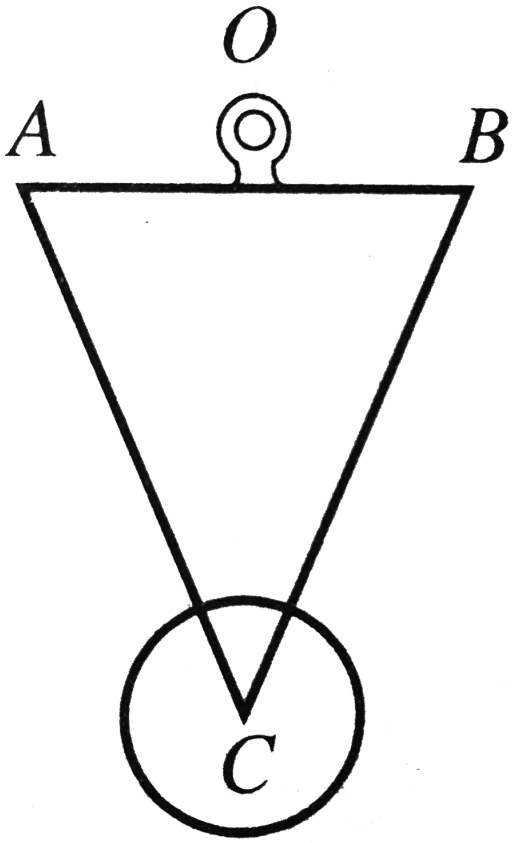

13.

A compensated pendulum shown if Fig. is in the from of an isosceles Delta of base length $l_1 = 5$cm and coefficent of linar expansion $\alpha_1 = 18 \times 10^{-6}$ and side length l_2 and coefficient of linear expansion $\alpha_2 = 12 \times 10^{-6}$. find l_2 so the the distance of centre of mass of the bob from

suspension centre O may remain the same at all the temperature.

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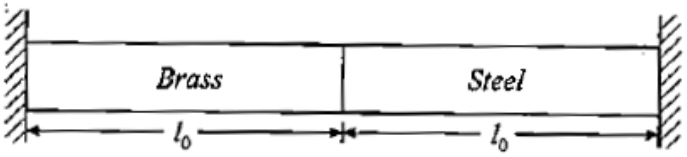
14. Two same length rods of brass and steel of equal cross-sectional area are joined end to end as shown in figure and supported between two rigid vertical walls. Initially the rods are unstrained. If the temperature of system is raised by Δt. Find the displacement of the junction of two rods. Given that the coefficient of linear expansion and young's modulus of brass and steel are $apha_b$. $\alpha_s(\alpha_b > \alpha_s)$, Y_b and Y_s respectively.



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15. A 1-L flask contains some mercury. It is found that at different temperature, the volume of air inside the flask remains the same. What is the volume of mercury in the flask, given that the coefficient of linear expansion of glass $= 9 \times 10^{-6}/^{\circ} C$ and the coefficient of volume expansion of $Hg = 1.8 \times 10^{-4}/^{\circ} C$?

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16. A sphere of radius 3.5 cm and mass 250 gm floats in a liquid at $20^{\circ} C$. As the temperature is raised, the sphere just being to sink at a temperature of $35^{\circ} C$. If the density

of liquid at $0^\circ C$ is $1.527 gm/cm^3$ find the coefficient of cubical expansion of the liquid. Neglect expansion of the sphere.

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17. A piece of metal weighs 46 g in air and 30 g in lipuid of density $1.24 \times 10^3 kgm^{-3}$ kept at $27^0 C$. When the temperature of the liquid is raised to $42^0 C$ the metal piece weights 30.5 g . The density of the liqued at $42^0 C$ is $1.20 \times 10^3 kgm^{-3}$. Calculate the coefficient of linear expandsion of the metal.

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18. A sinker of weight w_0 has an apparent weight w_1 when weighed in a liquid at a temperature t_1 and w_2 when weight in the same liquid at temperature t_2. The coefficient of cubical expansion of the material of sinker is β. What is the coefficient of volume expansion of the liquid.

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19. A barometer reads 75 cm on a steel scale. The room temperature is $30^\circ C$. The scale is correctly graduated for $0^\circ C$. Find the correct atmosphere pressure. Given that coefficient of linear expansion of steel is $1.1 \times 10^{-5}.^\circ C^{-1}$ and that of cubical expansion of

mercury is $1.8 \times 10^{-4}.^{\circ} C^{-1}$. Neglect expansion of glass tube.

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20. A aluminium can of cylindrical shape contains $500 cm^3$ of water. The area of the inner cross section of the can is $125 cm^2$. All measurements refer ti $10^{\circ} C$. Find the rise in the water level if the temperature increases to$80^{\circ} C$. The coefficient of linear expansion of aluminium $= 23 \times 10^{-6 \circ} C(-1)$ respectively.

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21. A steel ball initially at a pressure of $10^5 Pa$ is heated from 20° C to 120° C keeping its volume constant. Find the final pressure inside the ball. Given that coefficient of linear expansion of steel is $1.1 \times 10^{-5} / ^\circ C$ and Bulk modulus of steel is $1.6 \times 10^{11} Nt / m^2$.

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22. A lead ball at 25° C is dropped from a height of 2 km. It is heated due to air resistance and it is assumed that all of its kinetic energy is used in increasing the temperature of ball. Find the final temperature of the ball. s (ball) = 126 J/kg-K

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23. The temperatures of equal masses of three different liquids A, B and C are $15^\circ C, 20^\circ C$ and $30^\circ C$, respectively. When A and B are mixed their equilibrium temperature is $18^\circ C$. When B and C are mixed, it is $22^\circ C$ .What will be the equilibrium temperature when liquids A and C are mixed

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24. A metal block of density $5000 kg/m^3$ and mass $2kg$ in suspended by a spring of force constant $200 N/m$. The spring block system is submerged in water vessel. Total mass of water in vessel is $300 gm$ and in equilibrium the block is at a height 40 cm above the bottom of vessel. The

specific heat of material of block is $250 J / kg / k$ and that of water is $4200 J / kg / k$. Neglect the heat capacities of vessel and the spring. If the support is broken the rise in temperature of water, when block reaches botton of vessel is

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25. A copper cube of mass $200 g$ slides down an a rough inclined plane of inclination 37° at a constant speed. Assume that any loss in mechanical energy goes into the copper block as thermal energy .Find the increase in the temperature of the block as it slides down through $60 cm$. Specific heat capacity of copper $= 420 J kg^{-1} K^{-1}$

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26. An aluminium vessel of mass $0.5kg$ contains $0.2kg$ of water at $20^\circ C$. A block of iron of mass $0.2kg$ at $100^\circ C$ is gently put into the water .Find the equilibrium temperature of the mixture.

Specific heat capacities of aluminium , iron and water are $910Jkg^{-1}K^{-1}$, $470Jkg^{-1}K^{-1}$ and $420Jkg^{-1}K^{-1}$ respectively.

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27. Find the result of mixing 0.5 kg ice at $0^\circ C$ with 2 kg water at $30^\circ C$. Given that latent heat of ice is $L = 3.36 \times 10^5 J/kg$ and specific heat of water is $4200J/kg/K$.

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28. When 2 kg blocmk of copper at $100^\circ C$ is put in an ice container with 0.75 kf og ice at $0^\circ C$, find the equilibrium temperature and final composition of the mixture. Given that specific heat of copper is 378 J/kg K and that of water is 4200J/kg K and the latent heat of fusion of ic eis 3.36×10^5 J/kg

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29. How should $1kg$ of water at $50^\circ C$ be divided in two parts such that if one part is turned into ice at $0^\circ C$. It would release sufficient amount of heat to vapourize the

other part. Given that latent heat of fusion of ice is $3.36 \times 10^5 J/Kg$. Latent heat of vapurization of water is $22.5 \times 10^5 J/kg$ and specific heat of water is $4200 J/kgK$.

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30. In a pitcher when water is filled some water comes to outer surface slowly through its porous walls and gets evaprated. Most of the latent heat needed for evaporation is taken from water inside and hence this water is cooled down. If 10 kg water is taken in the pitcher and 12 gm water comes out and evaporated per minute. Neglect heat transfer by convection and radiation to surrounding, find the time in which the temperature of water is pitcher decreases by $5^\circ C$.

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Practice Exercise

1. Room temmerature is often taken to be 68° F, what will it be on Celsius scale?

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2. The temperature of the filament in a light bulb is about $1800^\circ C$, what will it be on Fahrenheit scale?

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3. If a temperature scale defined the freezing point of water as 100° and the boiling point is 0°. What temperature on thils scale corresponds to $25^\circ C$?

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4. In an alcohol in glass thermometer, the alcohol column has length 12.45 cm at $0.0^\circ C$ and length 21.30 cm at $100.0^\circ C$. What is the temperature if the column has length a. 15.10 cm, and b. 22.95 cm.

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5. At what temperature will both celsius and fahrenheit scales read the same value?

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6. A steel tape measures that length of a copper rod as 90.0 cm when both are at $10^{\circ}C$, the calibration temperature, for the tape. What would the tape read for the length of the rod when both are at $30^{\circ}C$. Given $\alpha_{\text{steel}} = 1.2 \times 10^{-5}$ per.$^{\circ} C$ and $\alpha_{Cu} = 1.7 \times 10^{-5} per.^{\circ} C$

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7. In the construction of a flyover, steel girders of length 12 m are used to place one after another. How much gap should be left between the two at their junction so that in summers whenpeak temperature is about $48^{\circ}C$, there should not be any compresion. Given that the construction is done in peak winters when temperature is $18^{\circ}C$. Given that the coefficient of linear expansion of steel is $1.1 \times 10^{-5}.^{\circ} C^{-1}$.

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8. A steel rod is clamped at its two ends and rests on a fixes horizontal base. The rod is unstrained at $20^{\circ}C$. Find the longitudinal strain developed in the rod if the

temperature rises to $50^\circ C$. Coefficient of linear expansion of steel $= 1.2 \times 10^{-5\circ} C^{-1}$.

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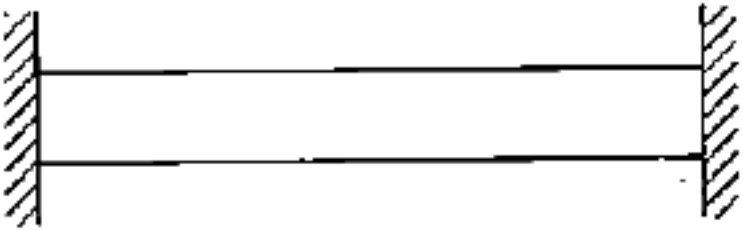
9. Figure shows a steel rod of cross sectional ara $2 \times 10^{-6} m^2$ is fixed between two vertical walls. Initially at $20^\circ C$ there is no force between the ends of the rod and the walls. Find the force which the rod will exert on walls at $100^\circ C$. Given that the coefficient of linear expansion of steel is $1.2 \times 10^{-5}.^\circ C^{-1}$ and Young's modulus is $2 \times 10^{11} N/m^2$



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10. A glass window is to be fit in an aluminium frame. The temperature on the working day is $40^\circ C$ and the glass window measures exact $20cm \times 30cm$. What should be the size of the aluminium frame so that there is no stress on the glass in winter even if the temperature drops to $0^\circ C$? Coefficients of linear expansion for glass and aluminium are $9.0 \times 10^{-6} {}^\circ C^{-1}$ respectively.

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11. A cylindrical steel component machined on an engine lathe is heated to temeprature of $80^\circ C$.The diameter of

the component should be 5 cm at temperature of $10^{\circ} C$ and the permissible error should not exceed 10 microns from the specified dimension. Do we need correctionis for the thermal expansioni component be introduced during the process of machining ? If so what diameter should be prepared? Take $\alpha_{\text{steel}} = 12 \times 10^{-6}.^{\circ} C^{-1}$.

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12. At certain temperature the pendulum of clock keeps correct time. The coefficient of lienar expansion for the pendulum material is $\alpha = 1.85 \times 10^{-5} \circ c^{-1}$. How much will the clock gain or lose in 24 hours if the ambient temperature is $10^{\circ} C$ higher?

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13. A clock pendulum made of invar has a period of 0.5 s at $20^{\circ}C$. If the clock is used in a climate where average temperature is $30^{\circ}C$,what correction may be necessary at the end of 30 days $\alpha_{\text{invar}} = 7 \times 10^{-7}(.^{\circ}C)^{-1}$

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14. The time period of a physical pendulum is given by $T = 2\pi\sqrt{\frac{I}{mgl}}$. Where m= mass of the pendulum I= moment of inertia about the axis of suspension, l= distance of centre of mass of bob from the centre of suspension. Calculate the change in time period when

temperature changes by ΔT. The coefficient of linear expansion of the material of pendulum is α.

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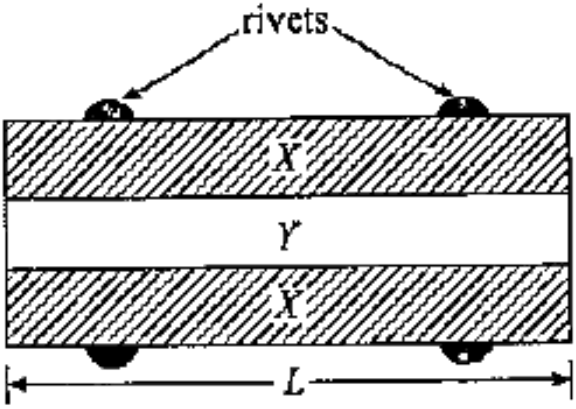
15. Two rods of material X sandwich another rod of material Y as shown in figure. At temperature t, the three rods are in a state of zero strailn and of length L and riveted to each other in this state. If the temperature of the system increases to $T + \Delta T$, find the final length of the system of the three rods. Given that the coefficients of linear expansions of the roods and their Young's modulus for material X and Y are $alpna_x, \alpha_y, Y_x$ and Y_y

respectively. Consider $\alpha_y > \alpha_x$.



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16. In a mercury in glass thermometer the cross section of the capillary is A_0 and volume of the bulb is V_0 at $0^\circ C$. If mercury just fills the bulb at $0^\circ C$, find the that the length of mercury in the capillary at temperature $t.^\circ C$. Given that β=coefficient of cubical, expansion on mercury and $\alpha =$ coefficient of linear expansion of glass.

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17. A 1-L flask contains some mercury. It is found that at different temperature, the volume of air inside the flask remains the same. What is the volume of mercury in the flask, given that the coefficient of linear expansion of glass $= 9 \times 10^{-6} / ^{\circ} C$ and the coefficient of volume expansion of $Hg = 1.8 \times 10^{-4} / ^{\circ} C$?

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18. Some steem balls are fixed at the bottom of a silica bulb of negligible exapnsivity. The bulb holds 340 gm of mercury at $0^{\circ} C$ when filled, in the absence of the steel

balls and 255 gm of mercyr, when the steel balls are inside. On heating the bulb and its contents (steel balls and mercury) to $100^{\circ} C$, 4.5 gm of mercury overflows. Find the coefficient of linear expansion of steel. $\gamma_{Hg} = 180 \times 10^{-6}.^{\circ} C^{-1}$

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19. If a liquid is contained in a long narrow rigid vessel so it an expand in essentially one direction only, show that the effective coefficient of linear expansion α of liquid is approximately equal to the coefficient of volume expansion β of liquid.

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20. In observing thereal expansion of a liquid a certain part of glass vessel is to be filled with a liquid of volume expansion $\gamma = 18 \times 10^{-5}$ in order to exclude the effect of the change in remaining volume of the vessel during heating. What fraction of the vessel should be filled wiht the liquid? The coefficient of linear expansion of glass is $= 9.0 \times 10^{-6}$.

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21. A clock with a metallic pendulum gains 6 seconds each day when the temperature is $20^{\circ}C$ and loses 6 second when the temperature is $40^{\circ}C$. Find the coefficient of linear expansions of the metal.

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22. The coefficient of apparent expansion of a liquid when determined using two different vessle A and B are γ_1 and $\gamma_{2,}$ respectily. If the coefficient of linerar expansion of vesel A is α. Find the coefficient of linear expension of the vessel B.

A.

B.

C.

D.

Answer: $\frac{\gamma_1 - \gamma_2 + 3\alpha_1}{3}$

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23. A solid whose volume does not change with temperature floats in a liquid. For two different temperatures t_1 and t_2 of the liqiud, fraction f_1 and f_2 of the volume of the solid remain submerged in the liquid. The coefficient of volume expansion of the liquid is equal to

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24. A small quantity of a liquid which dows not mix with water sinks to the bottom at 20°C, the densities of the liquid and water being 1021 and $990 kg/m^3$, respectively. To what teperature must the mixture be uniformly heated

in order that the liquid forms globules which just float on water ? the cubical expansion of the liquid and water over the temperature ranges is $85 \times 10^{-5} / K$ and $45 \times 10^{-5} / K$ respectively.

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25. A can of water of volume $0.5 m^3$ at a temperature $30^\circ C$ is cooled to $15^\circ C$. Neglect heat capacity of the can. If the amount of heat released by water is used to a box of weight 10 kg, find the height to whilch it can be lifted. Given that specific theat of water is $4200 J / kg.^\circ C$. Take $g = 10 m / s^2$.

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26. 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

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27. A water heater can generate 8500 kcal/hr. How much water can it heat from $10^{\circ}C$ to $60^{\circ}C$ per hour? Use specific heat of water $4500Jkg.^{\circ}C$

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28. When a $290gm$ piece of iron at $180^\circ C$ is placed in a $100gm$ aluminium calorimeter cup containing $250gm$ of glycerin at $10^\circ C$, the final temperature is observed to be $38^\circ C$. What is the specific heat of glycerin? Use specific heat of iron 470 J/k K and that of aluminium is 900 J/kg K.

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29. The specific heat of solids at low temperatures varies with absolute temperature T according to the relation $S = AT^3$, where A is a constant. The heat energy required to raise the temperature of a mass m of such a solid from $T = 0$ to $T = 20K$ is:

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30. A certain calorimeter has a water equivalent of 4.9 gm. That is in heat exchanges, the calorimeter behaves like 4.9 gm of water. It contains 40 gm of oil at $50.0^\circ C$. When 100 gm of lead at $30.0^\circ C$ is added, the final temperature is $48.0^\circ C$. What is the specific heat capacity of the oil?

[Take $S_{\text{water}} = 1cal/gm.^\circ C$, $S_{\text{lead}} = 0.305\text{cal}/gm.^\circ C$]

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31. $5g$ ice at $0^\circ C$ is mixed with $5g$ of steam at $100^\circ C$. What is the final temperature?

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32. A block of ice of mass M= 50 kg slides on a horizontal surface. It starts with a speed v=5.0m/s and finally stops after movng a distance s=30 m. What is the mass of ice that has melted due to friction between block and surface? Latent heat is fusion of ice is $L_f = 80$ cal/g.

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33. The temperature of a body rises by $44^\circ C$ when a certain amount of heat is given to it . The same heat when supplied to 22 g of ice at $-8^\circ C$, raises its temperature by $16^\circ C$. The water eqivalent of the body is $[Given: s_{water} = 1\text{cal}/g^\circ C$ & $L_t = 80\text{cal}/g, s_{\text{ice}} = 0.5\text{cal}/g^\circ C]$

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34. In a mixture of $35g$ of ice and $35g$ of water in equilibrium, $4gm$ steam is passed. The whole mixture is in a copper calorimeter of mass $50g$. Find the equilibrium temperature of the mixture. Given that specific heat of water is 4200 J/kg K and that of copper is 420 J/Kg K and latent heat of fusion of ice is 3.36×10^5 J/kg and latent heat of vaporization of water is 2.25×10^6 J/kg.

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35. A lead bullet just melts when stopped by an obstacle. Assuming that 25 per cent of the heat is absorbed by the obstacle, find the velocity of the bullet if its initial

temperature is $27^{\circ}C$. (Melting point of lead $= 327^{\circ}C$, specific heat of lead $= 0.03cal/g.^{\circ}C$, latent heat of fusion of lead $= 6cal/g$, $J = 4.2J/cal$).

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36. Aluminium container of mass of 10 g contains 200 g of ice at $-20^{\circ}C$. Heat is added to the system at the rate of 100 calories per second. What is the temperature of the system after four minutes? Draw a rough sketch showing the variation of the temperature of the system as a function of time . Given:

Specific heat of ice = $0.5\text{cal}g^{-1}(.^{\circ}C)^{-1}$

Specific heat of aluminium = $0.2\text{cal}g^{-1}(.^{\circ}C)^{-1}$

Latent heat of fusion of ice = $80\text{cal}g^{-1}$

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37. 1 kg of ice at $0^\circ C$ is mixed with 1 kg of steam at $100^\circ C$. Find the equilibrium temperature and the final composition of the mixture. Given that latent heat of fusion of ice is 3.36×10^5 J/kg and latent heat of vaporization of water is 2.27×10^6 J/kg. Specific heat of water is $4200 J / kg.^\circ C^{-1}$

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38. When a block of metal of specific heat $0.1 cal / g /^\circ C$ and weighing 110 g is heated to $100^\circ C$ and then quickly transferred to a calorimeter containing $200 g$ of a liquid at $10^\circ C$, the resulting temperature is $18^\circ C$. On repeating

the experiment with 400 g of same liquid in the same calorimeter at same initial temperature, the resulting temperature is $14.5^{\circ}C$. find

a. Specific heat of the liquid.

b. The water equivalent of calorimeter.

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39. A pitcher contains 10 kg of water at $20^{\circ}C$. Water comes to its outer surface through its porus walls and gets eveaporated. The latent heat required for evaporation is taken from the water inside the pithcer, thus the inside water is cooled down. It is given that the rate of evaporation is 0.2 g/s. Calculate the time in which the temperature of the water inside drops is $15^{\circ}C$. Given

that the specific heat of water is $4200 J / kg^{\circ} C$ and latent heat of vaporization of water is 2.27×10^{6} J/kg.

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40. A pitcher contains 1 kg water at $40^{\circ} C$. It is given that the rate of evaporation of water from the surface of pitcher is 50 gm/s. Find the time it will take to cool down the water inside to $30^{\circ} C$. Given that latent heat of vaporization of water is 540 cal /g and specific heat of water is $1 \mathrm{cal} / g .^{\circ} C$.

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Discussion Question

1. Explain why some rubber-like substances contract with rising temperature.

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2. Two thermometer are constructed in the same way except that one has a spherical bulb and the other has an elongted cylindrical bulb. Which out of the two will respond quickly to temperature change?

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3. Two large holes are cut in a metal sheet. If this is heated, will their diameters increase or decrease?

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4. A long metal rod is bent to form a ring with a small gap if this is heated, will this gap increase or decrease?

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5. A tightnened glass stopper can be taken out easily by pouring hot water around the nect of the bottle. Why it is so?

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6. The latent heat of fusion of a substance is always less than the latent heat vapourization or latent heat of sublimation of the same substace. Explain.

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7. Comment on the following statements.

(a) Evaporation produces cooling.

(b) Rate of evaporation of an aqueous solution decreases with increases with increase in humidity .

(c) Sponge though compressible is a solid.

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8. Is boiling of a liquid is possible without supplying heat?

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9. Why an ice block melt at the bottom first?

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10. In summers water kept in a pitcher is cooler as compared to water kept in a brass vessel but in rainy season water kept in brass vessel is cooler as compared to that in pitcher. Why?

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11. Wet clothes dry faster on a winter day than on a summer day. Explain.

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12. Why does it take longer to cook food in the mountains than in the plains?

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13. A flat uniform cylinder of lead floats in mercury at $0^{\circ} C$. Will the lead float higher or lower when the temperature is raised?

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14. The Pyrex glass is having very low coefficient of linear expansion. It is also used as a very good transparent heat resistor as compared to ordinary glass. Explain?

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15. Which will evaporation faster, water or alcohol ?

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16. Why does water in a steel container stay cooler if a cloth jacket surrounding the container is kept moist?

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17. Why does steam cause more severe burns than boiling water ?

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18. A thermometer is laid out in direct sunlight. Does it measure the temperature of the air, or that of sun or what it measures?

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19. Thermometers sometimes contain red or blue liquid, which is often ethanol. What advantages and

disadvantages does this have compared to mercury.

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20. Coolants are used in automobiles to cool engine. What can you say about specific heat of material used for coolant high or low.

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21. Water coolers used to cool room by blowing air in room thorugh a water soaked dry grass filter. How does this work. Would it work well in a high humidity climate?

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22. In cold countries, water pipes sometimes burst, because

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23. Glasses containing alcoholic drinks sometimes form frost on the outside. How does this happen?

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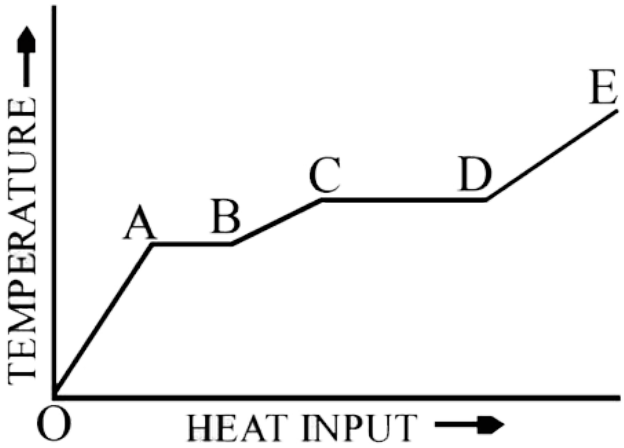
24. A solid material is supplied with heat at a constant rate. The temperature of the material is changing with the heat input as shown in the graph in figure. Study the graph carefully and answer the following questions:



(i) What do the horizontal regions AB and CD represent?

If CD is equal to 2AB, what do you infer?

What does the slope of DE represents?

The slope of OAgtthe slope of BC. What does this indicate?

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Conceptual Mcqs Single Option Correct

1. A vertical glass jar is filled with water at $10^{\circ}C$. It has one thermometer at the top and another at the bottom. The central region of the jar is grdually cooled. It is found that the bottom thermometer reads $4^{\circ}C$ earlier than the top thermometer. And the top thermometer reads $0^{\circ}C$. earlier than the bottom thermometer. This happens because

A. The top thermometer is faulty

B. The bottom thermometer is faullty

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

D. Density of water is minimum at $0^{\circ}C$

Answer:

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2. Two spheres A and B are made of the same material and have the same radius. Sphere A is hollow alnd sphere B is solid. Both the spheres are heated to the same temperature. Which of the following is correct ?

A. It will be more for hollow sphere

B. It will bemore for solid sphere

C. It will be same for both sphers

D. Ilt may be more or less depending on the ratio of the diameters of the two spheres.

Answer:

Watch Video Solution

3. If water at $0^{\circ}C$ kept in a container with an open top, is placed a large evacuated chamber,

A. All the water will vaporize

B. All the water will freeze

C. Part of the water will vaporize and the rest will freeze

D. Ice, water and water vapour will be formed and reached equilibrium at the triple point

Answer:

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4. What determines the ratio of specific heat capacityy to molar heat capacity of a compound?

A. Universal gas constant

B. Mass of the compound

C. Molecular weight of the compound

D. None of the above

Answer:

Watch Video Solution

5. A bimetal made of copper and iron strips welded together is straight at room temprature. It is held

vertically so that the iron strip is towards the left hand and copper strip is then heated. The bimetal strip will

A. Remain straight

B. Bend towards right

C. Bend towards left

D. No change

Answer:

Watch Video Solution

6. When a copper sphere is heated percentage change:

A. Is maximum in radius

B. Is maximum in area

C. Is maximum in density

D. Is equal in radius, area and density

Answer:

Watch Video Solution

7. A metal ball immersed in water weighs w_1 at $5^\circ C$ and w_2 at $50^\circ C$. The coefficient of cubical expansion of metal is less than that of water. Then

A. $W_1 > W_2$

B. $W_1 < W_2$

C. $W_1 = W_2$

D. Data is insufficient

Answer:

Watch Video Solution

8. Which of the following pehnomena gives evidence of the molecule motion ?

A. Brownian movment

B. Diffusion

C. Evaporation

D. All the above

Answer:

Watch Video Solution

9. Which one the following statements is NOT true about the evaporation process?

A. Evaporation takes place from the surface of a liquid at all temperature

B. The rate of evaporation depends upon the area of the exposed surface of the liquid, natue of the liquid and its temperature

C. The rate of evaporation is independent of the pressure to which the liquid in subjected

D. The cooling produced in evaporation is a consequence of the face that a liquid has latent heat

Answer:

Watch Video Solution

10. Two spheres of samemetal have the same volume. But one is solid and the other is hollow, when the change in temperature of both of them is same, which of the following statements about the change in their diameters is true?

A. More for solid spheres

B. More for hollow sphere

C. Same for both spheres

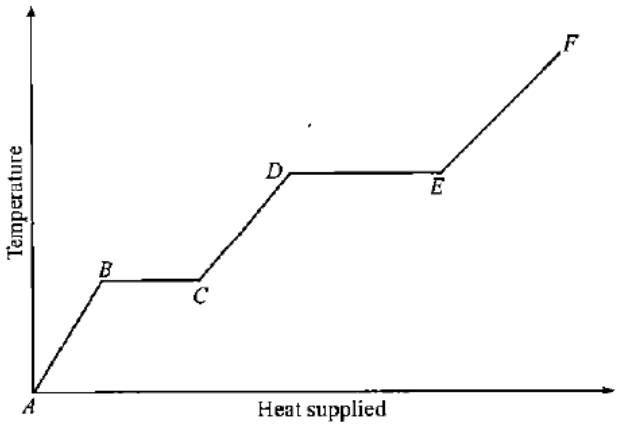
D. It cannot be predicted

Answer:

Watch Video Solution

11. A source of heat supplies heat at constant rate to a solid cube. The variatiion of the temperature of the cube with heat supplied is shown in figure. The portion DE of

the graph represents conversion of



A. Solid into liquid

B. Liquid into vapour

C. Solid into vapour

D. Vapour into liquid

Answer:

Watch Video Solution

12. A bimetalic strip is made of two strips A and B, having co-efficeint of linear expansion as α_A and α_B. If $\alpha_A > \alpha_B$ which of the following describes the behavior fo the metallic strip when heated?

A. It will bend but will not elongate

B. It will bend the metal A s the outer side

C. It will bend with metal B as the outer side

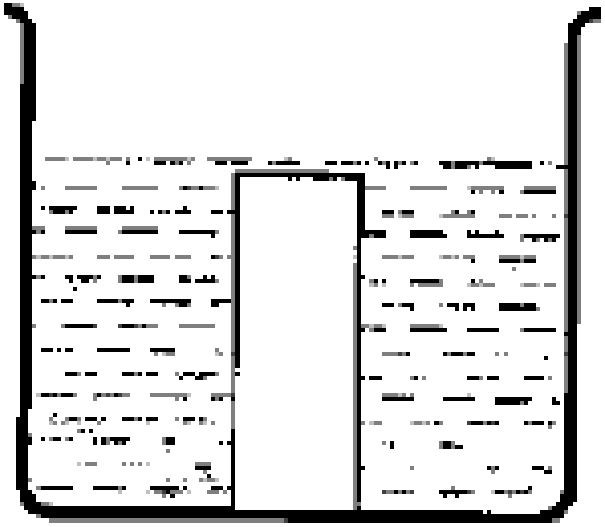
D. It will not bend

Answer:

Watch Video Solution

13. In a cylidrical glass container a solid silica is placed vertically at its bottom and remaining space is filled with mercury upto the top level of the silica. The volume of silica remains unchanged with variation in temperature. The coefficient of cubical expansion of mercury is γ and coefficient of linear expansion of glass is α. If the top surface of silica and mercury level remain at the same level wiht the variation in temperature then the ratio of volume

of silica tothe volume of mercury is equal:



A. $\frac{\gamma}{2\alpha}$

B. $\frac{\gamma}{3\alpha}$

C. $\frac{\gamma}{2\alpha} - 1$

D. $\frac{\gamma}{3\alpha} - 1$

Answer:

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14. The heat (Q) supplied to a solid, which is otherwise thermally isolated from it surrounding, is plotted as a function of its absolute temperature, θ. If is found that they are related by the equation$Q = a\theta^2 + b\theta^4$ (a, b are constants). The heat capacity of the solid is,

A. $a\frac{\theta^3}{3} + b\frac{\theta^5}{5}$

B. $a\theta + b\theta^3$

C. $a\frac{\theta}{3} + b\frac{\theta^5}{5}$

D. $2a\theta + 4b\theta^3$

Answer:

Watch Video Solution

15. The coefficient of linear expansion of an in homogeneous rod change linearly from α_1 to α_2 from one end to the other end of the rod. The effective coefficient of linear expansion of rod is

A. $\alpha_1 + \alpha_2$

B. $\frac{\alpha_1 + \alpha_2}{2}$

C. $\sqrt{\alpha_1 \alpha_2}$

D. $\alpha_1 - \alpha_2$

Answer:

Watch Video Solution

Numerical Mcqs Single Options Correct

1. Two rods of length l_1 and l_2 are made of material whose coefficient of linear expansion are α_1 and α_2 , respectively. The difference between their lengths will be independent of temperatiure if l_1 / l_2 is to

A. $\frac{l_1}{l_2} = \frac{\alpha_2}{\alpha_1}$

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

C. $\frac{l_1}{l_2} = \frac{\alpha_1}{\alpha_2}$

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

Answer:

Watch Video Solution

2. The loss of weight of a solid when immersed in a liquid at $0^\circ C$ is W_0 and at $t^\circ C$ is $'W'$. If cubical coefficient of expansion of the solid and the liquid are γ_s and γ_1 then $W =$

A. $W = W_0[(\gamma_s - \gamma_l)]$

B. $W = W_0[1 = (\gamma_2 + \gamma_l)t]$

C. $W = \dfrac{W_0 t}{\gamma_l - \gamma_s}$

D. $W = W_0[1 - (\gamma_s - \gamma_l)t]$

Answer:

Watch Video Solution

3. Two liquids are at temperatures $20^\circ C$ and $40^\circ C$. When same mass of both of them is mixed, the temperature of the mixture is $32^\circ C$. What is the ratio of their specific heats?

A. 43833

B. 43864

C. 43835

D. 43866

Answer:

Watch Video Solution

4. The densities of two materials X and Y are in the ratio 1:3. Their specific heats are in the ratio 3:1. If we take same volumes of the two substances, the ratio of their thermal capacities will be

A. $1:1$

B. $1:3$

C. $1:6$

D. $1:9$

Answer:

Watch Video Solution

5. A metallic container is completely filled with liquid. The coefficient of linear expansion of the metal is 2.0×10^{-6} per $.^{\circ} C$ and the coefficient of cubical expansion of the liquid is 6.0×10^{-6} per $.^{\circ} C$. On heating the vessel

A. The liquid will overflow

B. The level of the liquid will fall

C. The level of the liquid will remain unchanged

D. The level of liquid will rise or all depending on the of the metal and of the liquid

Answer:

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6. At $40^\circ C$, a brass rod has a length 50 cm and a diameter 3.0 mm. it is joined to a steel rod of the same length and diameter at the same temperature. What is the change in the length of the composite rod when it is heated to $240^\circ C$? The coefficient of liear expansion of brass and steel are $2.0 \times 10^{-5}.^\circ C^{-1}$ and $1.2 \times 10^{-5}.^\circ C^{-1}$ respectively:

A. 0.28 cm

B. 0.30 cm

C. 0.32 cm

D. 0.34 cm

Answer: 0.32 cm

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7. A uniform solid brass sphere is rotating with angular speed ω_0 about a diameter. If its temperature is now increased by $100^\circ C$, what will be its new angular speed. (given$\alpha_B = 2.0 \times 10^{-5} per^\circ C$)

A. $1.1\omega_0$

B. $1.01\omega_0$

C. $0.996\omega_0$

D. $0.824\omega_0$

Answer:

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8. An aluminium measuring rod, which is correct at $5^{\circ}C$ measures the length of a line as 80 cm at $45^{\circ}C$ If thermal coefficient of linear expansion of aluminium is $2.50 \times 10^{-4}/^{\circ}C$, the correct length of the line is:

A. 80.08 cm

B. 79.92 cm

C. 81.12 cm

D. 79.62 cm

Answer:

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9. A thin copper wire of length l increases in length by 1% when heated from $0^\circ C$ to $100^\circ C$. If a then copper plate of area $2l \times l$ is heated from $0^\circ C$ to $100^\circ C$, the percentage increases in its area will be

A. 1

B. 2

C. 3

D. 4

Answer:

Watch Video Solution

10. Which one of the following would raise the temperature of 20 g of water at $30^{\circ}C$ most when mixed with?

(Specific heat of water is $1cal/g - .^{\circ} C$)

A. 20 gm of water ate $40^{\circ}C$

B. 40 gm of water at $35^{\circ}C$

C. 10 gm of water at $50^{\circ}C$

D. 4 gm of waer of $80^{\circ}C$

Answer:

Watch Video Solution

11. The lower and upper fixed points of faulty thermometer are 5° and 99° respectively. If the reading of the thermometer is 52°, the temperature on the Fahrenheit scale is

A. $132^\circ F$

B. $122^\circ F$

C. $154^\circ F$

D. $151^\circ F$

Answer:

Watch Video Solution

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

A. $25^\circ C$

B. $40^\circ C$

C. $15^\circ C$

D. $12.5^\circ C$

Answer:

Watch Video Solution

13. The temperature of a body on Kelvin scale is found to be x K . When it is measured by Fahrenheit thermometer, it is found to be $x^{\circ} F$, then the value of x is

A. 301.25

B. 588.45

C. 313

D. 40

Answer:

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14. A 1-L flask contains some mercury. It is found that at different temperature, the volume of air inside the flask remains the same. What is the volume of mercury in the flask, given that the coefficient of linear expansion of glass $= 9 \times 10^{-6} / ^{\circ} C$ and the coefficient of volume expansion of $Hg = 1.8 \times 10^{-4} / ^{\circ} C$?

A. $50 cm^3$

B. $100 cm^3$

C. $150 cm^3$

D. $200 cm^3$

Answer:

Watch Video Solution

15. The readings of a thermometer at $0^\circ C$ and $100^\circ C$ are $50cm$ and $75cm$ of mercury column respectively. Find the temperature at which its reading is $80cm$ of mercury column ?

A. $105^\circ C$

B. $110^\circ C$

C. $115^\circ C$

D. $120^\circ C$

Answer:

Watch Video Solution

16. A wire of cross sectional ara A at temmperature T is held taut with negligible tension between two ridig supports . If the wire is cooled to a temperature $(T - \Delta T)$, what tension is developed in the wire? The coefficient of linear expansion is α and the Young's modulus of the wires is Y

A. $YA\alpha\Delta T$

B. $\frac{Y\alpha\Delta T}{A}$

C. $(A\alpha\Delta T)Y$

D. $\frac{YA}{\alpha\Delta T}$

Answer:

Watch Video Solution

17. A drilling machine of power P watts is used to drill a hole in copper block of mass M kg. If the spcific heat of coper is $sjkg^{-1}.^{\circ}C^{-1}$ and 40% of the powder is lost due to theating of the machine, the rise in the temperature of the block in T seconds will be (in $.^{\circ}C$)

A. $\frac{0.6PT}{Ms}$

B. $\frac{0.6P}{MsT}$

C. $\frac{0.4PT}{Ms}$

D. $\frac{0.4P}{MsT}$

Answer:

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18. A 2 kg copper block is heated to $500^\circ C$ and then it is placed on a large block of ice at $0^\circ C$. If the specific heat capacity of copper is $400\mathrm{J/kg/}^\circ C$ and latent heat of fusion of water is 3.5×10^5 J/kg. The amount of ice that can melt is :

A. $\frac{4}{3}kg$

B. $\frac{6}{5}kg$

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

D. $\frac{10}{9}$ kg

Answer:

Watch Video Solution

19. 5 gm of steam at $100^\circ C$ is passed into six gm of ice at $0^\circ C$. If the latent heats of steam and ice in cal per gm are 540 and 80 respectively, then the final temperature is -

A. $0^{©}$

B. $50^\circ C$

C. $30^\circ C$

D. $100^\circ C$

Answer:

Watch Video Solution

20. A water fall is 84 m high. Assuming that half the kinetic energy of falling water get converted to heat, the rise in temperature of water is

A. $0.098^\circ C$

B. $0.98^\circ C$

C. $98^\circ C$

D. $0.0098^\circ C$

Answer: A

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21. The density of a liquid of coefficient of cubical expansion γ is ρ at $0^{\circ}C$ when the liquid is heated to a temp T, the change in density will be

A. $-\frac{\rho\gamma T}{(1+\gamma T)}$

B. $\frac{\rho\gamma T}{(1+\gamma T)}$

C. $\frac{-(\rho(1+\gamma T))}{\gamma T}$

D. $\frac{\rho(1+\gamma)T}{\gamma T}$

Answer: A

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22. A glass flask of volume $1000cm^3$ is completely filled with mercury at $0^\circ C$. The coefficient of cubical epansioni of mercury is $182 \times 10^{-6}/.^\circ C$ and that of glas ils $30 \times 10^{-6}/.^\circ C$, how much mercury will over flow? When heated to $100^\circ C$

A. $30cm^3$

B. $18.2cm^3$

C. $15.2cm^2$

D. $3cm^2$

Answer: C

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23. 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. $0.2 \times 10^{-4}.^\circ C^{-1}$

B. $0.4 \times 10^{-4}.^\circ C^{-1}$

C. $0.6 \times 10^{-4}.^\circ C^{-1}$

D. None of the above

Answer:

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24. When x grams of steam at $100^\circ C$ is mixed with y grams of ice at $0^\circ C$, we obtain $(x + y)$ grams of water at

$100^\circ C$. What is the ratio y/x ?

A. 1

B. 2

C. 3

D. 4

Answer:

Watch Video Solution

25. Heat required to convert 1 g of ice at $0^\circ C$ into steam at $100^\circ C$ is

A. 100 cal

B. 0.01 kcal

C. 716 cal

D. 1 kcal

Answer:

Watch Video Solution

26. A piece of metal floats on mercury. The coefficients of volume expansion of the metal and mercury are γ_1 and γ_2 respectively. If the temperatures of both mercury and the metal are increased by an amount ΔT, the fraction of the volume of the metal submerged in mercury changes by the factor.....

A. $\left(\frac{1+\gamma_2\Delta T}{1+\gamma_1\Delta t}\right)$

B. $\left(\frac{1+\gamma_2\Delta t}{1-\gamma_1\Delta T}\right)$

C. $\left(\frac{1-\gamma_2\Delta T}{1+\gamma_1\Delta T}\right)$

D. $\frac{\gamma_2}{\gamma_1}$

Answer:

Watch Video Solution

27. Heat required to melt 1 g of ice is 80 cal. A man metls 60 g of ice by chewing in one minute. His power is

A. 4800 W

B. 336 W

C. 1.33 W

D. 0.75 W

Answer:

Watch Video Solution

28. A rod of length 20 cm made of metal A expands by 0.075 when its temperature is raised from 0°C to $100^\circ C$. Another rod of a different metal B having the same length expands by 0.045 cm for the same change in temperature. A third rod of the same length is composed of two parts, one of metal A and other of metal B. This rod expands by 0.065 cm for the same change in temperature. The portion made of metal A has the length :

A. 20 cm

B. 10 cm

C. 15 cm

D. 18 cm

Answer:

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29. When a metallic bar is heated from $0^\circ C$ to $100^\circ C$ its length increases by 0.05%. What is the coefficient of linear expansion of the metal?

A. $5 \times 10^{-3}.^\circ C^{-1}$

B. $5 \times 10^{-4}.^\circ C^{-1}$

C. $5 \times 10^{-5}.^{\circ} C^{-1}$

D. $5 \times 10^{-6}.^{\circ} C^{-1}$

Answer:

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30. A thin metal square plate has length l. when it is heated from $0^{\circ} C$ to $100^{\circ} C$ its length increases by 1%. What is the percentage increase in the area of the plate?

A. 2.00%

B. 2.02%

C. 2.03%

D. 2.01%

Answer: A

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31. How many grams of ice at $0^\circ C$ should be mixed with 240 g of water at $40^\circ C$ so that the ice completely melts and the final temperature is of $0^\circ C$?

A. 120 g

B. 240 g

C. 360 g

D. 480 g

Answer: A

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32. Three liquids with masses m_1, m_2, m_3 are thoroughly mixed. If their specific heats are c_1, c_2, c_3 and their temperatures T_1, T_2, T_3 respectively, then the temperature of the mixture is

A. $\frac{s_1\theta_1 + s_2\theta_2 + s_3\theta_3}{m_1s_1 + m_2s_2 + m_3s_3}$

B. $\frac{m_1s_1\theta_1 + m_2s_2\theta_2 + m_3s_3\theta_3}{m_1s_1 + m_2s_2 + m_3s_3}$

C. $\frac{m_1\theta_1 + m_2\theta_2 + m_3\theta_3}{s_1\theta_1 + s_2\theta_2 + s_3\theta_3}$

D. $\frac{m_1\theta_1 + m_2\theta_2 + m_3\theta_3}{s_1\theta_1 + s_2\theta_2 + s_3\theta_3}$

Answer:

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33. An electric kettle contains 1.5 kg of water of $100^{\circ}C$ and is poweredby a 2.0 kW electric element. If the thermostat of the kettle fails to operate, approximately how long will thekettle take to boil dry? (Take the specific latent heat of vaporisation of water as $2000kJkg^{-1}$)

A. 500s

B. 1000s

C. 1500s

D. 3000s

Answer:

Watch Video Solution

34. A Celsius thermometer and a Fahrenheit thermometer are put in a hot bath. The reading on Fahrenheit thermometer is just 3 times the reading on Celsius thermometer. The temperature of the hot bath is

A. 80/3

B. 80

C. 160/3

D. 160

Answer:

Watch Video Solution

35. The fundamental interval, that is the number of divisions between LFP and UFP on the two scales X and Y are 50 and 150 respectively. The ice point on both the scales is at 0°. If the temperature on the X scaleis 15°, then what is the temperature on the Y-scale?

A. 30°

B. 45°

C. 60°

D. 75°

Answer:

Watch Video Solution

36. At 30°C, the hole in a steel plate has diameter of 0.99970 cm. A cylinder of diameter exactly 1 cm at 30°C is to be slide into the hole. To what temperature the plate must be heated?

(Given $\alpha_{Steel} = 1.1 \times 10^{-5^\circ} C^{-1}$

A. $40^\circ C$

B. $50^\circ C$

C. $60^\circ C$

D. $70^\circ C$

Answer:

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37. A linear accelerator consists of a hundred brass discs tightly fitted into a steel tube. At $40^{\circ}C$ the diameter of each disc is 10.02 cm. The system is assembled by cooling the discs in dry ice at $-60^{\circ}C$ to enable them to slide into the close fitting tube. if the coefficient of linear expansion of brass is $2 \times 10^{-5}.^{\circ} C^{-1}$, the diameter of each disc in dry ice will be

A. 9.94 cm

B. 9.96 cm

C. 9.98 cm

D. 10.00 cm

Answer:

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38. At the top of the mountain the temperature is $-13^{\circ}C$ and the barometer reads 68 cm of Hg. At the bottom the temperature is $27^{\circ}C$ and the barometer reads 70 cm of Hg. What is the ratio of the densities of the air at the mountain to that the sea level?

A. 1.03

B. 1.12

C. 1.15

D. 1.24

Answer:

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39. 300 grams of water at $25^\circ C$ is added to 100 grams of ice at $0^\circ C$. The final temperature of the mixture is _____ $\hat{} \circ C$

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

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

C. $-5.^\circ C$

D. $0.^\circ C$

Answer:

Watch Video Solution

40. 100 g of ice at $0^\circ C$ is mixed with 100 of water $80^\circ C$. The final temperature of the mixture will be

A. $0^\circ C$

B. $20^\circ C$

C. $40^\circ C$

D. $60^\circ C$

Answer: A

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41. Thermocouples are used to measure temperature in the linear parts of the emf versus temperature graph wilth

cold junction at $0^\circ C$. The thermo electric power of Pt, Ni thermocouple are =-4 and -20 microcolt per $.^\circ C$ respectively. What will be the magnitudes of emfs of the thermocopule when thecold junction is at $0^\circ C$ and the hot junction is at $100^\circ C$?

A. 4mV

B. 2mV

C. 3.2mV

D. 1.6 mV

Answer:

Watch Video Solution

42. When a platinum resistance thermometer is put in contact with ice, steam and a liquid, the resistance of platinum wire recorded are 2.56 ohm, 3.56 ohm and 5.06 ohm respectively. The temperatue of the luqiud is

A. $100^\circ C$

B. $250^\circ C$

C. $40^\circ C$

D. $25^\circ C$

Answer:

Watch Video Solution

43. When a celsium thermometer reads $90^\circ C$, a faulty Fahrenheit thermometer reads $190^\circ F$. The correction to be made in the latter scale is

A. $+2^\circ F$

B. $-2^2 F$

C. $-4^\circ F$

D. $+4^\circ F$

Answer:

Watch Video Solution

44. The upper and lower fixed points of a faulty mercury thermometer are $210^\circ F$ and $34^\circ F$ respectively. The correct temperature read by this thermometer is

A. $22^\circ F$

B. $80^\circ F$

C. $100^\circ F$

D. $122^\circ F$

Answer:

Watch Video Solution

45. Two straight metallic strips each of thickness t and length l are rivetted together. Their coefficients of linear expansions are $\alpha_1 \text{and} \alpha_2$. If they are heated through temperature ΔT, the bimetallic strip will bend to form an arc of radius

A. $t/(\alpha_1 + \alpha_2)$

B. $t/(\alpha_1 - \alpha_2)\Delta T$

C. $t(\alpha_1 + \alpha_2)\Delta T$

D. $t(\alpha_1 - \alpha_2)\Delta T$

Answer:

Watch Video Solution

46. A metal cube of length of 10.0 mm at $0^\circ C$ is heated to $200^\circ C$. Given: its coefficient of linear expansion is $2 \times 10^{-5} K^{-1}$. The percent change of its volume is

A. 0.1

B. 0.2

C. 0.4

D. 1.2

Answer:

Watch Video Solution

47. Two thermometers x and y fundamental intervals of 80° and 120°. When immersed in ice, they show the

readings of 20° and 30°. If y measures the temperatures ofa body as 120°, the reading of x is

A. 55°

B. 65°

C. 75°

D. 80°

Answer:

Watch Video Solution

48. Which of the following temperatures is the highest?

A. $100K$

B. $-13^\circ F$

C. $-20^\circ C$

D. $-23^\circ C$

Answer:

Watch Video Solution

49. A difference of temperature of $25^\circ C$ is equivalent to a difference of

A. $45^\circ F$

B. $72^\circ F$

C. $32^\circ F$

D. $25^\circ F$

Answer:

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50. A thermometer has wrong calibration (of course at equal distances and the capillary is of uniform diameter). It reads the melting pont of ice as $-10^\circ C$. It reads $60^\circ C$ in place of 50°. The temperature of boiling point of water on this scale is

A. $100^\circ C$

B. $130^\circ C$

C. $110^\circ C$

D. $120^\circ C$

Answer:

Watch Video Solution

51. A fixed mass of an ideal gas is maintained at constant volume. The pressure of the gas at the triple point of water is p_{tr}. What is the thermodynamic temperature of the gas when its pressure is p?

A. $273.16\left(\frac{p_{tr}}{p}\right)K$

B. $273.16\left(\frac{p}{p_{tr}}\right)K$

C. $273.16\left(\frac{p-P_{tr}}{P_{tr}}\right)K$

D. $273.16\left(\frac{p-P_{tr}}{P}\right)K$

Answer:

Watch Video Solution

52. A graph is plotted between the temperature of a copper cube in $.^{\circ} C$ versus $.^{\circ} F$. The sine of the angle made by the graph with $.^{\circ} F$ axis is

A. $\frac{2}{\sqrt{106}}$

B. $\frac{3}{\sqrt{106}}$

C. $\frac{4}{\sqrt{106}}$

D. $\frac{5}{\sqrt{106}}$

Answer:

Watch Video Solution

Watch Video Solution

53. At what temperature do the Kelvin and Celsius scales coincide?

A. 0°

B. 3°

C. -9°

D. They never agree

Answer:

Watch Video Solution

54. The resistance of the platinum resistance thermometer at the triple point of water is 15.00Ω and that when put inside the furnace is found to be 30.00Ω. What is the temperature of the furnace?

A. 136.58 K

B. 273.16 K

C. 409.74 K

D. 546.32 K

Answer:

Watch Video Solution

55. An iron metre rod is allowed an error of 1 part per milliion. If the coefficient of linear expansion of ironis $1 \times 10^{-5}.^{\circ} C^{-1}$, what is the maximum variation in temperature that the rod could have?

A. $\pm 0.1K$

B. $\pm 0.01K$

C. $\pm 1.00K$

D. $\pm 10.00K$

Answer:

Watch Video Solution

56. On a hypothetical scale X, the ice point is 40° and the steam point is 120°. For another scale Y the ice point and steam points are -30° and 130° respectively. If X-reads 50° The reading of Y is

A. -5°

B. -8°

C. -10°

D. -12°

Answer:

Watch Video Solution

57. A Fahrenheit thermometer reads $113^\circ F$ while a faulty Celsius thermometer reads $44^\circ C$. The correct required to be applied to the Celsius thermometer is:

A. $+1^\circ C$

B. $-1^\circ C$

C. $+2^\circ C$

D. $-2^\circ C$

Answer:

Watch Video Solution

58. A steel scale measures the length of a copper rod as l_0 when both are at $20^\circ C$, which is the calibration temperature for the scale . The scale reading when both are at $40^\circ C$, is :-

A. $L\dfrac{(1+\alpha_c)}{(1+\alpha_s)}$

B. $L\dfrac{\alpha_c}{\alpha_s}$

C. $L\dfrac{\alpha_s}{\alpha_c}$

D. L

Answer:

Watch Video Solution

59. If temperature of a pendulum clock changes from θ_1 to θ_2 the fractional change in the period of a pendulum clock is

A. $\frac{1}{2}\alpha(\theta_2 - \theta_1)^2$

B. $2\alpha_{\theta_2 - \theta_1}$

C. $\frac{1}{2}\alpha((\theta_2 - \theta_1))$

D. $2\alpha(\theta_2 - \theta_1)^2$

Answer:

Watch Video Solution

60. The density of a substance at $0^\circ C$ is $10g/cc$ and at $100^\circ C$, its density is $9.7g/cc$. The coefficient of linear expansion of the substance is

A. $0.0001.^\circ C^{-1}$

B. $0.001.^\circ C^{-1}$

C. $0.00001.^\circ C^{-1}$

D. $0.1.^\circ C^{-1}$

Answer:

Watch Video Solution

61. A sphere made of iron is rotating about its diameter as axis $\alpha = 1 \times 10^{-5}.^{\circ} C^{-1}$. If the temperature rises by $100^{\circ} C$ the percentage increase in its moment of inertia is:

A. 0.1%

B. 0.2%

C. 0.5%

D. 0.002%

Answer:

Watch Video Solution

62. A solid occupies 1000ml at $20^\circ C$. Its volume becomes 1016.2ml at $320^\circ C$. What is the value of coefficient of cubical and linear expansion ?

A. $18 \times 10^{-6}.^\circ C^{-1}$

B. $16 \times 10^{-6}.^\circ C^{-1}$

C. $12 \times 10^{-6}.^\circ C^{-1}$

D. $36 \times 10^{6}.^\circ C^{-1}$

Answer:

Watch Video Solution

63. A clock with a metal pendulum beating sconds keeps correct time at $0^\circ C$. If it loses 10 second a day at $20^\circ C$, the coefficient of linear expansion of metal of pendulum is

A. $\frac{1}{43200}.^\circ C^{-1}$

B. $\frac{1}{86400}.^\circ C^{-1}$

C. $\frac{1}{64800}.^\circ C^{-1}$

D. $16 \times 10^{-6}.^\circ C^{-1}$

Answer:

Watch Video Solution

64. A clock which keeps correct time at $25^{\circ}C$ has a pendulum made of a metal. The temperature falls to $0^{\circ}C$. If thecoefficient oflinear expansion of the metal is 1.9×10^{-5} per.$^{\circ}$ C, then number of second the clock gains per day is

A. 10.25 s

B. 20.50 s

C. 30.75 s

D. 41s

Answer:

Watch Video Solution

65. A faulty thermometer has its fixed points marked as 5° and 95°. The temperature of a bady as measured by the faulty therature is 59°. Find the correct temperature of the body on Celsisus scale.

A. 59°

B. 48.6°

C. 60°

D. 58°

Answer:

Watch Video Solution

66. At what temperature (in $\hat{}\ (\circ)C$, the fahrenheit and celsius scale gives same reading?

Watch Video Solution

67. 0.93 watt - hour of energy is supplied to a block of ice weighing 10 gm. It is found that

A. Half of the block melts

B. The entire block melts and the water attains a temperature of $4^{\circ}C$

C. The entire block just melts

D. The block remains unchanged

Answer:

Watch Video Solution

68. The coefficient of linear expansion of iron is $0.000011.^{\circ} C$. An iron ro is 10 metre long at $27^{\circ} c$. The length of the rod will be decreased by 1.1 mm when the temperature of the rod changes to

A. $0^{\circ} C$

B. $10^{\circ} C$

C. $17^{\circ} C$

D. $20^{\circ} C$

Answer:

Watch Video Solution

69. A uniform metal rod of $2mm^2$ area of cross section is heated from $0^\circ C$ to $20^\circ C$. The coefficient of linear expansion of the rod is $12 \times 10^{-6}/^\circ C$. Its Young's modulus of elasticity is $10^{11} N/m^2$, then the energy stored per unit volume of rod is,

A. $1440 J/m^3$

B. $1500 J/m^3$

C. $2880 J/m^3$

D. $5760 J/m^3$

Answer:

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70. A beaker contains 200 g of water. The heat capacity of the beaker is equal to that of 20 g of water. The initial temperature of water in the beaker is $20^\circ C$ .If 440 g of hot water at $92^\circ C$ is poured in it, the final temperature (neglecting radiation loss) will be nearest to

A. $58^\circ C$

B. $68^\circ C$

C. $73^\circ C$

D. $78^\circ C$

Answer:

Watch Video Solution

71. A sphete of deamrter 7.0 cm and mass 266.5 g float in a bath of liquid. As the temperature is raised, the sphere begins to sink at a temperature of $35^\circ C$. If the density of liqued is $1.527 gcm^{-3}$ at$0^\circ C$, find the coeffiecient of cubical expamsion of the liquid. Neglect the expansion of the sphere.

A. $8.486 \times 10^{-3}.^\circ C$

B. $8.48 \times 10^{-4}.^\circ C$

C. $8.486 \times 10^{-5}.^\circ C$

D. $8.486 \times 10^{-6}.^\circ C$

Answer:

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Watch Video Solution

72. The real coefficient of volume expansion of glycerine is 0.000597 per $.^{\circ} C$. Then the apparent volume coefficient of expansion of glycerine in glass will be (linear expansion of glass is 0.000009 per $.^{\circ} C$.)`

A. 0.000606 pe $.^{\circ} C$

B. 0.000588 per $.^{\circ} C$

C. 0.00057 per $.^{\circ} C$

D. 0.00027 per $.^{\circ} C$

Answer:

Watch Video Solution

73. 10 gm of ice at $-20^{\circ}C$ is added to 10 gm of water at $50^{\circ}C$. Specific heat of water $= 1cal/g-.^{\circ}C$, specific heat of ice = $0.5cal/gm-.^{\circ}C$. Latent heat of ice = 80 cal/gm. Then resulting temperature is -

A. 10 g

B. 5 g

C. 0 g

D. 20 g

Answer:

Watch Video Solution

74. 10 gm of ice cubes at $0^\circ \mathrm{C}$ are released in a tumbler (water equivalent 55 g) at $40^\circ \mathrm{C}$. Assuming that negligible heat is taken from the surroundings, the temperature of water in the tumbler becomes nearly$(\mathrm{L} = 80\ \mathrm{cal/g})$

A. $31^\circ C$

B. $21.5^\circ C$

C. $19^\circ C$

D. $15^\circ C$

Answer:

Watch Video Solution

75. Steam at $100^\circ C$ is passed into 1.1 kg of water contained in a calorimeter of water equivalent 0.02 kg at $15^\circ C$till the temperature of the calorimeter and its contents rises to $80^\circ C$. The mass of the steam condensed in kilogram is

A. 0.13

B. 0.065

C. 0.26

D. 0.135

Answer:

Watch Video Solution

76. The temperature of equal masses of three different liquids A,B and C are $12^\circ C, 19^\circ C$ and $28^\circ C$ respectively. The temperature when A and B are mixed is $16^\circ C$ and when B and C are mixed it is $23^\circ C$. What should be the temperature when A and C are mixed?

A. $18.2^\circ C$

B. 20.3°

C. $22.2^\circ C$

D. $24.2^\circ C$

Answer:

Watch Video Solution

77. Hailstone at $0^\circ C$ from a height of 1 km on an insulating surface converting whole of its kinetic energy into heat. What part of it will melt? ($g = 10m/s$)

A. $\frac{1}{33}$

B. $\frac{1}{8}$

C. $\frac{1}{33} \times 10^{-4}$

D. All of it will melt

Answer:

Watch Video Solution

78. If the readin of the Reaumer scale is nunmerically less than that of Celsius scale by 3, then the reading of the Celsium scale is:

A. 5°

B. 10°

C. 15°

D. 20°

Answer:

Watch Video Solution

79. About $5g$ of water at $30^\circ C$ and $5g$ of ice at $-20^\circ C$ are mixed together in a calorimeter. Calculate final temperature of the mixture. Water equivalent of the calorimeter is negligible. Specific heat of ice $= 0.5 \text{cal} g^{-1} C^\circ - 1)$ and latent heat of ice $= 80 \text{cal} g^{-1}$

A. $0^\circ C$

B. -20°

C. $-10^\circ C$

D. $+1.2^\circ C$

Answer:

Watch Video Solution

80. One gram of ice at $0^\circ C$ is added to 5 gram of water at $10^\circ C$. If the latent heat of ice be 80 cal/g, then the final temperature of the mixture is -

A. $5^\circ C$

B. $0^\circ C$

C. $-5^\circ C$

D. None of these

Answer:

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81. 1 g of ice at $0^\circ C$ is mixed with 1 g of steam at $100^\circ C$. After thermal equilibrium is achieved, the temperature of

the mixture is

A. $0^\circ C$

B. $100^\circ C$

C. $55^\circ C$

D. $80^\circ C$

Answer:

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Advance Mcqs With One Or More Optionis Correct

1. Which of the following statements is not true ?

A. Size of degree is smallest on celsius scale

B. Size of degree is smallest on Fahreheit scale

C. Size of degree is equal on Fahrenheit and Kelvin scale

D. Size of degree is equal on Celsius and Kelvin scale

Answer:

Watch Video Solution

2. Which of the following statements are true?

A. Rubber contracts on heating

B. Water expands on freezing

C. Water contracts on heating from $0^\circ C$ to $4^\circ C$

D. Water expands on heating from $4^\circ C$ to $100^\circ C$

Answer:

Watch Video Solution

3. A metallic circular disc having a circular hole at its centre rotates about an axis passing through its centre and perpendicular to its plane. When the disc is heated:

A. Its angular speed will decrease

B. Its diameter will decrease

C. Its moment on inertia will increase

D. Its angular speed speed will increase

Answer:

Watch Video Solution

4. Due to thermal expansion with rise in temperature:

A. Metallic scale reading becomes lesser than true value

B. Pendulum clock becomes fast

C. A floating body sinks a little more

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

Answer:

Watch Video Solution

5. 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:

Watch Video Solution

6. Thermal capacity of a body depends on the

A. The heat supplied

B. The temperature raised of body

C. The mass of the body

D. The material of the body

Answer:

Watch Video Solution

7. Specific heat of a substance can be

A. Finite

B. Infinite

C. Zero

D. Negative

Answer:

Watch Video Solution

8. When two samples of finite specific heats at different temperatures are mixed the temperature of the mixture may be:

A. Lesser than lower or greater than higher temperature

B. Equal to lower or higher temperature

C. Greater than lower but lesser than higher temperature

D. Average of lower and higher temperatures

Answer:

Watch Video Solution

9. Which of the following statements are true?

A. Water in a test tube can be made of boil by placing it in a bath of boiling water

B. Heat cannot be stored in la body

C. With increase in pressure melting point decreases

D. Vapour can be directly converted into solid

Answer:

Watch Video Solution

10. A metal rod is shaped into a ring with a small gap. If this is heated,

(i) the length of the rod will increase

(ii) the gap will decrease

(iii) the gap will increase

(iv) the diameter gof the ring will increase in the same ratio as the length of the rod

A. The length of the rod will increase

B. The gap will decrease

C. The gap will increase

D. The diameter of the ring will increase in the same ratio as the length of the rod

Answer:

Watch Video Solution

11. Two rods of length L_1 and L_2 are made of materials of coefficients of linear expansions α_1 an α_2 respectively such that $L_1\alpha_1 = L_2\alpha_2$. The temperature of the rods is increased by ΔT and correspondingly the change in their respective lengths be ΔL_1 and ΔL_2

A. $\Delta L_1 \neq \Delta L_2$

B. $\Delta L_1 = \Delta L_2$

C. Difference in length $(L_1 - L_2)$ is a constant and is independent of rise of temperature.

D. Data in insufficient to arrive at a conclusion

Answer:

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12. A bimetallic strip is made up of two metals with different α

A. On heating it bends towards the metal with high α

B. On heating it bends towards the metal with low α

C. On cooling, it bends towards the metal with highα

D. On cooling, it bends towards the metal with low α

Answer:

Watch Video Solution

13. A bolt is passed through a pipe and a nut is just tightened. Coefficients of linear expansion for bolt and pipe material are α_b and α_p respectively. If the assembly is heated then:

A. A tensile stress will be induced in the bolt if $\alpha_b < \alpha_p$

B. A compresive stress will be induced in the bolt if

$\alpha_b < \alpha_p$

C. A compressive stress will be induced in the bolt is

$$\alpha_b = \alpha_p$$

D. No stress will be iduced in the bolt if $\alpha_b > \alpha_p$

Answer:

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14. A unifom cylinder of steel of mass M radius R is placed on frictionless bearings and sct to rotate about its axis with angular velocity ω_0 After the cylinder has reached the specified state of rotation, it is heated from temperature $T_0 \to (T_0 + \Delta T)$ without any mechanical contact. If (DeltaI)/I is the fractional change in moment of inertia of the cylinder and $\frac{\Delta\omega}{\omega_0}$ be the fractional change in the

angular velocity of the cylinder and alpha be the coefficient of linear expansion, then

A. $\frac{\Delta I}{I} = \frac{2\Delta R}{R}$

B. $\frac{\Delta I}{I} = \frac{\Delta \omega}{\omega_0}$

C. $\frac{\Delta \omega}{\omega_0} = -2\alpha \Delta T$

D. $\frac{\Delta I}{I} = -\frac{2\Delta R}{R}$

Answer:

Watch Video Solution

15. A bimetallic strip is formed out of two identical strips one of copper and the other of brass. The co-efficients of linear expansion of the two metals are α_C and α_B. On

heating, the the strip bends to form an are of radius of curvature R. Then R is

A. Proportional to ΔT

B. Inversely proportional to ΔET

C. Proportional to $|\alpha_B - \alpha_C|$

D. Inversely proportional to $|\alpha_B - \alpha_C|$

Answer:

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16. A body of mass m has gram specific heat c:

A. Heat capacity of te body is mc

B. Water equivalent of the body is m

C. Water equivalent of the body is mc

D. Heat capacity of the body is c

Answer:

Watch Video Solution

17. A thermos flask contains coffee. It is vigorously sheken, considering the coffee as the system. (a) Does its temperature rise ? (b) Has heat been added to it ? (c) Has work been done on it ?

A. Its temperature would rise

B. Heat has been added to it

C. Work has been done on it

D. Its internal energy has changed

Answer:

Watch Video Solution

18. The temperature of an isotropic cubical solid of length L, density d and coeficient of linear expansion α per degree C, is raised by $10^{\circ}C$, then, at this temperatrue to a good approximation

A. Length is $L(1+10\alpha)$

B. Total surface area is $L^2(1+20\alpha)$

C. Density is $d(1+30\alpha)$

D. Density is $dl(1 + 30\alpha)$

Answer:

Watch Video Solution

19. Specific heat of a substance can be

A. Finite

B. Infinite

C. Zero

D. Negative

Answer:

Watch Video Solution

20. 5g of steam at $100^\circ C$ is mixed with 10g of ice at $0^\circ C$. Choose correct alternative /s) :- (Given $s_{\text{water}} = 1\text{cal}/g^\circ C, L_F = 80cal/g, L_V = 540cal/g$)

A. Equilibrium temperature of mixture is $160^\circ C$

B. Equilibrium temperature of mixture is $100^\circ C$

C. At equilibrium, mixtrue contatin $13\frac{1}{3}$g of water

D. At equilibrium, mixture contain $1\frac{2}{3}$ g of steam

Answer:

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21. The temperature of an isotropic cubical solid of length l_0, density ρ_0 and coefficient of linear expansion α is increased by $20^\circ C$. Then at higher temperature , to a good approximation:-

A. Length is $l_0(1 + 20\alpha)$

B. Total surface area is $l_0^2(1 + 40\alpha)$

C. Total volume is $l_0^3(1 + 60\alpha)$

D. Density is $\frac{\rho_0}{1 + 60\alpha}$

Answer:

Watch Video Solution

22. A pressure cooker reduces cooking time because

A. The boiling point of water is raised by the increased pressure inside the cooker

B. The boiling point of water is lowered by pressure

C. More steam in available to cook the food at $100^{\circ} C$

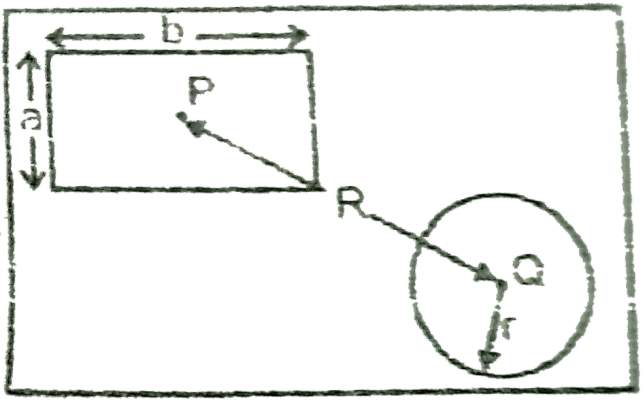
D. None of these

Answer:

Watch Video Solution

23. There is a rectangular metal plate in which two cavities in the shape of rectangle and circle are made, as shown

with dimensions. P and Q are the centres of these cavities. On heating the plate, which of the following quantities increases?



A. πr^2

B. ab

C. R

D. b

Answer:

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24. A temperature T is measured by a constant volume gas thermometer

(i) T is independent of the gas used at all pressure

(ii) T is independent of the gas used only at low pressure

(iii) The ideal gas scale agrees with the absolute scale of temperature

(iv) The ideal gas scale does not agrees with the absolute scale of temperature

A. T is independent of the gas used for all pressures

B. T is independent of the gass used only at low pressure

C. The ideal gas scale agrees with the abosulute scale of temperature

D. The ideal gas scale does not agree with the absolute scale of temperature.

Answer:

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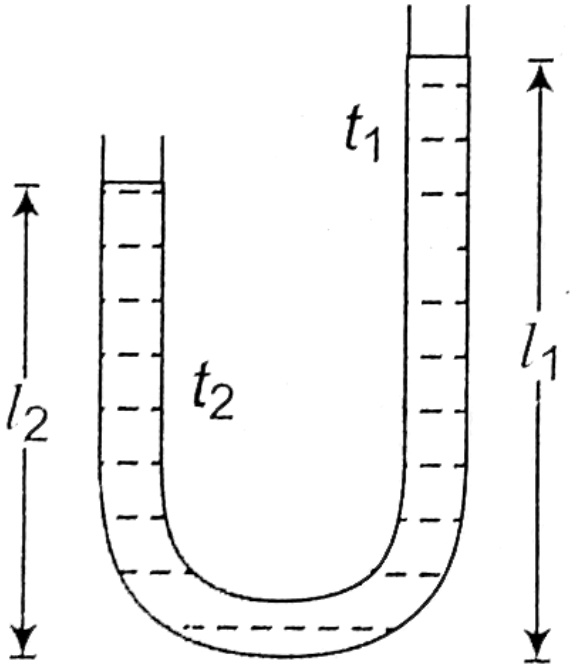
Unsolved Numrical Problems For Preparation Of Nsep Inpho Ipho

1. In a vertical U-tube containing a luquid, the two arms are maintained at different temperatures, t_1 and t_2 . The liquid coplumns in the two arms have heights l_1 and l_2

respectively. The coefficient of volume expansion of the liquid is equal to



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2. How many kilograms of copper will experience the same temperature rises as 10 kg of water when the same amount of heat is absorbed? $(S_{cu} = 0.09\text{cal}/g.^{\circ} C)$

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3. If coal gives off 7000 kcal/ kg when it is burnt, how much coal will be needed to heat a house that requires 4.2×10^7 kcal for the whole winter? Assume that an additional 30 percent of the heat is lost up the chimney.

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4. How much water would have to evaporate from the skin per minute to make away all the heat generated by the basal metabolism (60 kcal/h) of a 65 kg person?

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5. During exercise, a person may give offf 180 kcal of heat in 30 min by evaporation of water from the skin. How much water has been lost? Given that latent heat of vaporization of water is 540 cal/gm.

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6. A 55.0 kg ice skater moving at 8.5 m/s glides to a stop. Assuming the ice is at $0^{\circ}C$ and that 50 percent of the heat generated by friction is absorbed by the rice, how much ice melts?

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7. The design of some physical instrument requires that there be a constant difference in length of 10 cm between an iron rod and a copper cylinder laid side by side at all temperature find their lengths

$\left(\alpha_{Fe} = 11 \times 10^{6}.^{\circ} C^{-1}, \alpha_{Cu} = 17 \times 10^{-6}.^{\circ} C^{-1}\right)$

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8. A steel rod 25 cm long has a cross -sectiional area of $0.8cm^2$. What force wouyld be required to stretch this rod by the same amount as the expansion produced by heating it by $10^\circ C$? Given that for steel coefficient of linear expansion and Young's modulus are given as $\alpha = 1.1 \times 10^{-5}.^\circ C^{-1}$ and $Y = 2 \times 10^{11} Nm^{-2}$

View Text Solution

9. How should 1 kg of water at $5^\circ C$ be divided into two parts so that if one part turned into ice at $0^\circ C$, it would release enough heat to vapourize the other part? Latent heat of steam $= 540cal/g$ and latent heat of ice $= 80cal/g.$

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10. A steel wire of cross sectional area $5 \times 10^{-7} m^2$ is tied between two rigid clamps. It is given that at $30^\circ C$ wire is just taut. If the temperature of wire is decreased to $10^\circ C$, find the tension in the wire. Given that the coefficient of linear expansion of stees is $1.1 \times 10^{-5}.^\circ C^{-1}$ and its Young's modulus is $2 \times 10^{11} N/m^2$

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11. A bar measured with a vernier caliper is found to be 180 mm long. The temperature during the measurement is $10^\circ C$. The measurement error will be if the scale of the vernier caliper has been graduated at a temeprature of

$20^\circ C$. ($\alpha = 1.1 \times 10^{-5}.^\circ C^{-1}$. Assume that the length of the bar does not change.)

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12. The brass scale of a mercury barometer has been graduated at $0^\circ C$. At $18^\circ C$ the barometer shows a pressure of 760 mm. Reduce the reading of the barometer to $0^\circ C$. The coefficient of linear expansion of brass $= 1.9 \times 10^{-5} = 1$ and the coefficient of volume expansion of mercury $\gamma = 1.8 \times 10^{-4}.^\circ C^{-1}$

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13. A piece of metal weighs 46 g in air and 30 g in lipuid of density $1.24 \times 10^3 kgm^{-3}$ kept at $27^0 C$. When the temperature of the liquid is raised to $42^0 C$ the metal piece weights 30.5 g . The density of the liqued at $42^0 C$ is $1.20 \times 10^3 kgm^{-3}$. Calculate the coefficient of linear expandsion of the metal.

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14. Calculate the percentage increase in the moment of inertia of a ring of iron. Given that $\alpha_{\text{iron}} = 11 \times 10^{-6}.^\circ C^{-1}$ and rise in temperature is $20^\circ C$

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15. A gas heated geyser consumes $V_{00=1.8cm^3}$ of methane (CH_4) in an hour. Find the temperature of the water heated by the geyser if the water flows out at the rate of v=50 cm/s. The diameter of the stream D=1cm, the initial temeprature of the water and the gas is $t_1 = 11.^\circ C$ and teh calorific value of methane is $q_0 = 13$ kcal/g. The gas in the tube is under a pressure of 1.2 atm. the efficiency of the heater is $\eta = 60\,\%$

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16. A mixture of 250 g of water and 200 g of ice at $0^\circ C$ is kept in a calorimeter which has a water equivalent of 50 g. If 200 g of steam at $100^\circ C$ is passed through this mixture,

calculate the final temperature and the weight of the contents of the calorimeter.

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17. An earthware vessel loses 1 g of water per second due ot evaporation. The water equivalent of the vessel is 0.5 kg and the vessel contains 9.5 kg of water. Find the time required for the water in the vessel to cool to $28^{\circ}C$ from $30^{\circ}C$. Neglect radiation losses. Latent heat of vaporisation of water in this range of temperature is 540 cal/g.

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18. A steel rule is calibrated at $22^\circ C$ against a standard so that the distance between numbered divisiions is 10.00 mm. a. What is the distance between these divisions when the rule is at $-5^\circ C$? (b) If a nominal length of 1 is measured with the rule at this lower temperature, what percent error is made? c. What absolute error is made for a 100 m length?

$[\alpha_{st} = 1.1 \times 10^{-5}.^\circ C^{-1}]$

View Text Solution

19. An iron cube floats in a bowl of liquid mercury at $0^\circ C$ a. if the temperature is raised to $30^\circ C$ will the cube float

higher or lower in the mercuyr? B. By wat percent will the fraction of volume submerged change?

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20. A precise steel tape measure has been calibrated at $20^\circ C$. At $40^\circ C$ a. will it read high or low, and b. what will be the percentage error?

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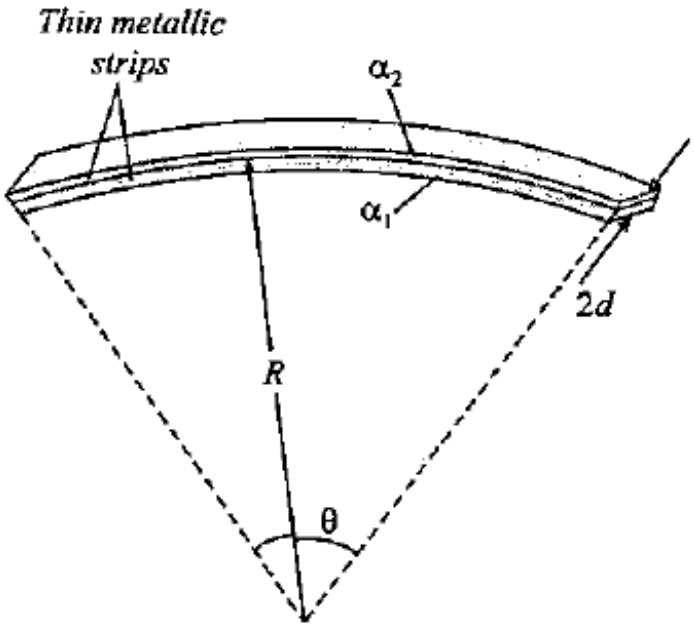
21. An 18-g ice cube (at $0^\circ C$) is dropped into a glass containing 200 g of water at $25^\circ C$. If there is negligible heat exchange with the glass, what is the temperature after the ice melts?

Watch Video Solution

22. A bimetalis strip conists of two metakl strips with diffesrent coefficients of linear expansion α_1 and α_2 each of small thickness d and length L_0 at T_0. They are bonded together and, with a change in temperature $De < AT$, will curve in a circular arc, as shown in figure. Show that the radius of curvature R is given approximately be



$$R = \frac{d}{(\alpha_2 - \alpha_1)\Delta T}$$

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23. A thin smooth tube of length 2 m containing a small pallet of mercury in it is rapidly inverted 50 times. If capillary effect is neglected find the approximate increase

in temperature of the mercury. Given that the specific heat of mercury is 30 cal/kg K.

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24. From what height must a block of ice fall to just melt by the impact assuming that half of the heat generated is absorbed by ice? ($J = 4.2$ joules per calories and $L = 80$ kilocalories per kg)

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25. A hole is drilled into a block of lead of mass $10kg$ by a driller. The driller is driven by an electric motor of 30 r.p.m. and the couple exerted by the motor on the driller is

$10Nm$. Calculate the rise in temperature of the lead in 10 minutes. $J = 4.2$ joules cal^{-1}. Relative specific heat capacity of lead 0.03 and sp. heat capacity of water $1000calkg^{-1}K^{-1}$.

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26. A mercury thermometer is to be made with glass tubing of internal bore 0.5 mm diameter and the distance between the fixed point is to be 20 cm. Estimate the volume of the bulb below the lower fixed point, given that the coefficient of cubical expansion of mercury is $0.00018/K$. and the coefficient of linear expansion of glass is $0.000009/K$.

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27. A lump of ice of 0.1 kg at $-10^{\circ}C$ is put in 0.15 kg of water at $20^{\circ}C$. How much water and ice will be found in the mixture whenit has reached thermal equilibrium? Specific heat of ice $= 0.5 kcal kg^{-1}.^{\circ} C^{-1}$ and its latent heat of melting $= 80$ kcal kg^{-1}

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28. A metallic bob weights $50g$ in air. If it is immersed in a liquid at a temperature of $25^{\circ}C$, it weights $45g$. When the temperature of the liquid is raised to $100^{\circ}C$, it weights $45.1g$. Calculate the coefficient of cubical expansion of the liquid. Given that coefficient of cubical expansion of the metal is $12 \times 10^{-6}.^{\circ} C^{-1}$.

A. its

B.

C.

D.

Answer: $\gamma_1 = 3 \times 10^{-1}.^{\circ} C^{-1}$

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29. A copper calorimeter of mass 190 g contains 300 g of water at $0^{\circ}C$ and 50 g of ice at $0^{\circ}C$.Find the amount of steam at $100^{\circ}C$ required to raise the temperature of this mixture by $10^{\circ}C$. Given that the specific heat of copperis $420J/kg^{\circ}C$, latent heat of vaporization of water is

$2.25 \times 10^5 \times J/kg$ and latent heat of fusion of ice is $3.36 \times 10^5 J/kg$.

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30. In an industrial process 10 kg of water per hour is to be heated from $20^\circ C$ to $80^\circ C$. To do this steam at $150^\circ C$ is passed from a boiler into a copper coil immersed in water. The steam condenses in the coil and is returned to the boiler as water at $90^\circ C$. How many kilograms of steam is required per hour (specific heat of steam $= 1cal/g^\circ C$, Latent heat of vapourization $= 540cal/g$)?

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31. In the past it was practice to measure temperature using so called weight thermometer which consists of glass sphere having a narrow flow out tube. Such a certain weight thermometer is completely filled with 14.578 g of liquid at $15^{\circ}C$. It is found that 1.232 g of liquid over flows when the temperature is raised to $100^{\circ}C$. How much more liquid overflow when the temperature is further raised to $200^{\circ}C$?

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32. A barometer having a brass scale reads 77.24 cm at a temperature of $20^{\circ}C$. The scale is graduated to be accurate at $0^{\circ}C$. What would be the readint at $0^{\circ}C$?

Coefficient of cubical expansion of mercury $= 18 \times 10^{-5}.^{\circ} C^{-1}$ and linear expansion of brass $-19 \times 10^{-6}.^{\circ} C^{-1}$

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33. A horizontal thin copper ring has a diameter exactly 1.00000 inch at temperature $0^{\circ} C$ and is ficed to a non conducting stand. An aluminium sphere of diameter exactly 1.00200 inch at $100^{\circ} C$ is placed on the top of the ring. When the two attain temperature equilibrium, the sphere just passes through the ring. Assuming that the whole heat energy remains within the ring sphere system find

$(\alpha_{Cu} = 1.67 \times 10^{-5}.^{\circ} C^{-1}, \alpha_{Al} = 2.4 \times 10^{-4}.^{\circ} C^{-1})$

(i) the final equilibrium temperature

(ii) the ratio of the mass of the ring to that of the sphere.

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34. Aniline is a liquid which does not mix with water. When a small quantity of it is poured into a beaker of water at $20^\circ C$, it sinks to the bottom. The densities of aniline and water at $20^\circ C$ and $1021 kgm^{-3}$ and $998 kgm^{-3}$ respectively. Find the minimum temperature to which the mixture is to be heated so that aniline will form a globule and just start floating.

$\gamma_{\text{aniline}} = 85 \times 10^{-5}.^\circ C^{-1}, \gamma_{\text{water}} = 45 \times 10^{-5}.^\circ C^{-1}.$

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35. During light activity a $70kg$ person may generate 200 kcal/hr. Assuming that $20\,\%$ of this goes into useful work and the other $80\,\%$ is converted to heat, calculate the temperature rise of the body after $1.00hr$ if none of this heat is transferred to the environment. Assume specific heat of the human body is $450\text{cal}/kg^\circ C$

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36. A makki ki roti has 100 kcal of thermal energy. What a man of 60 kg eats five such roti, how many meters can he climb by using this energy. Given that the working efficiency of man is 30% of the total energy gain by eating.

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37. A copper calorimeter of negligible thermal capacity is filled with a liquid. The mass of the liquid is 250 gm. A heating element found that the temperature of the calorimeter and its contents rise form $25^{\circ}C$ to $30^{\circ}C$ in 5 minutes when a current of 2.05 A is passed through it at al potential difference of 5 volts. The liquid is thrown off and the heater is switched on again. it is now found that the temperature of the calorimeter alone remains constant at $32^{\circ}C$ when the current through the heater is 0.7 A at the potential difference 6 volts. Calculate the specific heat capacity of the liquid. The temperature of the surrounding is $25^{\circ}C$

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38. A long horizontal glass capillary tube open at both ends contains a mercury thread 1 m long at $0^\circ C$. Find the length of the mercury thread, as read on this scale, at $100^\circ C$.

$\left(\gamma_{\text{mercury}} = 18.2 \times 10^{-5} K^{-1} \alpha_{\text{glass}} = 9 \times 10^{-6} K^{-1}\right)$

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39. Ice with mass $m_1 = 600g$ and at temperature $t_1 = -10^\circ C$ is placed into a copper vessel heated to $t_2 = 350^\circ C$. As a result, the vessel now contains $m_2 = 550g$ of ice mixed with water. Find the mass of the vessel. The specific heat of copper $= 0.1\text{cal}/C^\circ g$ and sp. heat of ice $= 0.5\text{cal}/gC^\circ$. Latent heat of ice $= 80\text{cal}/g$.

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40. A metal rod of length 5 m placed on a smooth tabel. Given that Young's modulus of the material of the rod is $1.6 \times 10^{11} N/m^2$ and the its coefficient of linear expansion is $1.2 \times 10^{-5}.^{\circ} C^{-1}$. If temperature of rod is changed from $20^{\circ} C$ to $80^{\circ} C$ find the elastic stress developed in the rod.

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41. An ice block of volume $3.2 \times 10^{-5} m^3$ and at temperature $0^{\circ} C$ is put in 200 gm water at $10^{\circ} C$. Find the temperature and composition of mixture when thermal equilibrium is attained. Given that density of ice is

$900kg/m^3$, specific heat of water is $4200J/kg^\circ$ C and latent heat of fusion of ice $.4 \times 10^{-5} J/kg$

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42. A body made up of an alloy (40% copper +60% nickel) of mass 0.1 kg is placed in a container of water equivalent 10 gm which contains 90 g of water at $10^\circ C$. If the equilibrium temperature is $20^\circ C$, find the initial temperature of the body. Given that specific heat of water is $4200J/kg^\circ C$ and that of copper is $420J/kg^\circ C$ and that of nickel is $460J/kg^\circ C$

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43. A block of $10kg$ mass is thrown on a rough surface having friction coefficient 0.3 with an initial speed of 5 m/s. Find the amount by which the internal energy of the blocked and the surface will increase. If this block is seen from a frame moving at a speed of 5 m/s in the direction of its velocity it is observed that the block is gently put on the rough surface moving in opposite direction at speed 5 m/s. Find the gain kinetic energy of the block as seen from this frame.

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44. A vessel is completely filled with $500g$ of water and $1000g$ of mercury. When 21,200 calories of heat are given

to it $3.52g$ of water overflows. Calculate the volume expansion of mercury. Expansion of the vessel may be neglected. Given that coefficient of volume expansion of water $= 1.5 \times 10^{-4}/C^{\circ}$, density of mercury $= 13.6g/cm^3$, density of water $e = 1g/cm^3$, and specific heat of mercury $= 0.03\text{cal}/gC^{\circ}$

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45. When a certain quantity of liquid bismuth at its melting point of $271^{\circ}C$ is transferred to a calorimeter contaiing oil, the temperature of oil from $13.4^{\circ}C$ to $28.5^{\circ}C$. When the experiment under identical conditions except that bismuth is in solid form, the temperature of oil rises to $19^{\circ}C$ if the specific heat of bismuth is

$0.134 Jg^{-1}.^{\circ} C^{-1}$, fine the metal heat of fusion of bismuth

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46. An iron plug is to be placed in a ring made of brass. At room temperature $28^{\circ} C$ the diameter of the plug is 9.114 cm and that of the inside of the ring is 9.097 cm. To what common temperatue these both be brought in order to fit? Give that coefficient of linear expansion of iron is $1.1 \times 10^{-5}.^{\circ} C^{-1}$ and that of brass sis $1.9 \times 10^{-5}.^{\circ} C^{-1}$

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47. The 0.50 kg head of a hammer has speed of 5.0 m//s just before its strikes a nail and is brought to rest. Estimate the temperature rise a 15 g nail generated by ten such hammer blows done in quick succession. Assume the nail absorbs all the heat.

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48. Two metal spheres (10 kg and 30 kg) moving towards each other at speeds 10 m/s and 20 m/s respectivley.They collide inelasticity. What is the rise in temperature of the combined body after collision if al the energy lost appears in the form of heat. Given that specific heat of the metal of spheres is $0.03\text{cal}/g^\circ C$

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49. A 25 g bullet travelling at 400 m//s passes through a thin iron wall and emerges at a speed of 250 m/s. If the bullet absorbs 50 percent of the heat generated, a. what will be the temperature rise of the bullet? B. If the ambient temperature is $20^\circ C$ will the bullet melt, and if so how much? Given that specific heat of head is $0.03 \text{cal} / gm^\circ C$ and latent heat of fusion of lead is 6000 cal/kg. It is also given that melting pont of lead is $320^\circ C$.

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50. About 5 g water at $30^\circ C$ and $5g$ is at $-20^\circ C$ are mixed in a container of negligible heat capacity. Find the

final temperature and composition of the mixture. Given that specific heat of water is $4200 J / kg^{\circ} C$ and that of ice of $2100 / kg^{\circ} C$ and latent heat of ice is 3.36×10^{5} J/Kg

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51. A brass pipe that is 10 cm indiameter and has a wall thickness of 0.26 cm carries steam at $100^{\circ} C$ through a vat of circulating water at $20^{\circ} C$. How much heat is lost per meter of pipe in 1s?

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52. The tube of a mercury thermometer has an inside diameter of 0.120mm.The bulb has a voluem of $0.250 cm^{3}$.

How far will the thread of mercury move when the temperature changes from $10.0^{\circ}C$ to $20.0^{\circ}C$? Take inot account expansion of the glass (Pyrex). b. Determined a formula for the length of the mercury column in terms of relavant variables.

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53. 200 g of water and equal volume of another liquid of masss 250 g areplaced in turn in the same calorimeter of mass 100 g and specific heat capacity 420 J/kg K. The liquids which are constantly stirred are found to cool from $60^{\circ}C$ to $20^{\circ 0C}$ in 3 minutes and 2 minutes 20 seconds, respectively. Find the specific heat capacity of the liqudi. The temperature of the surrounding is $20^{\circ}C$.

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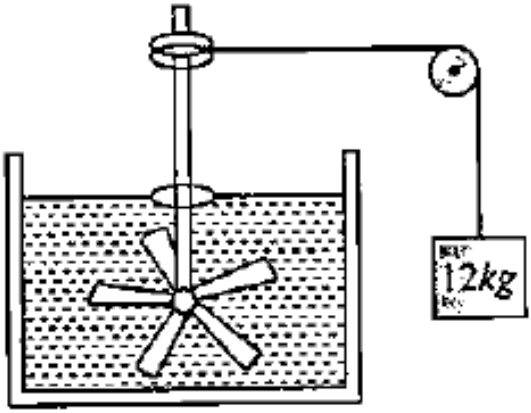
54. Figure shows a wheel pivoted at its centre in a water tank containing 1 kg water. A light string is wound on the shaft of the wheel and its other end is connected to a hainging block of mass 12 kg as shown. It is observed that the block falls slowly by a distance 0.7 m. Find the rise in temperature of the water. Also find the amount of theat supplied to the water. Give that the specific heat fo water

is $4200 J / kg^{\circ} C$ and that of wheel is negligible.



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55. 0.6 kg of ice at $-10^{\circ} C$ is place in a copper calorimeter at $350^{\circ} C$. After some time when thermal equilibrium is attained, calorimeter contains 550 g of ice with some water. Find the water equivalent of the calorimeter. Given that the specific heat of copper is 420 J/kgK, and that of

ice $2100 J / kg^{\circ} C$ and latent heat of ice is $3.32 \times 10^{-5} J / kg$ check the answer

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56. Two pendulum clocks, one having an iron pendulum and the other having a brass pendulu, are keeping correct time at $5^{\circ} C$. How much per day will they differ at $25^{\circ} C$? $\alpha_{\text{iron}} = 12 \times 10^{-5}.^{\circ} C^{-1}, \alpha_{\text{brass}} = 18.7 \times 10^{-6}.^{\circ} C^{-1}$

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57. AS 12.4 kg solid iron cylindrical wheel of radius 0.45 m is rotating about its axle in frictionless bearings with angular velocity $\omega = 32.8$ rad/s. If its temperature is now

raised from $20^\circ C$ to $80^\circ C$ what is the fractional change in ω? Given that coefficient of linear exapansion of iron is $1.1 \times 10^{-5}.^\circ C^{-1}$

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58. When a man does exercise on a treadmill machine, work doen by him is supplied in the form of heat of an ice bath. Find how much he has to do to convert a piece of 5 gm of ice at $-3^\circ C$ to steam at $100^\circ C$.Given that the specific heat of ice is 0.5 cal/$gm^\circ C$, latent heat of fusion of ice is 80 cal/gm and laten heat of vaporization of water is 540 cal/gm.

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59. A steel ball, of mass 10 g and specific heat $100\text{cal}/kg(\circ)C$, is pushed out after being heated inside a furnace. It is quickly caught inside a thick copper vessel of mass 200 g and relative specific heat 0.09 at $50^\circ C$ and the vessel is dropped into a calorimeter of water equivalent 20 g containing 180 g of water at$20^\circ C$. The thermometer in the calorimeter shows maximum temperature of $26^{\circ 0C}$. Calculate the temperature of the furnace and find the calculation whether there was any local boiling in the calorimeter.

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60. At a temperature of $20^\circ C$, the volume of a certain glass flask, up to a reference mark on the cylindrical stem

of the flask is exactly is $100cm^3$. The flask is filled to this point with a liquid of coefficient of cubical expansion $120 \times 10^{-5}.^\circ C^{-1}$., when both the flask and the liquid are at $20^\circ C$. The corss section ofthe stem is $1mm^\circ$ and the coeffiocient of linear expansion of glass is $8 \times 10^{-5}.^\circ C^{-1}$. Fidn the rise of fall of the liquid level in the stem, when the temperature is raised to $40^\circ C$.

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61. Find the final temperature and composition of the mixtue of 1 kg of ice at $0^\circ C$ and 1.5 kg of water at $45^\circ C$. Given that specific heat of water is 4200 J/kg and latent heat of fusion of ice is $3.36 \times 10^5 J/kg$

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62. A solid substance of mass 10 g at $-10^{\circ}C$ was heated to $-2^{\circ}C$ (still in the solid state). The heat required was 64 calories. Another 880 calories was required to raise the temperature of the substance (now in the liquid state) to $1^{\circ}C$, while 900 calories was required to raise the temperature from $-2^{\circ}C$ to $3^{\circ}C$. Calculate the specific heat capacities of the substance in the solid and liquid state in calories per kilogram per kelvin.

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63. The volume of a mixture of ice and water is found to decrease by $0.125 \times 10^{-6}m^3$ without change in temperature when $10 \times 10^{-3}kg$ of a metal at $100^{\circ}C$ is

immersed into it. The relative density of ice is 0.917. Find the specific heat capacity of the metal.

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64. Water in a fall falls through h=1.0 km considering this as a thermodynamical process, calculate the difference in temperature of water at the top and bottom of the fall. Specific heat of water $= 1000\text{cal}/kg^\circ C$ and J=4.2J/cal.

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65. A calorimeter of specific heat 0.42 J/gm.$^\circ C$ and weighing 40 g contains 50 g of water mixed with 50 g of ice. Dry steam at $100^\circ C$ is passed into the mixture until

the temperature rises to $20^{\circ}C$. Find the mass of steam condensed.

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66. How much steam at $100^{\circ}C$ is needed to change 40 g of ice at $-10^{\circ}C$ to water at $20^{\circ}C$ if the ice in a 50 g copper can? Assume that the can maintains the same temperature as the ice and water. Given that specific heat of copper is $S_{Cu} = 0.09\text{cal}/gm^{\circ}$ and specific heat of ice is $S_{\text{ice}} = 0.5$ cal /gm.$^{\circ}$ C .

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67. A vertical steel beam at the base of buiolding is 6.0 m tall, thas a mass of 300 kg, and supports a load of $3.0 \times 10^5 N$. If the beam's temperature decreases by$4.0^\circ C$, calculate the change in its internal energy using the facts that for steel c_p is $0.11 \mathrm{kcal} / kg^\circ$ and the coefficient of the linear expansion is $11 \times 10^{-6} .^\circ C^{-1}$

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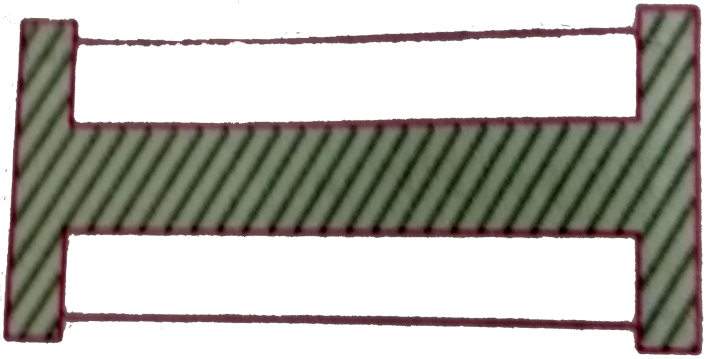
68. A heavy brass bar has projections at its ends as shown in the figure. Two find steel wires, fastened between the projections, are just taut (zero tension) when the whole systeam is at $0^0 C$. What is the tensile stress in the steel wires when the temperature of the systeam is raised to

$300^0 C$?

Given that

$\alpha_{\text{brass}} = 20 \times 10^{-6^\circ} C^{-1}$

$\alpha_{\text{steel}} = 12 \times 10^{-6\circ} C^{-1} Y_{\text{steel}} = 2 \times 10^{11} Nm^{-2}$



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69. Find the final temeprature and composition of the mixture of 1 kg of ice at $-10^\circ C$ and 4.4 kg of water at $30^\circ C$. Given that specific heat of water is $4200 J/kg^\circ C$

and that of ice is $2100 J / kg^{\circ} C$ and latent heat of fusion of ice is 3.36×10^{5} J/kg

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70. Suppose that 40 g of solid mercury at its freezing point $(-39^{\circ} C)$ is dropped into a mixture of water and ice of $0^{\circ} C$. After equilibrium is achieved, the mercury -ice - water mixture is still at $0^{\circ} C$. How much additiional ice is produced by the addition of the mercury?

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71. A calorimeter contains ice. Determine the heat capacitiy of the calorimeter if $2.1 kJ$ of heat is required to heat it

togheter with its contents from $270^{\circ} K$ to $272^{\circ} K$, and $69.72 kJ$ of heat of required to raise its temperature of $272 K$ to $274^{\circ} K$.

(L of ice $= 336 \times 10^{3} Jkg^{-1}$, specific heat capacity of ice $= 2100 kg^{-1} K^{-1}$)

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72. A steel drill making 180 rpm is used to drill a hole in a block of steel. The mass of the steel block and the drill is 180 gm. If the entire mechanical work is used up in producing heat and the rate of raise in temperature of the block and the drill is 0.5 °C/s. Find

(a) the rate of working of the drill in watts, and

(b) the torque required to drive the drill. Specific heat of steel $= 0.1$ and $J = 4.2J/cal.$ Use : $P = \tau\omega$

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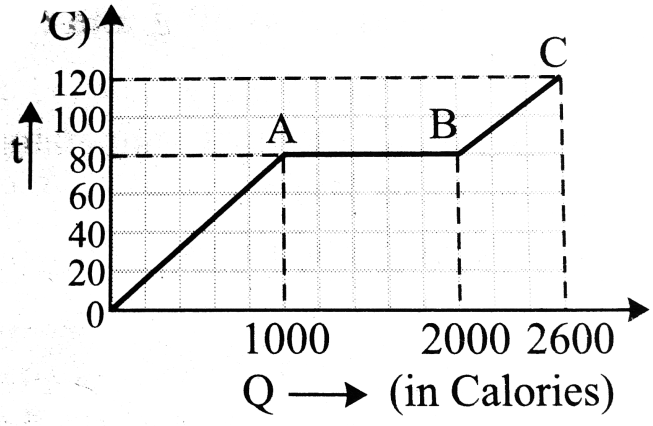

73.

A substance is in the solid form at 0°C. The amount of heat added to this substance and its temperature are plotted in the following graph. If the relative specific heat capacity of the solid substance is 0.5, find from the graph (i) the mass of the substance, (ii) the specific latent heat of

the melting process and (ii) the specific heat of the substance in the liquid state.

Specific heat capacity of water $= 1000 cal / kg / K$

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74. Steam at $100^\circ C$ is passed into a calorimeter of water equivalent 10 g containing 74 cc of water and 10 g of ice at $0^\circ C$. If the temperature of the calorimeter and its contents rises to $5^\circ C$, calculate the amount of steam passed. Latent heat of steam $= 540 kcal / kg$, latent heat of fusion $= 80 kcal / kg$.

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75. An electron beam travelling at a speed of 10^7 m/s strikes a metal target and absorbed by it. If the mass of the target is 0.5 g its specific heatis 100 cal /kg.$^\circ C$, find the rate at which its temperature rises. Given that the electron beam curen is 0.048 A.

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76. Some water at $0^\circ C$ is placed in a large insulated enclosure (vessel). The water vapour formed is puped out continuously. What fraction of the water will ultimately freeze, if the latent heat of vapourization is seven times the latent heat of fusion?

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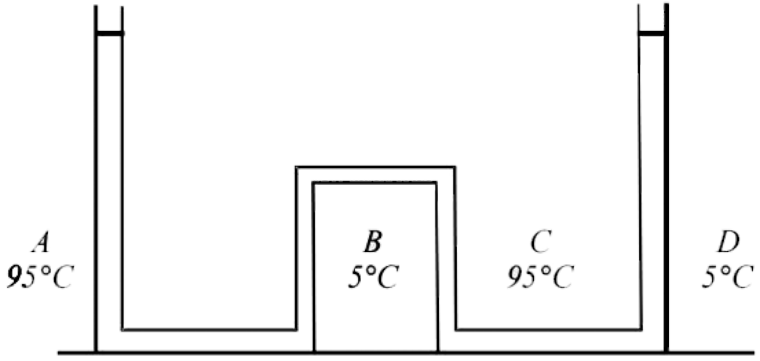
77. The apparatus shown in the figure consists of four glass columns connected by horizontal section. The height of two central column B and C are 49 cm each. The two outer columns A and D are open to the temperature. A and C are maintained at a temperature of $95^\circ C$ while the columns B and D are maintained at $5^\circ C$. The height of the liquid in A and D measured from the base the are 52.8 cm and 51cm respectively. Determine the coefficient of thermal expansion of the liquid



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78. A non conducting vessel thermally insulated from its surroundings, contains 100 g of water $0^{\circ}C$. The vessel is connected to a vacuum pump to pump to water vapour. As a result of this, some water is frozen. If the removal of water vapour is continued, what is the maximum amount of water that can be frozen in this manner? Laten heat of vaporisation of water $= 22.5 \times 10^5 Jkg^{-1}$ and latent heat of fusion of ice $= 3.36 \times 10^5 Jkg^{-1}$

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79. A mercury in glass thermometer has a stem of internal diameter 0.06 cm and contains 43 g of mercury. The mercury thread expands by 10 cm when the temperature changes from $0^\circ C$ to $50^\circ C$. Find the coefficient of cubical expansion of mercury. Relative density of mercury $= 13.6$ and $\alpha_{\text{glass}} = 9 \times 10^{-6}/K$.

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80. A loaded and completely sealed glass bulb weighs 156.25 gm inair at $15^\circ C$, 57.5 gm when completely immersed in a liquid at $15^\circ C$ and 58.57 gm when completely immersed at $52^\circ C$. Calculate the mean

coefficient of real expansion of the liquid between $15^{\circ}C$ and $52^{\circ}C$. $\alpha_{\text{glass}} 9x10^{6}.^{\circ} C^{-1}$

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81. A certain amount of ice is supplied heat at a constant rate for 7 minutes. For the first one minute the temperature rises uniformly with time. Then, it remains constant for the next 4 minute and again the temperature rises at uniform rate for the last two minutes. Calculate the final temperature at the end of seven minutes.

(Given, L of ice $= 336 \times \left(10^{3}\right) J/kg$ and specific heat of water $= 4200 J/kg.K$).

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82. Two cylinders of equal masses, one made of aluminium and the other of copper, with their lateral surfaces thermally insulated, are heated to $50^{\circ}C$ and placed on two large blocks of ice at $0^{\circ}C$. If both the cylinders haver the same height, find the ratio of their depths of penetration in the ice. Assume that no heat is lost to the surroundings. Given that

$S_{Al} = 0.22 \text{cal} gm^{-1}.^{\circ} C^{-1}, \rho_{Al} = 2.7 gmcm^{-3}$

$S_{CU} = 0.1 \text{cal} gm^{-1}.^{\circ} C^{-1}, \rho_{Cu} = 8.9 gmcm^{-3}$

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