Physicsaholics

Exercise

Thermo-1

Elasticity, Calorimetry,

Thermal Expansion, Heat Transfer

(Physicsaholics)

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Unacademy

Exercise-1

(Objective Type: Single Correct)

Level-2

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Questions Highlighted in Grey Colour: Calorimetry

Questions Highlighted in Cyan Colour: Heat Transfer

Rest of the questions which are left unhighlighted are from Elasticity and Thermal Expansion and you have to attempt these questions once these topics are covered in classes.

Q 1. When the temperature of a body increases from t to t + Δt, its moment of inertia increases from I to I + ΔI. The coefficient of linear expansion of the body is α. The ratio $\frac{\Delta I}{I}$ is equal to

(A) $\frac{\Delta t}{t}$ (B) $\frac{2\Delta t}{t}$ (C) $\alpha\Delta t$ (D) $2\alpha\Delta t$

Q 2. Consider two cylindrical rods of identical dimensions, one of rubber and the other of steel. Both the rods are fixed rigidly at one end to the roof. A mass M is attached to each of the free ends at the centre of the rods.

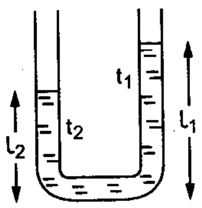
(A) Both the rods will elongate but there shall be no perceptible change in shape.

(B) The steel rod will elongate and change shape but the rubber rod will only elongate.

(C) The steel rod will elongate without any perceptible change in shape, but the rubber rod will elongate and the shape of the bottom edge will change to an ellipse.

(D) The steel rod will elongate, without any perceptible change in shape, but the rubber rod will elongate with the shape of the bottom edge tapered to a tip at the centre.

Q 3. In a vertical U-tube containing a liquid, the two arms are maintained at different temperatures, t_1 and t_2. The liquid columns in the two arms have heights l_1 and l_2 respectively. The coefficient of volume expansion of the liquid is equal to



(A) $\frac{l_1 - l_2}{l_2 t_1 + l_1 t_2}$ (B) $\frac{l_1 - l_2}{l_1 t_1 - l_2 t_2}$

(C) $\frac{l_1 + l_2}{l_2 t_1 + l_1 t_2}$ (D) $\frac{l_1 + l_2}{l_1 t_1 + l_2 t_2}$

Q 4. A cylindrical wire of radius 1 mm, length 1 m, Young's modulus = 2×10^{11} N/m^2, poisson's ratio $\mu = \pi/10$ is stretched by a force of 100 N. Its radius will become

(A) 0.99998 mm (B) 0.99999 mm (C) 0.99997 mm (D) 0.99995 mm

Q 5. A thermally insulated vessel contains some water at 0^0C. The vessel is connected to a vacuum pump to pump out water vapour. This results in some water getting frozen. It is given Latent heat of vaporization of water at 0°C = 21×10^5 J/kg and latent heat of freezing of water = 3.36×10^5 J/kg. The maximum percentage amount of water that will be solidified in this manner will be

(A) 86.2% (B) 33.6% (C) 21% (D) 24.36%

Q 6. Ice at 0°C is added to 200 g of water initially at 70°C in a vacuum flask. When 50 g of ice has been added and has all melted the temperature of the flask and contents is 40°C. When a further 80g of ice has been added and has all melted, the temperature of the whole is 10°C. Calculate the specific latent heat of fusion of ice.[Take S_w =1 cal /gm °C.]

(A) 3.8×10^5 J/ kg (B) 1.2×10^5 J/ kg (C) 2.4×10^5 J/ kg (D) 3.0×10^5 J/ kg

Q 7. The coefficient of linear expansion of copper is 17×10^{-6} $(°C)^{-1}$. A copper statue is 93 m tall on the summer morning of temperature 25°C. What is maximum order of increase in magnitude of the height in statue (maximum temperature of day is 45°C)

(A) 0.1 mm (B) 1 mm (C) 10 mm (D) 100 mm

Q 8. The coefficients of thermal expansion of steel and a metal X are respectively 12×10^{-6} and 2×10^{-6} per°C. At 40°C, the side of a cube of metal X was measured using a steel vernier callipers. The reading was 100 mm. Assuming that the calibration of the vernier was done at 0°C, then the actual length of the side of the cube at 0°C will be

(A) > 100 mm (B) < 100 mm

(C) = 100 mm (D) data insufficient to conclude

Q 9. A metal ball immersed in alcohol weighs w_1 at 0^0C and w_2 at 50^0C. The coefficient of cubical expansion of the metal is less than that of alcohol. If the density of the metal is large compared to that of alcohol then.

(A) $w_1 > w_2$ (B) $w_1 = w_2$

(C) $w_1 < w_2$ (D) cannot be determined

Q 10. A child running a temperature of 101^0 F is given an antipyrine (i.e., a medicine that lowers fever) which cause an increase in the rate of evaporation of sweat from his body. If the fever is brought down to 98^0 F in 20 minutes, the average rate of evaporation caused by drug is (Assume the evaporation mechanism to be only way by which heat is lost. The mass of child is 30 kg. the specific heat of human body is approximately the same as that water, the latent heat of evaporation of water at that temperature is 580 cal/gm)

(A) 4.31 g/min (B) 43.1 gm/min (C) 4.31 gm/sec (D) 43.1 gm / sec

Q 11. The volume of the bulb of a mercury thermometer at 0°C is V_0 and cross section of the capillary is A_0. The coefficient of linear expansion of glass is α_g per °C and the cubical expansion of mercury γ_m per °C. If the mercury just fills the bulb at 0°C, what is the length of mercury column in capillary at T°C.

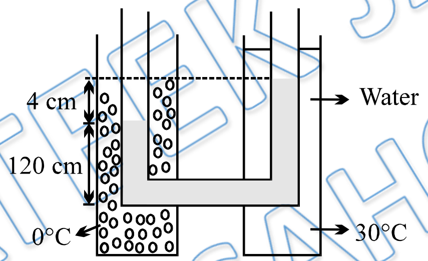
(A) $\frac{V_0T(\gamma_m+3\alpha_g)}{A_0(1+2\alpha_gT)}$ (B) $\frac{V_0T(\gamma_m-3\alpha_g)}{A_0(1+2\alpha_gT)}$

(C) $\frac{V_0T(\gamma_m+2\alpha_g)}{A_0(1+3\alpha_gT)}$ (D) $\frac{V_0T(\gamma_m-2\alpha_g)}{A_0(1+3\alpha_gT)}$

Q 12. A rod of length 2m at 0°C and having expansion coefficient $\alpha = (3x + 2) \times 10^{-6}\,°C^{-1}$ where x is the distance (in cm) from one end of rod. The length of rod at 20°C is :

(A) 2.124 m (B) 3.24 m (C) 2.0120 m (D) 3.124 m

Q 13. Two vertical glass tubes filled with a liquid are connected by a capillary tube as shown in the figure. The tube on the left is put in an ice bath at 0°C while the tube on the right is kept at 30°C in a water bath. The difference in the levels of the liquid in the two tubes is 4 cm while the height of the liquid column at 0°C is 120 cm. The coefficient of volume expansion of liquid is (Ignore expansion of glass tube)



(A) 22×10^{-4}/°C (B) 1.1×10^{-4}/°C (C) 11×10^{-4}/°C (D) 2.2×10^{-4}/°C

Q 14. A liquid is given some heat.

Statement A: Some liquid evaporates.

Statement B: The liquid starts boiling.

(A) A implies B and B implies A (B) B implies A but, A does not imply B

(C) A implies B but B does not imply A (D) Neither A implies B nor B implies A

Q 15. A long solid cylinder is radiating power. It is remoulded into a number of smaller cylinders, each of which has the same length as original cylinder. Each small cylinder has the same temperature as the original cylinder. The total radiant power emitted by the pieces is twice that emitted by the original cylinder. How many smaller cylinders are there? Neglect the energy emitted by the flat faces of cylinder.

(A) 3 (B) 4 (C) 5 (D) 6

Q 16. Four rods of same material with different radii r and length *l* are used to connect two reservoirs of heat at different temperatures. Which one will conduct most heat ?

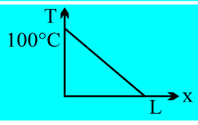
(A) r =2cm, *l* =0.5m (B) r = 2cm, *l* = 2m

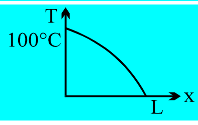
(C) r =0.5cm, *l* =0.5m (D) r = 1 cm, *l* = 1 m

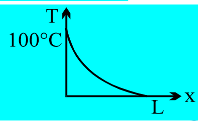
Q 17. In a 10-metre-deep lake, the bottom is at a constant temperature of 4°C. The air temperature is constant at -4°C. The thermal conductivity of ice is 3 times that of water. Neglecting the expansion of water on freezing, the maximum thickness of ice will be

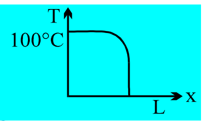
(A) 7.5 m (B) 6 m (C) 5 m (D) 2.5 m

Q 18. A rod of length L and uniform cross-sectional area has varying thermal conductivity which changes linearly from 2K at end A to K at the other end B. The ends A and B of the rod are maintained at constant temperature 100°C and 0°C, respectively. At steady state, the graph of temperature: T = T(x) where x = distance from end A will be

(A) 

(B) 

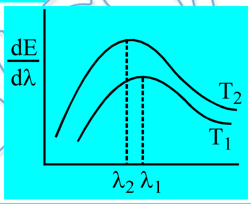
(C) 

(D) 

Q 19. One end of a uniform rod of length 1 m is placed in boiling water while its other end in placed in melting ice. A point P on the rod is maintained at a constant temperature of 800°C. The mass of steam produced per second is equal to the mass of ice melted per second. If specific latent heat of steam is 7 times the specific latent heat of ice, the distance of P from the steam chamber must be

(A) l/7 m (B) 1/8 m (C) l/9m (D) 1/10 m

Q 20. The spectral emissive power E_λ for a body at temperature T_1 is plotted against the wavelength and area under the curve is found to be A. At a different temperature T_2 the area is found to be 9A. Then λ_1/λ_2 =



(A) 3 (B) 1/3 (C) $1/\sqrt{3}$ (D) $\sqrt{3}$

Q 21. 'Gulab Jamuns' (assumed to be spherical) are to be heated in an oven. They are available in two sizes, one twice bigger (in radius) than the other. Pizzas (assumed to be discs) are also to be heated in oven. They are also in two sizes, one twice big (in radius) than the other. All four are put together to be heated to oven temperature. Choose the correct option from the following:

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

(B) Smaller gulab jamuns are heated before bigger ones.

(C) Smaller pizzas are heated before bigger ones.

(D) Bigger pizzas are heated before smaller ones.

Q 22. The temperature of an isolated black body falls from T_1 to T_2 in time t. Let c be a constant.

(A) t = c$\left[\frac{1}{T_2}-\frac{1}{T_1}\right]$ (B) t = c$\left[\frac{1}{T_2^2}-\frac{1}{T_1^2}\right]$ (C) t = c$\left[\frac{1}{T_2^3}-\frac{1}{T_1^3}\right]$ (D) $\left[\frac{1}{T_2^4}-\frac{1}{T_1^4}\right]$

Q 23. An experiment is performed to measure the specific heat of copper. A lump of copper is heated in an oven, then dropped into a beaker of water. To calculate the specific heat of copper, the experimenter must know or measure the value of all of the quantities below EXCEPT the

(A) heat capacity of water and beaker
(B) original temperature of the copper and the water
(C) final (equilibrium) temperature of the copper and the water
(D) time taken to achieve equilibrium, after the copper is dropped into the water

Q 24. One end of a conducting rod is maintained at temperature 50°C and at the other end, ice is melting at 0°C. The rate of melting of ice is doubled if:

(A) the temperature is made 200°C and the area of cross-section of the rod is doubled
(B) the temperature is made 100°C and length of rod is made four times
(C) area of cross-section of rod is halved and length is doubled
(D) the temperature is made 100°C and the area of cross-section of rod and length both are doubled.

Q 25. A point source of heat of power P is placed at the centre of a spherical shell of mean radius R. The material of the shell has thermal conductivity k. If the temperature difference between the outer and inner surface of the shell is not to exceed T, the thickness of the shell should not be less than

(A) $\frac{4\pi kR^2T}{P}$ (B) $\frac{4\pi kR^2}{TP}$ (C) $\frac{4\pi R^2T}{kP}$ (D) $\frac{4\pi R^2P}{kT}$

Q 26. A black body is at a temperature of 2880 K. The energy of radiation emitted by this object with wavelength between 499 nm and 500 nm is U_1, between 999 nm and 1000 nm is U_2 and between 1499 nm and 1500 nm is U_3. The Wien constant b = 2.88 × 10^6 nm K. Then

(A) $U_1 = 0$ (B) $U_3 = 0$ (C) $U_1 > U_2$ (D) $U_2 > U_1$

Answer Key

Q.1) D	Q.2) D	Q.3) A	Q.4) D	Q.5) A
Q.6) A	Q.7) C	Q.8) A	Q.9) C	Q.10) A
Q.11) B	Q.12) C	Q.13) C	Q.14) B	Q.15) B
Q.16) A	Q.17) A	Q.18) B	Q.19) C	Q.20) D
Q.21) B	Q.22) C	Q.23) D	Q.24) D	Q.25) A
Q.26) D				