PHYSICS – CLASS XI

Chapter 10 : Thermal Properties of Matter

PRACTICE PAPER (Chapter-wise Test)

Time : 1½ Hours **Max. Marks : 35**

General Instructions

(a) All questions are compulsory.

(b) There are 17 questions in total. Section A: Q. 1 to 8 carry 1 mark each. Section B: Q. 9 to 12 carry 2 marks each. Section C: Q. 13 to 15 carry 3 marks each. Section D: Q. 16 and 17 carry 5 marks each.

(c) There is no overall choice. An internal choice is given in one 2-mark question (Q. 11), one 3-mark question (Q. 14) and both 5-mark questions (Q. 16, Q. 17). Attempt only one of the given choices.

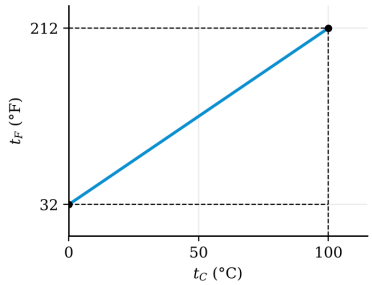
(d) Use of calculators is not permitted. Take T (K) = t (°C) + 273, R = 8.3 J mol^{-1} K^{-1}, specific heat of water = 4200 J kg^{-1} K^{-1}, specific heat of ice = 2100 J kg^{-1} K^{-1}, latent heat of fusion of ice = 3.3 × 10^{5} J kg^{-1}, Stefan's constant σ = 5.67 × 10^{-8} W m^{-2} K^{-4} and Wien's constant = 2.9 × 10^{-3} m K, unless different values are given in the question.

(e) Figures are schematic and not drawn to scale. Write the unit with every numerical answer.

SECTION A

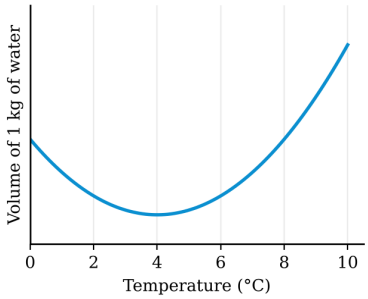
Questions 1 to 8 carry 1 mark each.

1. The graph shows the relation between the Fahrenheit temperature t_F and the Celsius temperature t_C. The Fahrenheit reading corresponding to 50 °C is **(1)**



(a) 90 °F
(b) 112 °F
(c) 122 °F
(d) 132 °F

2. The figure shows how the volume of 1 kg of water changes with temperature between 0 °C and 10 °C. The density of water is maximum at **(1)**

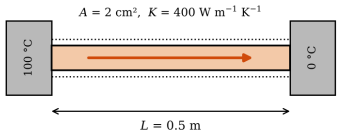


(a) 0 °C
(b) 4 °C
(c) 8 °C
(d) 10 °C

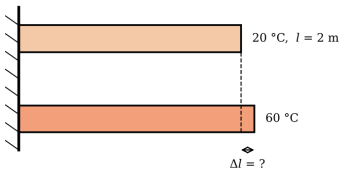
3. The coefficients of linear expansion, area expansion and volume expansion of a solid ($\alpha_l : \alpha_A : \alpha_V$) are in the ratio **(1)**
(a) 1 : 2 : 3
(b) 1 : 3 : 2
(c) 3 : 2 : 1
(d) 1 : 1 : 1

4. **Assertion (A):** Steam at 100 °C causes a more severe burn than boiling water at 100 °C. **(1)**
Reason (R): Steam carries an extra amount of heat equal to the latent heat of vaporisation.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

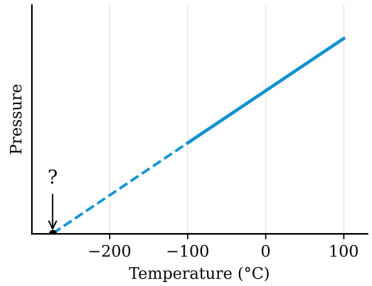
5. A copper bar of cross-section 2 cm² (= 2 × 10⁻⁴ m²) and length 0.5 m has its ends at 100 °C and 0 °C (figure). Its sides are insulated. Find the rate of flow of heat along the bar in the steady state. (K = 400 W m⁻¹ K⁻¹) **(1)**



6. An aluminium rod of length 2 m is heated from 20 °C to 60 °C (figure). Find the increase in its length. (α_{Al} = 2.5 × 10⁻⁵ K⁻¹) **(1)**



7. The graph shows the pressure of a low-density gas kept at constant volume versus its temperature in °C. At what temperature does the straight line, when extended backwards, meet the temperature axis? Name this temperature. **(1)**

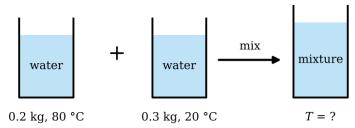


8. The wavelength at which a black body emits maximum energy is 5×10^{-7} m. Find its absolute temperature. **(1)**

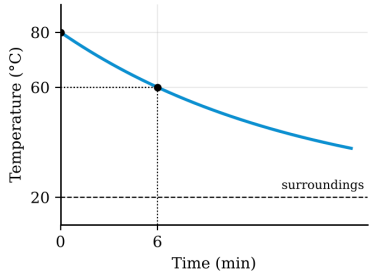
SECTION B

Questions 9 to 12 carry 2 marks each.

9. 0.2 kg of water at 80 °C is mixed with 0.3 kg of water at 20 °C in an insulated container (figure). (i) State the principle used in calorimetry. (ii) Find the final temperature of the mixture. **(2)**



10. A body cools from 80 °C to 60 °C in 6 minutes (figure). The temperature of the surroundings is 20 °C. Using Newton's law of cooling, find the time it takes to cool from 60 °C to 40 °C. **(2)**

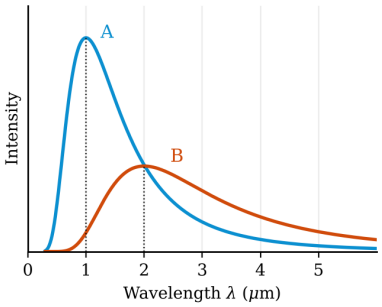


11. Calculate the heat required to convert 0.2 kg of ice at 0 °C into water at 10 °C. **(2)**

OR

Explain why a sea breeze blows from the sea towards the land during the day. Give the role of specific heat capacity and convection.

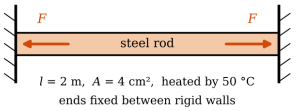
12. The figure shows the energy distribution of the radiation emitted by two black bodies A and B. The wavelengths of maximum intensity are 1.0 μm for A and 2.0 μm for B. (i) Which body is hotter, and what is the ratio of their temperatures $T_A : T_B$? (ii) If both have the same surface area, find the ratio of the total energy radiated per second by A and B. **(2)**



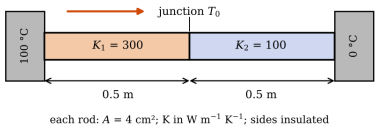
SECTION C

Questions 13 to 15 carry 3 marks each.

13. A steel rod of length 2 m and cross-sectional area 4 cm² (= 4 × 10⁻⁴ m²) is fixed between two rigid walls so that it cannot expand (figure). Its temperature is raised by 50 °C. Take $\alpha_{steel} = 1.2 \times 10^{-5}\ K^{-1}$ and $Y_{steel} = 2 \times 10^{11}\ N\ m^{-2}$. Find (i) the thermal strain produced, (ii) the thermal stress and (iii) the force exerted by the rod on each wall. **(3)**

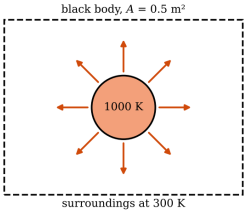


14. Two rods of equal length 0.5 m and equal cross-sectional area 4 cm² (= 4 × 10⁻⁴ m²) but of thermal conductivities $K_1 = 300\ W\ m^{-1}\ K^{-1}$ and $K_2 = 100\ W\ m^{-1}\ K^{-1}$ are joined end to end. The free ends are kept at 100 °C and 0 °C (figure). Find (i) the temperature of the junction, (ii) the heat current through the compound rod and (iii) the equivalent thermal conductivity of the compound rod. **(3)**

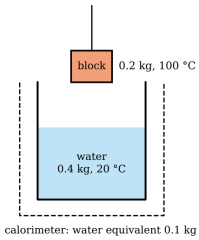


OR

A black body of surface area 0.5 m² is at a temperature of 1000 K in surroundings at 300 K (figure). Find (i) the rate at which it radiates energy, (ii) the net rate of loss of energy and (iii) the wavelength at which it emits maximum energy.



15. A metal block of mass 0.2 kg at 100 °C is dropped into 0.4 kg of water at 20 °C contained in a calorimeter of water equivalent 0.1 kg (figure). The final steady temperature is 25 °C. Find (i) the heat gained by the water, (ii) the heat gained by the calorimeter and (iii) the specific heat capacity of the metal. **(3)**



SECTION D

Questions 16 and 17 carry 5 marks each.

16. 0.1 kg of ice at −10 °C is heated at a constant rate until it is converted into steam at 100 °C (figure). The latent heat of vaporisation of water is 2.25×10^6 J kg^{-1}. **(5)**

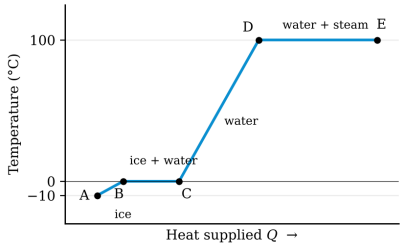
(a) Define latent heat. (1)

(b) Find the heat absorbed in the part AB. (1)

(c) Find the heat absorbed in the part BC. (1)

(d) Find the heat absorbed in the part CD. (1)

(e) Find the heat absorbed in the part DE and hence the total heat required. (1)



OR

A cylinder of volume 8.3×10^{-3} m^3 closed by a movable piston contains 2 mol of an ideal gas at 300 K (figure).

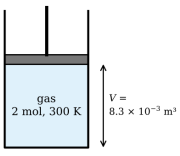
(a) Write the ideal-gas equation. (1)

(b) Find the pressure of the gas. (1)

(c) The piston is locked and the gas is heated until its pressure doubles. Find the new temperature. (1)

(d) The gas is brought back to 300 K and the piston is allowed to move out slowly until the volume doubles at constant temperature. Find the new pressure. (1)

(e) Find the coefficient of volume expansion of the gas at 300 K. (1)



17. A cubical icebox of thermocole has a total wall area of 0.55 m² and wall thickness 5 cm (figure). It contains ice at 0 °C and the outside temperature is 50 °C. The thermal conductivity of thermocole is 0.02 W m^{-1} K^{-1}. **(5)**

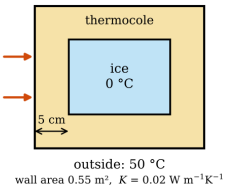
(a) Write the expression for the rate of flow of heat through a slab. (1)

(b) Find the rate at which heat flows into the box. (1)

(c) Find the heat that enters the box in 5 hours. (1)

(d) Find the mass of ice that melts in 5 hours. (1)

(e) Why is thermocole a good insulator? (1)



OR

Three thermometers read the same temperature on the Celsius, Kelvin and Fahrenheit scales (figure).

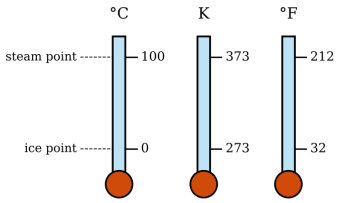
(a) Write the relation between t_F and t_C. (1)

(b) Normal body temperature is 98.6 °F. Find it in °C. (1)

(c) At what temperature do the Celsius and Fahrenheit scales give the same reading? (1)

(d) Express 300 K in °C. (1)

(e) A temperature rises by 18 °F. Find the rise on the Celsius and Kelvin scales. (1)



— END OF QUESTION PAPER —