

Board – CBSE

Class – 11

Topic – Thermal properties of matter

2 marks questions:

1. A 'thermacole' icebox is a cheap and efficient method for storing small quantities of cooked food in summer in particular. A cubical icebox of side 30 cm has a thickness of 5.0 cm. If 4.0 kg of ice is put in the box, estimate the amount of ice remaining after 6h the outside temperature is 45°C and co-efficient of thermal conductivity of thermacole is $0.01 \text{ J s}^{-1} \text{ m}^{-1} \text{ K}^{-1}$. [Heat of fusion of water = $335 \times 10^3 \text{ J kg}^{-1}$]

3 marks questions:

2. Two absolute scales A and B have triple points of water defined to be 200 A and 350 B. What is the relation between T_A and T_B ?
3. In an experiment on the specific heat of a metal, a 0.20 kg block of the metal at 150°C is dropped in a copper calorimeter (of water equivalent 0.025 kg) containing 150 cm³ of water at 27°C the final temperature is 40°C. Compute the specific heat of the metal. If hat losses to the surroundings are not negligible, is your answer greater or smaller than the actual value for specific heat of the metal?

4 marks questions:

4. The electrical resistance in ohms of a certain thermometer varies with temperature according to the approximate law:
$$R = R_0[1 + \alpha(T - T_0)]$$
The resistance is 101.6 Ω at the triple –point of water 273.16 K, and 165.5 Ω at the normal melting point of lead (600.5 K). what is the temperature when the resistance is 123.4 Ω
5. The coefficient of volume expansion of glycerin is $49 \times 10^{-5} \text{ K}^{-1}$. What is the fractional change in its density for a 30°C rise in temperature ?

5 marks Question:

6. Answer the following:

- The triple- point of water is a standard fixed point in modern thermometry. Why? What is wrong in taking the melting point of ice and the boiling point of water as standard fixed points (as was originally done in the Celsius scale)?
- There were two fixed points in the original Celsius scale as mentioned above which were assigned the number 0°C and 100°C respectively. On the absolute scale is assigned the number 273.16 K . what is the other fixed point on this (kelvin) scale?
- The absolute temperature (kelvin scale) T is related to the temperature t_c on the Celsius scale by

$$t_c = T - 273.15$$
 Why do we have 273.16 in this relation, and not 273.16?
- What is the temperature of the triple-point of water on an absolute scale whose unit interval size is equal to that of the Fahrenheit scale?

7. Two ideal gas thermometers A and B use oxygen and hydrogen respectively. The following observations are made:

Temperature	Pressure Thermometer A	Pressure thermometer B
Triple- point of water	$1.250 \times 10^5 \text{ Pa}$	$0.200 \times 10^5 \text{ Pa}$
Normal melting point of Sulphur	$1.797 \times 10^5 \text{ Pa}$	$0.287 \times 10^5 \text{ Pa}$

- What is the absolute temperature of normal melting point of Sulphur as read by thermometers A and B?
 - What do you think is the reason behind the slight difference in answers of thermometers A and B? (The thermometers are not faulty). What further procedure is needed in the experiment to reduce the discrepancy between the two readings?
8. Answer the following question based on the P – T phase diagram of CO_2 :
- CO_2 at 1 atm pressure and temperature -60°C is compressed isothermally. Does it go through a liquid phase?
 - What happened when CO_2 at 4 atm pressure is cooled from room temperature at constant pressure?
 - Describe qualitatively the changes in a given mass of solid CO_2 at 10 atm pressure and temperature -65°C as it is heated up to room temperature at constant pressure.

- (d) CO_2 is heated to a temperature 70°C and compressed isothermally. What changes in its properties do you expect to observe?
9. A child running a temperature of 101°F is given an aspirin (i.e. a medicine that lowers fever) which causes an increase in the rate of evaporation of sweat from his body. If the fever is brought down to 98°F in 20 min. what is the average rate of extra evaporation caused by the drug? Assume the evaporation mechanism to be the only way by which heat is lost. The mass of the child is 30 kg. The specific heat of human body is approximately the same as that of water and latent heat of evaporation of water at that temperature is about 580 cal g^{-1} .
10. Explain why:
- (a) A body with large reflectivity is poor emitter
 - (b) A brass tumbler feels much colder than a wooden tray on a chilly day
 - (c) An optical pyrometer (for measuring high temperatures) calibrated for an ideal black body radiation gives too low a value for the temperature of a red hot iron piece in the open. But gives a correct value for the temperature when the same piece is in the Furnace
 - (d) The earth without its atmosphere would be inhospitably cold
 - (e) Heating systems based on circulation of steam are more efficient in warming a building than those based on circulation of hot water