TENDER HEART HIGH SCHOOL, SEC.-33'B, CHD. 12.08.24

CLASS-X SUBJECT- PHYSICS

CHAPTER-11 TEACHER-charanjeet kaur

Good Morning Students!

This lesson is of class-X for the subject of 'Physics' Topic - 'Heat capacity, specific heat capacity and its measurement' which is covered in Chapter - 11 'Calorimetry' and this particular topic is on Page Number- 261 of your textbook, Titled: 'Concise Physics by Selina Publications' and is being submitted to you on 31st July, 2023. All students may now open Page Number- 261 in front of you.

Concept of Heat

Heat is a form of energy which flows from a hot body to a cold body when they are kept in contact.

The measurement of the quantity of heat is called calorimetry.

S.I unit of Heat is Joule (J)

Common unit of Heat is Calorie (cal)

1 cal = 4.186 J or, 4.2 J (approximately)

A hot body has more internal energy than an identical cold body. When a hot body is kept in contact with a cold body, the internal energy of cold body increases (as it warms up) and internal energy of hot body decreases (as it cools down).

Note: The molecules in a substance possess Kinetic Energy due to their random motion and Potential Energy due to the molecular attractive forces (as a molecule exerts a force of attraction on other molecules).

One calorie can be defined as the heat energy required to raise the temperature of 1 g of water from 14.5°C to 15.5°C.

Students, 1 kcal = 1000 cal = 10^3 cal = 4200 J

One Kilo - calorie is the heat energy required to raise the temperature of 1 kg of water from 14.5°C to 15.5°C

CONCEPT OF TEMPERATURE

Temperature is a parameter which tells the thermal state of a body, that is the degree of hotness or coldness of the body. It determines the direction of flow of heat when two bodies at different temperatures are placed in contact.

NOTE: If there is no transfer of heat between the two bodies placed in contact, they are said to be at same temperature, but it does not mean that they have equal amount of thermal energy in them. The amount of heat energy (thermal energy) contained in a body depends on its mass, temperature and the material of body.

S.I. unit of temperature - Kelvin (K)

Also, $T(K) = 273 + t(°C)$

Q. Students, now you all convert (i) 27° C into Kelvin and, (ii) also write the value of boiling point of water in °C and K.
(After solving the questions you can resume this session further to check your answers)

(i) $T(K) = 27°C + 273 = 300\,K$

(ii) Boiling point of water is 100°C. So,
$T(K) = 100°C + 273 = 373\,K$

Students note that, Temperature difference (that is a degree or rise or fall) is same on both the Celsius and Kelvin scales.

For example: If temperature is given to be risen by 5°C, then rise in Kelvin scale will also be 5 K.

Suppose, $T = 30°C$

So, $T(K) = 30 + 273 = \underline{303\ K}$

and the temperature rises by 5°C, such that the value of temperature now is 35°C

Then, $T(K) = 35 + 273 = \underline{308\ K}$

Now see the difference in the reading of temperature given in units of Kelvin. So, the rise in temperature in Kelvin scale is

$308\ K - 303\ K = 5\ K$

FACTORS AFFECTING THE QUANTITY OF HEAT ABSORBED TO INCREASE THE TEMPERATURE OF A BODY

The quantity of heat energy absorbed to increase the temperature of a body depends on three factors, which are:

i) the mass of the body (m),
ii) the rise (or increase) in temperature of the body (ΔT),
iii) the material of the body.

Amount of heat energy absorbed by the body (Q) $= m \cdot c \cdot \Delta T$

where, c = specific heat capacity of the material.

Now students,

1.) If you are having two containers - in one of the container you have powred 2 Kg of milk and in the second container you have powred 4 Kg of milk, then if you want to increase the temperature by 5°C in same time, then which container will require more heat?

• Yes, the second container having 4 Kg of milk will require more heat.

2.) If you have two containers having equal quantity of milk in it, and if in container A we have to raise temperature by 5°C while in container B we need to raise temperature by 20°C, then which container will require more heat?

• Container B will require more heat energy as the temperature to be raised is more.

3.) Students, whenever we get burnt it is advised in certain cases to pour cold water on it. This is done because water can absorb more heat. Students, if equal mass of water and copper are heated through 1°C, the amount of heat absorbed by water is nearly ten times the amount of heat absorbed by copper.

* Amount of heat energy absorbed depends on the substance of the object which is expressed in terms of its specific heat capacity (c).

Hence, the relation between heat energy with all the three factors is:

$$Q = m\ c\ \Delta T$$

ΔT = change in temperature

S.I. unit of c : $c = \frac{Q}{m \cdot \Delta T}$

c = J/kg K or J/kg °C

Specific heat capacity depends on material and is independent of mass of that material.
For example: Specific heat capacity of H_2O = 4200 J/kg°C
So, if water is 1 litre or 5 litre of water in a container the value of specific heat capacity is same, that is, 4200 J/kg K.

THERMAL CAPACITY (HEAT CAPACITY) → c'

The heat capacity of a body is the amount of heat energy required to raise its temperature by 1°C (or 1 K).
Mathematically, $c' = \frac{Q}{\Delta T} = \frac{c\,m\,\Delta T}{\Delta T}$

So, $[c' = cm]$

Students, thermal capacity (c') depends on mass of body and its S.I. unit is J/K

Q1. What do you mean by the following statements:
i) the heat capacity of a body is 50 J/K?
ii) the specific heat capacity of copper is 0.4 J/g K?

Ans i) $c' = 50$ J/K
It means that 50 J of heat energy is required to raise the temperature of the body by 1 K (or 1°C).

ii) $c = 0.4$ J/g K
It means that the heat energy required to raise the temperature of 1 g of copper by 1 K (or 1°C) is 0.4 J.

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