

## Phys11 Heat Energy : Notes/W.S. - 50

The **Heat** (or thermal energy  $E$ ) of a body, is the total kinetic energy of all of the particles in the body. At a temperature of absolute zero, ( $-273\text{ }^{\circ}\text{C}$ ), the heat energy of a body is zero.

**Temperature** is a measure of the average kinetic energy of the atoms or molecules in a body.

If the thermal energy of a body rises, there must be a corresponding inflow of heat energy and the temperature of the body rises. The converse is also true. Heat flow obeys the law of conservation of energy. Also, if two bodies are in contact, heat will flow from the body with the higher temperature to that with the lower temperature until both bodies are at the same temperature.

If an amount of heat ( $Q$ ) is transferred to a body,  $Q$  is proportional to the mass of the body and the change in the temperature of the body.

$$Q = m c \Delta T$$

$Q = \Delta E$ , or the change in heat energy of the body. The mass is  $m$  in kg. The change in temperature is  $\Delta T$ . The constant of proportionality is  $c$ . It is called the **Specific Heat Capacity**. Its value depends on the substance.

<b>Substance</b>	<b>S.H.C. (J/kg/<math>^{\circ}\text{C}</math>)</b>
water	4200
concrete	880
iron	450
aluminum	900
cork	2100

Problems :

- 1) Define : heat; temperature.
- 2) Find the amount of energy required to increase the temperature of a quantity of 8.5 kg of water from  $22^{\circ}\text{C}$  to  $67^{\circ}\text{C}$ .

3) Find the amount of energy required to raise the temperature of 560 grams of iron from 20.°C to 530°C.

4) A tub of hot water containing 50. L of water radiates heat. How much heat is radiated as the water cools down from 95°C to 22°C. (1 L water = 1 kg)

5) Find the specific heat capacity for wood if the temperature of a 1.0 kg piece of wood is found to rise from 20.°C to 55°C when an amount of heat equal to 55,000 J is added.

6) 1.0 kW-hr equals  $3.6 \times 10^6$  J. If 1.0 kW-hr of electrical energy costs 7.2¢, find the cost of heating 250 L of water from 20°C to 55°C.

7) How much time does it take a 950 watt kettle to heat 1.5 liters (1.5 kg) of water from 20. °C to 100. °C ? Assume that the kettle is 100.% efficient.

8) The human body radiates heat energy at a rate of about 150 watts. How many joules are given off in one hour ?

9) If 1.0 L of 25°C water is added to 1.0 L of 35°C, what is the temperature of the mixture ?

10) If a 100. gram piece of iron that has been heated to 350.°C, is put into 500. grams of water that has a temperature of 20.°C, find the increase in the temperature of the water.

Answers : 1) Heat is the total kinetic energy of the atoms and molecules in a body., Temperature is a measure of the average kinetic energy of the atoms and molecules in the body., 2)  $1.6 \times 10^6$  J, 3)  $1.3 \times 10^5$  J, 4)  $1.5 \times 10^7$  J, 5) 1600 J/kg/°C, 6) 74 ¢, 7) 530 s, 8)  $5.4 \times 10^5$  J, 9) 30.°C, 10) 27°C.