Answer on Question #51930-Physics-Field Theory

A solid X is in thermal equilibrium with a solid Y, which is at the same temperature as a third solid Z. The three bodies are of different materials and masses. Which one of the following statements is certainly correct?

X and Y have the same heat capacity

X and Y have the same internal energy

It is not necessary that Y should be in thermal equilibrium with Z

There is no net transfer of energy if X is placed in thermal contact with Z

Solution

X and Z have the same temperature, therefore they would be in thermal equilibrium. If Y is in thermal equilibrium with X, then by the zeroth law of thermodynamics X and Z would also be in thermal equilibrium. Hence there would be no net transfer of heat between X and Z.

Answer: There is no net transfer of energy if X is placed in thermal contact with Z.

14 A hot water tank of heat capacity 5000 JK-1 contains 10 kg of water at 25 °C. What is the time taken to raise the temperature of the water to 45 °C using a heater coil of power of 3.0 kW, given that the specific heat capacity of water is 4200 Jkg-1 K-1?

61 s

280 s

310 s

610 s

Solution

$$Q = Pt = mc\Delta T + C\Delta t = (mc + C)\Delta t.$$

So,

$$t = \frac{(mc + C)\Delta T}{P} = \frac{(10\ \text{kg} \cdot 4200\ \text{Jkg}^{-1}\ \text{K}^{-1} + 5000\ \text{JK}^{-1})(45\ - 25)K}{3.0 \cdot 10^3\text{W}} = 310\ s.$$

Answer: 310 s.

15 A solid object M is made of a material with a specific capacity c and a specific latent heat of fusion L. The object is heated up at a constant rate P. Its initial temperature is below its melting point by ΔT. The time for the object to be completely melted is given by

M(cΔT + L)/P

M(c + L)ΔT/P

P/[mΔT(c + L)]

P/[m(cΔT + L)]

Solution

$$Q = Pt = Mc\Delta T + ML.$$

Thus,

$$t = \frac{M(c\Delta T + L)}{P}.$$

Answer : $\frac{M(c\Delta T+L)}{P}$.