

Q- A household refrigerator that has a power input of 450W and a COP of 2.5 is to cool 5 large watermelons, 10 kg each, to 10°C. If the melons are initially at 20°C, determine how long it will take for the refrigerator to cool them. The specific heat of melons = 4.2kJ/(kg.°C)

The coefficient of performance (COP) of a refrigerator is the ratio of the amount of expelled to the work done or energy input.

$$K = Q_L/W$$

And hence energy input is given by

$$W = Q_L/K \quad \text{----- (1)}$$

Now the heat to be taken out

$$Q_L = m \cdot C \cdot \Delta t = (5 \cdot 10 \text{ kg}) \cdot (4.2 \cdot 10^3 \text{ J}/(\text{kg} \cdot ^\circ\text{C})) \cdot [(20 - 10)^\circ\text{C}]$$

$$\text{Or } Q_L = 2.1 \cdot 10^6 \text{ J} = 2100 \text{ KJ}$$

Hence the time required will be

$$t = \text{energy given} / \text{power} = 2.1 \cdot 10^6 \text{ J} / 450 = 4666.67 \text{ s}$$

Hence the time required will be 1.296 hour or 1 hour 17 min and 47 s.

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