Answer on Question #42542 – Physics – Molecular Physics|Thermodynamics

Question.

The motor in a refrigerator has a power output of 200w. If the freezing compartment is at 270 k and the outside air is at 300 k, assuming ideal efficiency, calculate the maximum amount of heat that can be extracted from the freezing compartment in 10 minutes..

Given:

$N = 200\ W$

$T_1 = 270\ K$

$T_2 = 300\ K$

$t = 10\ min = 600\ s$

Find:

$Q = ?$

Solution.

Energy conversion efficiency (η) is the ratio between the useful output of an energy conversion machine and the input. Energy conversion efficiency for refrigerator is refrigerating efficiency ε:

$$\varepsilon = \frac{Q}{A} \rightarrow Q = \varepsilon \cdot A$$

Q is amount of heat;

A is work done.

By definition:

$$\varepsilon = \frac{T_1}{T_2 - T_1}$$

And $A = N \cdot t$

So, maximum amount of heat is:

$$Q = \frac{T_1}{T_2 - T_1} N \cdot t$$

Calculate:

$$Q = \frac{270}{30} \cdot 200 \cdot 600 = 1.08 \cdot 10^6\ J = 1.08\ MJ$$

Answer.

$$Q = \frac{T_1}{T_2 - T_1} N \cdot t = 1.08 \cdot 10^6\ J = 1.08\ MJ$$