

Exam 2020

A refrigerator is cooling your food to 8 °C. The temperature of your kitchen is a cosy 20 °C.

(a) What power will have to be supplied to the fridge if the heat output from the back of the fridge is 5 kW? [4]

(b) What is the efficiency of the fridge (for a fridge: $\eta = Q_2/W$)? [1]

$$Q_2 = Q_1 - W$$

a)

20°C

$\uparrow Q_1 = 5 \text{ kW}$

(F) $\leftarrow W$

$\uparrow Q_2$
8°C

$$\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$$

$$Q_2 = \frac{T_2}{T_1} \cdot Q_1$$

$$= \frac{20}{8} \cdot \frac{1}{8}$$

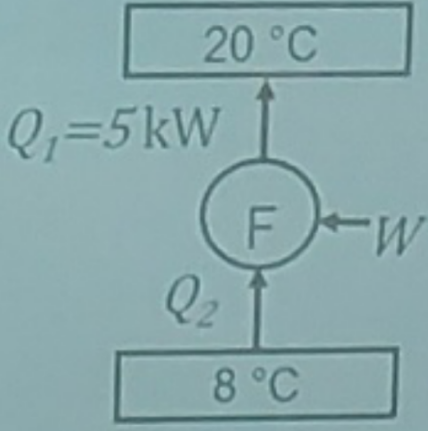
$$W = Q_1 - Q_2$$

$$= 4.5 \text{ kW}$$

$$Q_2 = \frac{1}{2}$$

$$b) \eta = \frac{W_{out}}{Q_1}$$

Comet's:



a) Find W .
b) Find $\eta = Q_2/W$.

Assume Carnot engine:

$$\frac{Q_1}{Q_2} = \frac{T_1}{T_2} \Rightarrow Q_2 = Q_1 \frac{T_2}{T_1}$$

$$Q_1 = W + Q_2 \Rightarrow W = Q_1 - Q_2 = Q_1 \left(1 - \frac{T_2}{T_1}\right)$$

a) $W = 5 \text{ kW} \left(1 - \frac{281 \text{ K}}{293 \text{ K}}\right) = 205 \text{ W}$

b) $\eta = \frac{5000 \text{ W} - 205 \text{ W}}{205 \text{ W}} = 23.4$

heat taking out
of our pool

