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$T_{inside} = 21C = 294K$

$T_{outside} = 32C = 305K$

Inside = Cold

Outside = Hot

$T_C = 294K$

$T_H = 305K$

$P_{into\ house} = 11kW$

AC ⇒ carnot efficiency

To maintain inside temperatures

11kW must be removed from inside

$$\left( \frac{Q_c}{t} = 11E3 \frac{J}{s} \right)$$

$$W_{max} = \left(1 - \frac{T_C}{T_H}\right) Q_H$$

$$\frac{Q_H}{Q_C} = \frac{T_H}{T_C}$$

$$Q_H = \frac{Q_C T_H}{T_C}$$

$$W_{max} = \left(1 - \frac{T_C}{T_H}\right) \frac{Q_c T_H}{T_C}$$

$$\frac{W_{max}}{t} = \left(1 - \frac{294K}{305K}\right) \frac{(11E3\ J/s)\ 305K}{294K}$$

$$= 4.12E2\ W$$

$$\boxed{4.1E2\ W}$$

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a) Entropy increases, not a reversible process.

b) $\Delta S = \frac{Q}{T}$ with Power $\frac{\Delta S}{t} = \frac{P}{T}$

$$\left(\frac{\Delta S}{t}\right)_{Total} = \left(\frac{\Delta S}{t}\right)_{AC} + \left(\frac{\Delta S}{t}\right)_{Leak}$$

$$\left(\frac{\Delta S}{t}\right)_{AC} = \frac{P_{Hot}}{T_H} + \frac{-P_{Cold}}{T_C}$$

↙ heat leaves cold reservoir

$$\left(\frac{\Delta S}{t}\right)_{Leak} = \frac{-P_{Hot}}{T_H} + \frac{P_{Cold}}{T_C}$$

↙ heat leaves high temp reservoir

From #59

For AC

$$P_{cold} = 11E3\ J/s$$

$$P_{net} = 4.1E2\ J/s$$

$$P_{Net} = P_{hot} - P_{cold}$$

$$P_{hot} = P_{Net} + P_{cold} = 1.141E4\ J/s$$

$$\Delta \frac{S}{t}_{AC} = \frac{+1.141E4\ J/s}{305k} + \frac{-11E3\ J/s}{294k} = -5.13E{-}3\ \frac{W}{K}$$

For Leak

$$P_{hot} = P_{cold} = 11E3\ J/s$$

$$\Delta \frac{S}{t}_{Leak} = \frac{-11E3\ J/s}{305k} + \frac{11E3\ J/s}{294k} = 1.35\ \frac{W}{K}$$

$$\Delta \frac{S}{t}_{total} = -5.13E{-}3\ \frac{W}{K} + 1.35\ \frac{W}{K} = 1.34\ \frac{W}{K} = \boxed{1.3\ \frac{W}{K}}$$