Phy 2B 3/16

Monday, March 16, 2015 9:40 AM

Radiation Problem:

Wood stove in a room:

a) Stove at room temp

What is the Net radiated Power of the stove?

Zero → at room temp it must be emitting and absorbing the same amount

$$P_{Net} = P_{emitted} - P_{absorbed} = 0$$

$$P = \text{Power} = \frac{Q}{t} \quad \frac{\text{energy}}{\text{time}}$$

b) Stove is at 198°C to keep the room at 29°C

Stove: $e = 0.9$

$A = 3.5\ m^2$

$$\frac{Q}{t} = e \sigma T^4 A$$

$P_{absorbed}$ from the room is the power the stove would emit if it was at room temp

29°C → 302 K

$$P_{absorbed} = (0.9)\left(5.67 \times 10^{-8} \frac{J}{s\ m^2\ K^4}\right)(302\ K)^4 (3.5\ m^2)$$

$$= 1490 \frac{J}{s} \text{ or } W$$

198°C → 471 K

$$P_{radiated} = (0.9)(5.67 \times 10^{-8})(471\ K)(3.5\ m^2)$$

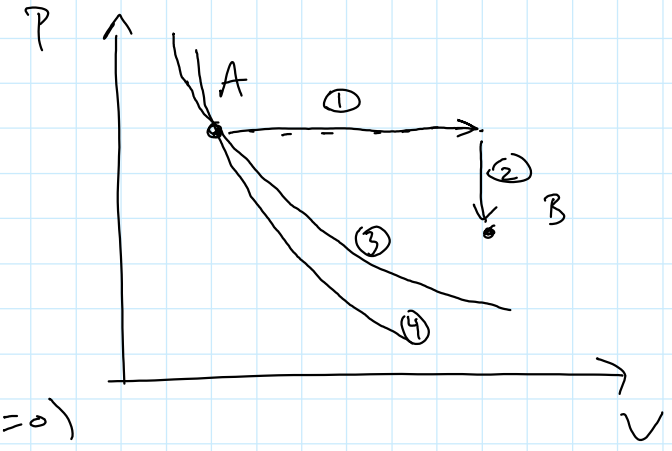
$= 8790\ W$

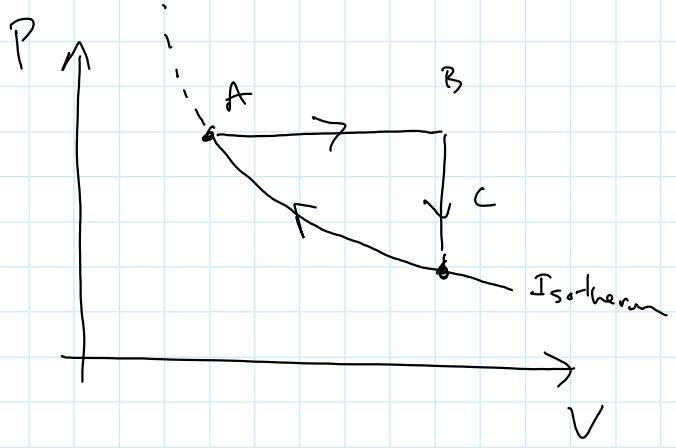
$P_{Net} = P_{radiated} - P_{absorbed}$

$= 8790 - 1490 = 7300\ W$

Thermal Processes:

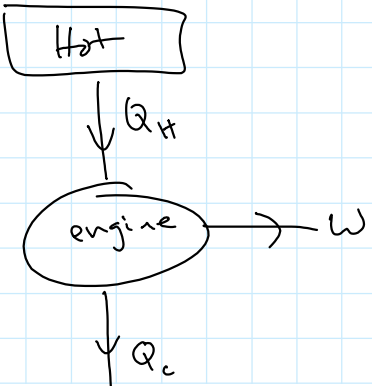
1) Constant P
2) Constant V
3) Constant T
4) No heat exchange ($Q = 0$)





$\Delta U = 0$

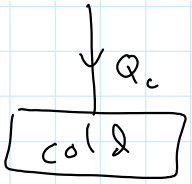
for a closed path



Cons. of energy

$Q_H = W + Q_c$

$e = \frac{W}{Q_H} = \frac{Q_H - Q_c}{Q_H}$

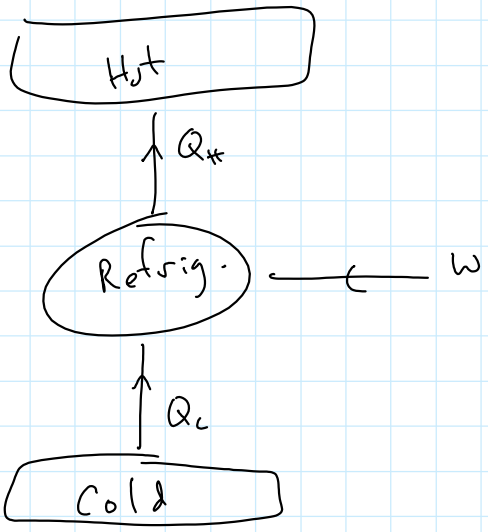


$$e = \frac{}{Q_H} = \frac{}{Q_H}$$

$$= 1 - \frac{Q_c}{Q_H}$$

Max. efficiency:

$$e_{max} = 1 - \frac{T_c}{T_H}$$



$$W + Q_c = Q_H$$

$$COP = \frac{Q_c}{W}$$

Entropy