HW chp. 10

Questions

4] 'Heat death' refers to the idea that if everything had the same temperature, if it were all in equilibrium — then no heat would flow. This doesn't imply that the final temp. is zero.

6.] The first law says that energy taken in from the hot region, 1000 kJ in this case, should equal energy out to cold, 400 energy + 600 work.

9.] The engine would work by taking heat between regions of different temp. The tube connects the engine to cold water below the warmer water at the surface.

13] First — implies that the energy of useful work cannot exceed the input energy.

Second — implies that you cannot convert all thermal energy to mechanical energy.

19] On a cold day, the temp. difference between hot and cold regions will be greater, thus giving greater efficiency.

30] Actually, it is closer to the first law.

45] a.) The mechanical energy converts to thermal via friction. b.) The temp rises, ~~due~~ thanks to the input thermal energy. c.) The entropy has probably risen → although the water as a whole is not moving, the increased heat means that the water molecules are moving randomly about their average locations, so the disorder has increased.

51] (b.) The crises refers to the amount of available energy, which decreases as entropy increases.

55] The electricity ~~[illegible]~~ in the light bulb, converts to light and heat, and the light then converts to heat upon hitting the walls. So the lights do contribute to the heating.

Exercises

1] $Q_{in} = W + Q_{out} = 200\text{ kJ} + 400\text{ kJ} = 600\text{ kJ}$

5] $\eta = \frac{W}{Q_{in}} = \frac{50\text{ J}}{200\text{ J}} = .25$

9] $\eta = 1 - \frac{T_{c}}{T_h} = 1 - \frac{285\text{ K}}{293\text{ K}} = .0273$

11] $T_{exhaust} = T_{cold}$, $\eta = 1 - \frac{T_c}{T_h} = \frac{T_h - T_c}{T_h} \rightarrow T_h = \frac{T_c}{1-\eta}$

$T_h = \frac{27°C = 300\text{ K}}{1 - .60} = 750\text{ K} = 477°C$

13] $\eta_{max} = 1 - \frac{T_c}{T_h} = 1 - \frac{300}{400} = 1/4$.

if $T_c = 350$ k and $\eta = 1/4$, then $T_h = \frac{T_c}{1-\eta} = \frac{350}{3/4}$

$= 467$ K

15] $W = Q_{out} - Q_{in} = 1600\ J - 1000\ J = 600\ J$

18] Extracted energy from cold air $= Q$ in.

$Q_{in} = Q_{out} - W = \left(2400 \frac{J}{sec}\right) \cdot 1 sec - (400\ W) \cdot 1 sec$ (J/sec)

$= 2000\ J$ each second.

19] $C_{perform} = \frac{Q_{in}}{W}$, ~~$\frac{Q}{second} = (400\ W) = 400 \frac{J}{sec}$~~

$\frac{W}{sec} = 400 \frac{J}{sec}$, $\frac{Q_{in}}{sec} = \frac{W}{sec} \cdot c_p = (3)(400 \frac{J}{s}) = 1200 \frac{J}{sec}$

$Q_{out/sec} = Q_{in} + W = 1200 + 400 = 1600\ J_{/sec}$

The engine takes in heat and is worked on, so the out put heat is the sum.

22] 6 arrangements for 2 heads 2 tails.

4 for 3 h, 1 t or 3 t 1 h.

1 for 4 h or 4 t.