Homework Solutions, Physics 117, SPRING 2005
Home Work Problem Set # 11, (due WED 4/27/05).

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Solutions by JG

Ch 14: CQ 11, 15, 19 Ex 11, 15, 23 Ch 15: CQ 3, 5 / Ex 3, 9.

14 CQ 11

1. You cannot get more energy out of a heat engine than you put into it. (1st Law)
2. You cannot convert all of the heat energy back into mechanical work (2nd Law)

14: CQ 15 Heat engine A has the greater maximum theoretical efficiency, because its exhaust temperature, T_C, is lower: $\eta_{MAX} = 1 - T_C/T_H$.

For A, $\eta_{MAX} = 1 - \frac{293}{573} = 0.488$; For B $\eta_{MAX} = 1 - \frac{333}{573} = 0.419$.

14 CQ 19: If $\eta = \frac{W}{Q_{HOT}} = \frac{Q_{HOT} - Q_{COLD}}{Q_{HOT}} < 1$, Q_{COLD} must be > 0; i.e. SOME ENERGY MUST be ejected to the low temperature reservoir; It follows that it is NOT possible to build a heat engine which performs mechanical work and does not exhaust heat to the surroundings, which is in fact the heat engine form of the second law

14: Ex 11.

$$\eta = 1 - \frac{T_C}{T_H}$$

$$T_H = \frac{T_C}{1 - \eta}$$

$$T_C = 27^\circ C = 300 K, \quad \eta = 60\% = 0.6$$

$$T_H = \frac{300 K}{1 - 0.6} = 750 K = 477^\circ C$$

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14 Ex 15 $W = Q_{out} - Q_{in}$

$= 1500\,J - 800\,J$ (per second)

W/sec $= 700\,J/sec = 700$ watts of power

14: Ex 23 The configurations which total 5 are (6) in number; as follows,
(1, 1, 3), (1, 3, 1), (3, 1, 1), (1, 2, 2), (2, 1, 2), (2, 2, 1),
out of a total of $(6)^3 = (216)$ possibilities.
Therefore, the probability is $\frac{6}{216} = \frac{1}{36} = 2.78\%$.

15 CQ 3 When mass is above Equil/b. point, the Net force (and the acceleration, by NII) is DOWNWARD, independent of whether the mass is moving UP or DOWN. Thus, net force is DOWN in both cases.

15 CQ 5 If m increases, T increases because $T = 2\pi\sqrt{m/k}$, and $f = \frac{1}{T}$ DECREASES

15 Ex 3 $f = \frac{1}{T} = \frac{1}{6\,sec} = 0.167\,1/sec. = f$

15: Ex 9 If frequency doubles period is cut in half.
& $T = 2\pi\sqrt{m/k}$; THEN k must be increased by 4X.
to make $\frac{1}{\sqrt{k}}$ decrease by 2X

— End HW # 11 —