# Homework Solutions, Physics 117
## Home Work Problem Set # 11

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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. $\eta = \frac{T_C}{T_H}$

$T_H = T_C$

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

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

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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 Equilib. 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 Hertz $= f$

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