14:Q11 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:Q15 Heat engine A has the greater maximum theoretical efficiency, because its exhaust temperature, $T_c$, is lower: $\eta_{\text{max}} = 1 - \frac{T_c}{T_H}$.
For A, $\eta_{\text{max}} = 1 - \frac{273}{573} = 0.488$; for B $\eta_{\text{max}} = 1 - \frac{333}{573} = 0.419$.

14:Q19: If $\eta = \frac{W}{Q_{\text{hot}}} = \eta_{\text{cold}}$ and $\eta < 1$, $Q_{\text{cold}}$ 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:Ex11. $\eta = \frac{T_c}{T_H}$

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

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

$T_H = \frac{300K}{1 - 0.6} = 750 K = 477^\circ C$
14. Ex 15  
\[ W = Q_{\text{out}} - Q_{\text{in}} \]
\[ = 1500 \text{ J} - 800 \text{ J} \]  
( per second)
\[ \frac{W}{\text{sec}} = \frac{700 \text{ J}}{\text{sec}} = \text{700 watts of power} \]

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 equilibrium, Net Force (and the acceleration, by N.E.B.) is DOWNWARD, independent of whether the mass is moving UP or DOWN. Thus, net force is \text{DOWN} in both cases.

15. CQ 5  
If \( m \) increases, \( T \) increases because \( T = \frac{2\pi \sqrt{m/k}}{k} \), and \( f = \frac{1}{T} \) decreases

15. Ex 3  
\[ f = \frac{1}{T} = \frac{1}{6 \text{ sec}} = 0.167 \text{ Hz} \]

15. Ex 9  
If frequency doubles, period is cut in half.
\[ \& T = 2\pi \sqrt{m/k}; \text{ THEN } k \text{ must be increased by } 4x \]

to make \( \frac{1}{\sqrt{k}} \) decrease by \( 2x \)

--- End HW #11 ---