121 SOLUTIONS: YELLOW FINAL F98

1. $x = (1/2)at^2$, so $t = \sqrt{2x/a}$.

a. $x = 100$ m, $a = 3\text{m/s}^2$, $t = 8.16$ s.

b. $x = 100$ m, $a - 2.5$ m/s^2, $t = 8.94$ s.

c. $v = at$. $v_A = 3 \times 8.16 = 24.5$ m/s. $v_B = 2.5 \times 8.94 = 22.4$ m/s. $v_{rel} = 24.5 - 22.4 = 2.1$ m/s.

2. $\Delta v^2 = 2gh$, so $v_f = \sqrt{2gh}$.

a. $h = 75$ m, $g = 9.8$ m/s^2, so $v_f = 38.3$ m/s.

b. $v_{av}\Delta t = h$, so $t_f = 2h/v_f = 3.92$ s.

c. $mgh = PE_i = KE_f = mc\Delta T$, so $\Delta T = gh/c = 1.7$ °C, giving $T_f = 26.7$ °C.

3. $f_{listener}/(c \pm v_l) = f_{source}/(c \pm v_s)$. [Minus signs when source is behind listener.]

a. $f_l = 1500(340/305) - 1672$ Hz.

b. $f_l = 1500(340/375) = 1360$ Hz.

c. $f_l = 1500(372/375) = 1488$ Hz.

4. $T_C = 5(T_F - 32)/9$, $T_K = T_C + 273$.
a. $T_K = 273 + 5(43/9) = 297$ K. $KE = 1.38 \times 10^{-23} \times (3/2)T_K = 6.15 \times 10^{-21}$ J.
b. $KE = (1/2)mv^2$, so $m = 2KE/v^2 = 1.23 \times 10^{-12}$ kg.
c. $m = \rho \times a^3$, so $a = (m/\rho)^{1/3} = (1.23 \times 10^{-15})^{1/3} = 1.07 \times 10^{-5}$ m $= 10.7\ \mu$.

5. $f = c/\lambda = (N+1)c/2L$, so $\lambda_N = 2L/(N+1)$.
a. $\lambda_0 = 2L = 0.6$ m.
b. $c = f\lambda = 400(0.6)$=240 m/s.
c. $c = \sqrt{T/\mu}$, so $\mu = T/c^2 = 6.08 \times 10^{-5}$ kg/m, so $m = \mu L = 1.82 \times 10^{-5}$ kg $= 18.2$ mg.

6. $v_{1f} = v_{1i}(m_1 - m_2)/(m_1 + m_2)$.
a. $v_{1f} = 4(0.1/0.3) = 1.33$ m/s.
b. $v_{2f} = 2m_1v_{1i}/(m_1 + m_2) =$
$2 \cdot 4(0.2/0.3) = 5.33$ m/s.
c. $v_{3f} = 2m_2v_{2i'}/(m_2 + m_3) = v_{2i'}$
$= 5.33$ m/s.