Physics 103 Quiz # 8, Thursday (3/14/2013) Key

Show all work in order to obtain points for problems

Name:_____

1. (4 pts) A runaway railroad car, with mass 30×10^4 kg, coasts across a level track at 2.0 m/s when it collides with a spring-loaded bumper at the end of the track. If the spring constant of the bumper is 2.0×10^6 N/m, what is the maximum compression of the spring during the collision? (Assume the collision is elastic.)

a. 0.77 m
b. 0.58 m
c. 0.34 m
d. 1.07 m

$E_f = E_i$ $\quad \frac{1}{2}mv_i^2 + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_f^2 + \frac{1}{2}kx_f^2$

$mv_i^2 = kx_f^2$

$x = \sqrt{\frac{m}{k}}v = \left(\frac{30 \times 10^4 kg}{2.0 \times 10^6 N/m}\right)^{1/2} 2.0 m/s$

$= 0.7$

2. (2 pts.) The position of a 0.64-kg mass undergoing simple harmonic motion is given by $x = (0.160\text{ m}) \cos(\pi t/16)$. What is its period of oscillation?

a. 100 s
b. 32 s
c. 16 s
d. 8.0 s

$\omega = \frac{\pi}{16} = 2\pi f = \frac{2\pi}{T} \Rightarrow \frac{\pi}{16} = \frac{2\pi}{T}$

$T = 2 * 16$

$= 32$ sec

3. (2 pts.) A simple pendulum has a period of 2.0 s. What is the pendulum length? ($g = 9.8\text{ m/s}^2$)

a. 0.36 m
b. 0.78 m
c. 0.99 m
d. 2.4 m

$\omega^2 = \frac{g}{L}$

$\omega = \sqrt{g/L} = \frac{2\pi}{T}$

9.

$L = g/\omega^2 = \frac{g}{(2\pi/T)^2}$

$= \frac{9.8 m/s^2}{(2\pi/2)^2}$

$= 0.99$ m