

A - 6
H - ~~10~~ 11
NA - 5
T - Z

KEY

Physics 9B, Fall 2013, Quiz 1

A 0.40 kg glider, attached to the end of an ideal spring with force constant $k = 500 \text{ N/m}$, undergoes simple harmonic motion with an amplitude 0.08 m. Compute:

- (a) The maximum speed of the glider.
- (b) The speed of the glider when it is at $x = -0.03 \text{ m}$.
- (c) The maximum acceleration of the glider.
- (d) The acceleration of the glider when it is at $x = -0.03 \text{ m}$.
- (e) The mechanical energy of the glider at any point in its motion.

a) When $x = A$, $v = 0$ so energy is $E = \frac{1}{2} k A^2 = \frac{1}{2} (500) (0.08)^2 = 1.6 \text{ J}$

when $v = v_{\text{max}}$, $x = 0$ so $\frac{1}{2} m v_{\text{max}}^2 = 1.6$
 \uparrow
0.4 $\Rightarrow v_{\text{max}} = 2.83 \text{ m/s}$

b) $\frac{1}{2} m v^2 + \frac{1}{2} k x^2 = E$ always $\sqrt{\frac{500}{0.4} \cdot 0.08} = 2.83 \text{ m/s}$

at $x = -0.03$ $\frac{1}{2} (.4) v^2 + \frac{1}{2} (500) (-0.03)^2 = 1.6$
 $\underbrace{\hspace{10em}}_{.225} \Rightarrow v = 2.62 \text{ m/s}$
 $\sqrt{\frac{500}{0.4} (0.08^2 - 0.03^2)}$

c) $F = ma = -kx$

max a occurs when x is max, i.e. $x = \pm A$

$$|\text{max } a| = \frac{kA}{m} = \frac{500(0.08)}{.4} = 100 \text{ m/s}^2$$

d) $ma = -kx$ at any time

$$a = -\frac{k}{m} x = -\frac{500}{.4} (-0.03) = 37.5 \text{ m/s}^2$$

e) see a) $E = 1.6 \text{ J}$