Arts & Science 2D06

Quiz #6 2007 Feb 9 **Name:**

NB: Mark values are given in brackets [ ] beside each problem. Write all your answers on the quiz paper. No books or notes allowed. Time to write quiz: 50 minutes.

Period of simple pendulum: $T = 2\pi\sqrt{\frac{L}{g}}$ Wave speed: $v = f\lambda$

SHM equation of motion: $x = A\cos(\omega t + \varphi)$ where $\omega = \sqrt{k/m} = 2\pi/T$

Wave equation: $y = A\sin(kx - \omega t + \varphi)$ where $k = 2\pi/\lambda$

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1. [3] (a) If a block on a spring is oscillating back and forth, is there any point in its motion where the acceleration is zero? Where?

(b) If a simple pendulum is swinging back and forth, is there any point in its motion where its acceleration is zero? Where?

2. [3] Plotted is the $x(t)$ motion for a particular simple harmonic oscillator. Which of the following is a correct mathematical form for its equation of motion? (Mark all correct versions.)

(a) $x = Asin(\omega t)$ (b) $x = Acos(\omega t)$

(c) $x = Asin(\omega t + \frac{\pi}{2})$ (d) $x = Asin(\omega t - \frac{\pi}{2})$

(e) $x = Acos(\omega t + \frac{\pi}{2})$ (f) $x = Acos(\omega t - \frac{\pi}{2})$

3. [4] A box of mass 2.0 kg slides at 3.5 m/sec (horizontal, no friction) into an unstretched spring. The spring has $k = 250$ N/m.

(a) How far does the spring compress?

(b) How long does the box stay in contact with the spring?

4. [2] If a particle undergoes SHM with amplitude A, what is the total distance it travels in one period?

(a) zero (b) A (c) $2A$ (d) $4A$

5. [3] If two successive harmonics of a vibrating string are 1200 Hz and 1400 Hz, what is the frequency of the fundamental mode?

6. [5] A sinusoidal wave on a string has a period $T = 0.020$ sec and travels forward with a speed 30 m/sec. At $t = 0$, a particle on the string at $x = 0$ has a location $y = 0.015$ m and a velocity of +4.0 m/s. From this information, calculate all the constants in the wave function $y = A \sin(kx - \omega t + \phi)$. (Hint: yes, you can calculate A from the given information.)

[20] total marks