AP Physics 1: Simple Harmonic Motion 2 Name: KEY

Consider an ideal simple harmonic oscillator(A mass on a spring). The mass of the block is 2kg. A force of 20n stretches the spring to a displacement of .5m.

1. What is the spring constant?

40 N/m $F = Kx$ $K = \frac{20}{.5} = 40\ N/m$

2. What is the total energy of the oscillator?

5J $U = \frac{1}{2}Kx^2 = \frac{1}{2}(40).5^2$ 5J

3. What is the velocity of the mass at .3m?

1.79 m/s $U = \frac{1}{2}40 .3^2 = 1.8$ $5 - 1.8 = 3.2$ $3.2 = \frac{1}{2}mv^2$ $3.2 = \frac{1}{2}2v^2$

4. What is it's velocity at .4m?

1.34 $U = \frac{1}{2}40 .4^2 = 3.2$ $\frac{5 - 3.2}{1.8}$ $1.8 = \frac{1}{2}2v^2 = 1.34$

5. What is its acceleration at x=.5 m and x=-.5m

-10 m/s² .5m 10 m/s² -.5m $ma = Kx$ $2a = 40 \cdot .5$ $a = 10$

6. What is its acceleration at .3m?

-6 m/s² $ma = Kx$ $2a = 40 \cdot .3$ $a = 6\ m/s^2$

7. What is the net force on the mass at equilibrium?

0N

8. What is the size of the net force at .25m?

-10N $F = -Kx$ $-40 \cdot .25 = -10N$

9. The position of the oscillator where the Kinetic energy equals the Potential energy?

.353m 5J is total energy ½ is 2.5J of each $2.5 = U$ $2.5 = \frac{1}{2}Kx^2$ $2.5 = \frac{1}{2}(40)x^2$ .353m

AP Physics 1: SHM 3 Name: KEY

IN THESE PROBLEMS, THE MOTION IS ALWAYS HORIZONTAL...NEVER VERTICAL!

1. A 12cm spring has a force constant of 400N/m. How much force is required to stretch the spring to 14cm?

$F = Kx$

$F = 400 \cdot .02$

$= 8N$

8N

2. A 1.5kg block oscillates on a spring whose k value is 500N/m. The amplitude of the oscillations is 4cm. What is the maximum speed of the block?

$U_0 = KE$ $\quad \frac{1}{2}500(.04)^2 = \frac{1}{2}1.5v^2$

.73 m/s $\quad \frac{1}{2}Kx^2 = \frac{1}{2}mv^2$ $\quad v = .73 m/s$

3. A 2 kg mass is attached to a spring with a k value of 500N/m. The amplitude of the oscillation is 8cm. Find

1.6J total energy present $\quad U = \frac{1}{2}Kx^2 = \frac{1}{2}500(.08)^2$

1.6 Total
- .4 PE
1.2 KE

$U = \frac{1}{2}Kx^2 = \frac{1}{2}500(.04)^2 = .4J$ Elastic PE

1.09 m/s The speed when it is 4cm from the resting point $\quad 1.2 = \frac{1}{2}(2)v^2 = 1.09$

4. A 2kg block is attached to a spring (k=500N/m). The block rests at its equilibrium position. A force acts on the block to give it an initial speed of 2m/s. What is the amplitude of the oscillation?

$KE = U$ $\quad \frac{1}{2}2 \cdot 2^2 = \frac{1}{2}500x^2$

$\frac{1}{2}mv^2 = \frac{1}{2}Kx^2$

.126m

5. A block oscillating on a spring move from maximum stretch to compression in .25s. Find the period and frequency. $.25s = \frac{1}{2}$ a cycle $\quad .5 = 1$ cycle

.5 s period $\quad \frac{1}{.5} = 2hz$ frequency

6. A student performs and experiment with a spring. In trial 1 the amplitude is 3cm, trial 2 it is 6cm. Compare the values of Period/Frequency/ and maximum speed between these two trials. Period and Frequency remain the same

Doubling amplitude = 4x the energy 4x the energy is 2x the speed