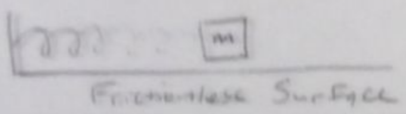
Simple Harmonic Oscillator (S.H.O) & Simple Harmonic Motion (S.H.M.)

Horizontal Spring System : Period Equation Derivation

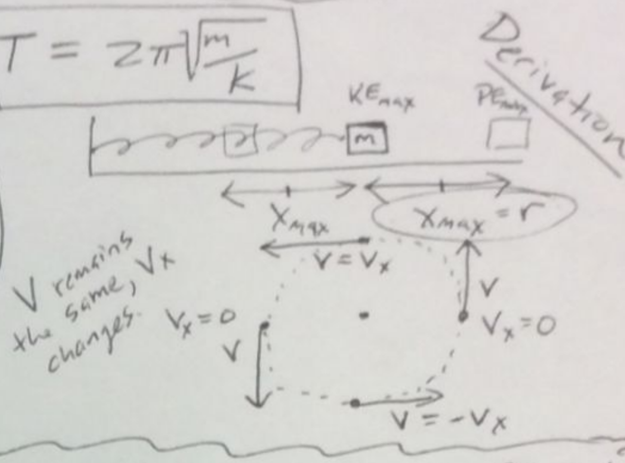


$$T = 2\pi\sqrt{\frac{m}{K}}$$

m = mass T = period
K = spring constant

$$T = \frac{\text{distance}}{\text{speed}} = \frac{2\pi r}{V} = 2\pi\left(\frac{X_{max}}{V_{max}}\right)$$

$$\boxed{T = 2\pi\sqrt{\frac{m}{k}}}$$



SPRING ENERGY EQUATIONS:

E_{total} = constant

$$PE_{max} = \tfrac{1}{2}k x_{max}^2$$
$$KE_{max} = \tfrac{1}{2}m V_{max}^2$$

so $PE_{max} = KE_{max}$

$$\tfrac{1}{2}k x_{max} = \tfrac{1}{2}m V_{max}^2$$

$$\frac{X_{max}}{V_{max}} = \sqrt{\frac{m}{k}}$$

#1 For a vertical S.H.O if mass is quadrupled, how is period affected?

#2 If you were to conduct a vertical S.H.O. with a spring and mass system, what are some potential sources of error?

#3 If a spring and mass oscillator's amplitude changes by a factor of 1/2, by what factor does it's period change?

Equations for... Position as a function of Time

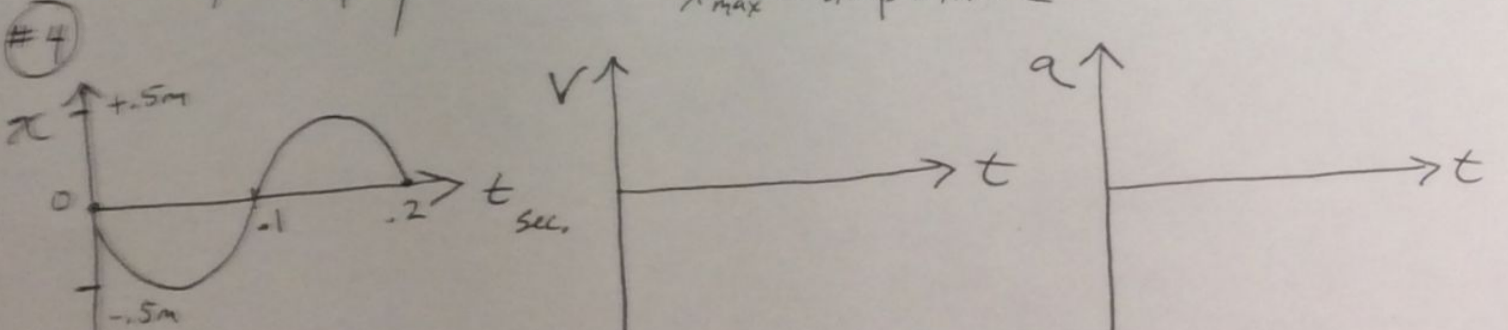
$$x(t) = (A)[\cos(\omega \cdot t)] \text{ or}$$
$$x(t) = (x_{max})\left[\cos\left(\frac{2\pi}{T}\cdot t\right)\right]$$

$\omega = \frac{2\pi}{T}$ = angular frequency

radians → must equal 2π or 1 cycle so T=t

X_{max} = amplitude

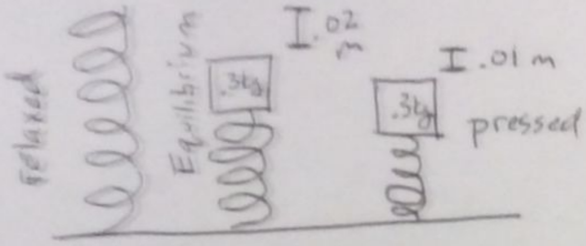
#4



Draw the V-time and a-time graphs.

#5 write the position as a function of time equation:

#6



Find (a) k, (b) x_{max}, (c) v_{max}, (d) $x(t)$.

#7 A 2 kg mass attached to the end of a spring oscillates twice a second with an amplitude of .3m. Find the frequency of oscillation, k, Velocity at an end point, velocity at equilibrium, and $x(t)$ if $x = 0$ at $t = 0$.

#8 A .1 kg mass vibrates according to $x(t) = .2 \cos(5t)$ on a horizontal frictionless surface (x is in meters and time in seconds). Find T, f, x_{max}, total mechanical energy, v_{max}, and v at $x = .01$ m.