From HW (pg 580)

4. $r = 5.30 \times 10^{-11}$ m

$m_1 = 9.109 \times 10^{-31}$ kg (electron)

$m_2 = 1.673 \times 10^{-27}$ kg (proton)

$$F_g = \frac{G m_1 m_2}{r^2}$$

5. Venus:

m_1 $m = 68$ kg

$F_g = 575$ N

$r = 6.31 \times 10^6$ m

m_2 $m_{venus} = ?$

$$F_g = \frac{G m_1 m_2}{r^2}$$

$$m_2 = \frac{F_g r^2}{G m_1}$$

$$m_2 = \frac{(575 N)(6.31 \times 10^6 m)^2}{(6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2})(68 kg)}$$

$$m_2 = 5.0 \times 10^{24} \text{ kg}$$

OR $F_g = \frac{G m_1 m_2}{r^2}$

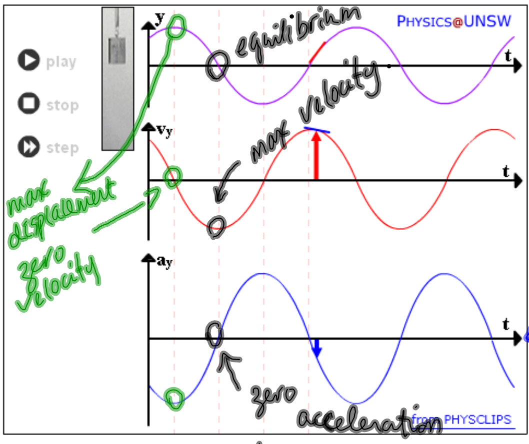
mass of venus

← object

← g

$F_g = mg$

SIMPLE HARMONIC MOTION



max displacement

zero velocity

← slope of tangent gives the velocity

slope of tangent gives the acceleration

(no stretch/compression ∴ no force ∴ no acc.)

Pendulum:

displacing from the lowest point (equilibrium) and giving the pendulum gravitational potential energy which is transformed into kinetic energy.

RECALL:

$$E_{total} = E'_{total}$$
$$E_g + E_k = E'_g + E'_k$$

LAW OF CONSERVATION OF MECHANICAL ENERGY

$$E_g = mgh$$
$$E_k = \frac{1}{2}mv^2$$

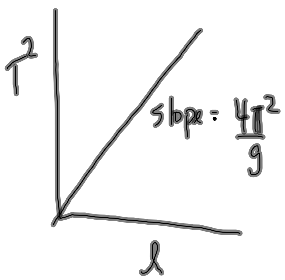
$$T = 2\pi\sqrt{\frac{l}{g}}$$

for small amplitudes, the period of a pendulum depends only on its length.

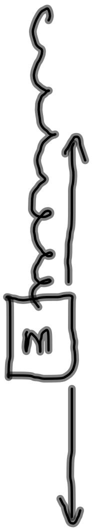
square both sides

$$\underset{y}{T^2} = \overset{m}{\frac{4\pi^2}{g}}\,\underset{x}{l}$$

$$y = mx + b$$



Harmonic Oscillator (Mass/Spring System)



When the mass is displaced from its equilibrium position, the mass will have elastic potential energy which is transformed into kinetic energy:

$$E_{total} = E'_{total}$$
$$E_e + E_k = E_e' + E_k'$$

LAW OF CONSERVATION OF MECHANICAL ENERGY.

$E_e = \frac{1}{2}kx^2$

$F_a = kx$ (restoring force is: $F = -kx$)

Period of oscillation: $\boxed{T = 2\pi\sqrt{\frac{m}{k}}}$ k is the spring constant

A graph of T^2 vs m will linear with a slope of $\frac{4\pi^2}{k}$

$$T^2 = \frac{4\pi^2}{k}m$$ ($y = mx + b$)

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$m = 125g$

20.0 cycles in 15.5s

a) Period $T = \frac{15.5s}{20.0\text{cycles}}$ $T = \frac{\Delta t}{N}$

$\boxed{T = 0.775s}$

b) $k = ?$

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

$T^2 = 4\pi^2 \frac{m}{k}$

$k = \frac{4\pi^2 m}{T^2}$

$k = \frac{4\pi^2(0.125kg)}{(0.775s)^2}$

$\boxed{k = 8.22 N/m}$

c) total energy:

$E_e = \frac{1}{2}kx^2$

$E_e = \frac{1}{2}(8.22N/m)(0.120m)^2$

$E_e = 0.0592J$

d) the maximum velocity (at equilibrium, $E_e = 0$)

max stretch, equilib

$E_{total} = E'_{total}$

$E_e + \cancel{E_k}^{0} = \cancel{E_e'}^{0} + E_k'$

$E_e = E_k'$

$0.0592J = \frac{1}{2}(0.125kg)v^2$

$\boxed{v \doteq 2.75 m/s}$

e) v at 10cm?

max stretch, @ 10cm

$E_{total} = E'_{total}$

$E_e + \cancel{E_k}^{0} = E_e' + E_k'$

$0.0592J = \frac{1}{2}(8.22\frac{N}{m})(0.100m)^2 + \frac{1}{2}(0.125kg)v^2$

$0.0592J = 0.0411J + \frac{1}{2}(0.125kg)v^2$

$0.0181J = \frac{1}{2}(0.125kg)v^2$

$\boxed{v = \pm 0.538 m/s}$

Dec 8-11:07 AM