14.4 notes

elastic potential energy of a spring stretched

$$U = \frac{1}{2} k x^2$$

constant

conservation of energy

$$E = K + U = \frac{1}{2} m v^2 + \frac{1}{2} k x^2 = \text{constant}$$

maximum value (potential energy)

$$E(\text{at } x = \pm A) = U_{max} = \frac{1}{2} k A^2$$

maximum value (kinetic energy)

$$E(\text{at } x = 0) = K_{max} = \frac{1}{2} m (v_{max})^2$$

frequency for SHM

☆ turning pts = purely potential

☆ equilibrium pt = purely kinetic

$$\frac{1}{2} m (V_{max})^2 = \frac{1}{2} k A^2$$

using Amplitude

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

$$V_{max} = 2\pi f A$$

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frequency + period of SHM

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

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

☆ The f and T of SHM are determined by the physical properties of the oscillator. The f and T of a mass on a spring are determined by 1) mass and 2) stiffness of the spring

☆ The f and T of SHM do not depend on the A.

14.5

tangential restoring force

$$(F_{net})_t = -\frac{mg}{L} s$$

— arc length (s)

length (L)

★ only for small angles < 10°

$$\frac{mg}{L} = k$$

↑ replaced in pendulum motion

SHM of a pendulum

arc length	angle
$s(t) = A \cos(2\pi f t)$	$\theta(t) = \theta_{max} \cos(2\pi f t)$

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$ — if length increased, then f decrease

period of a pendulum

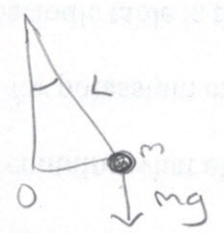
$$T = 2\pi\sqrt{\frac{L}{g}}$$

★ f doesn't depend on the A

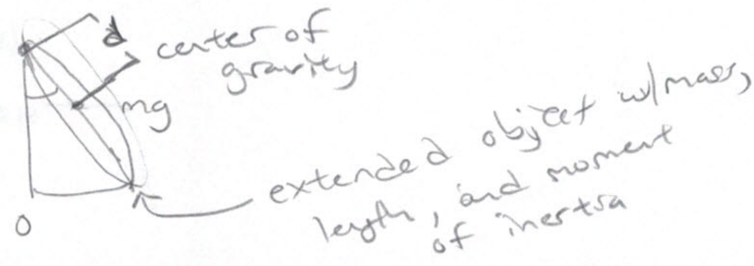
★ f is independent of the m

★ f is only dependent on the L of the pendulum physical pendulum – where mass is distributed along its length

☆ the position of the C of G of the physical pendulum is at a distance (d) from the pivot.



– mass at the end of the string



– physical pendulum

☆ moment of inertia (I) is an object's resistance to rotation. Increase in I, decreases f.

☆ Gravitational torque pulls pendulum back
> distance of the C of G from the pivot pt, the > the (T) torque. Increase d, increases f.

$$f = \frac{1}{2\pi}\sqrt{\frac{mgd}{I}}$$