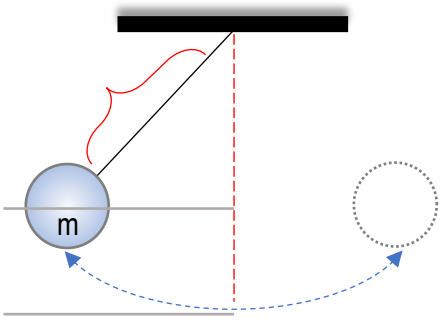
CONCEPT: Energy in Simple Pendulums

● Just like mass-spring systems, energy in pendulums → 2 types: _____ and _____.



Energy in Mass-Springs	
Amplitude:	**EQ:**
Elastic: Max	Elastic: 0
Kinetic: 0	Kinetic: Max
Total ME: $1/2kA^2$	Total ME: $1/2mv_{max}^2$

● For any θ, height h = _____

Amplitude:	**Equilibrium:**	**Any other Point:**
θ = _____	θ = _____	θ = _____
Grav. Potential = mgh = 0 / max	Grav. Potential = mgh = 0 / max	Grav. Potential = mgh
Kinetic Energy = $\frac{1}{2}mv^2$ = 0 / max	Kinetic Energy = $\frac{1}{2}mv^2$ = 0 / max	Kinetic Energy = $\frac{1}{2}mv^2$
Total M.E. = _____	**Total M.E. = _____**	**Total M.E. = _____+_____**

M.E. = _____ = _____ = _____+_____

(Energy Conservation for Pendulums)

EXAMPLE: A mass **m** is attached to a pendulum of length **L.** It is pulled up an angle ***θ*** and released**.** Using energy conservation, derive an expression for the maximum speed this mass experiences**.**

EXAMPLE: A mass of 0.400 kg hangs from a 2m pendulum. At the moment when it makes a 5° with the vertical, it has a speed of 1.5 m/s. What is the maximum height the pendulum will reach?

Pendulum SHM Equations
$\lvert F_S \rvert = \lvert F_A \rvert = -mg\theta$ $a = -g\theta = -\frac{g}{L}x$
$\omega = 2\pi f = \frac{2\pi}{T} = \sqrt{\frac{g}{L}}$ $N\ [\text{cycles}] = \frac{t\ [\text{time}]}{T\ [\text{Period}]} = t * f$
$\theta(t) = \theta_{max} cos(\omega t)$ $v_{max} = \sqrt{2gL(1 - \cos\theta_{max})}$
$h = L(1 - cos\theta)$ $M.E. = mgh_{max} = \frac{1}{2}mv_{max}^2 = mgh_p + \frac{1}{2}mv_p^2$

PRACTICE**:** A mass swinging at the end of a pendulum has a speed of 1.32m/s at the bottom of its swing**.** At the top of its swing, it makes a 9° with the vertical**.** What is the length of the pendulum?

Pendulum SHM Equations
$\lvert F_R \rvert = -mg\theta$ $a = -g\theta = -\frac{g}{L}x$
$\omega = 2\pi f = \frac{2\pi}{T} = \sqrt{\frac{g}{L}}$ $N\ [\text{cycles}] = \frac{t\ [\text{time}]}{T\ [\text{Period}]} = t * f$
$\theta(t) = \theta_{max} cos(\omega t)$ $\quad A = L\theta$ $v_{max} = \sqrt{2gL(1-\cos\theta_{max})}$ $\quad \rightarrow v_{max} = A\omega$
$h = L(1-cos\theta)$ $M.E. = mgh_{max} = \frac{1}{2}mv_{max}^2 = mgh_p + \frac{1}{2}mv_p^2$