OSCILLATORY MOTION

K — SPRING CONSTANT [N/m]

HOOKE'S LAW: $F_s = -Kx$

SECOND NEWTON'S LAW: $F = ma$

$$\Rightarrow -Kx = ma_x; \quad a_x = \frac{-Kx}{m}$$

FOR SPRING: $\boxed{w = \sqrt{\frac{K}{m}}}$

POSITION: $x(t) = A\cos(wt + \phi)$ $\qquad x(t)_{MAX} = A$

SPEED: $v(t) = -wA\,\mathrm{sen}(wt + \phi)$ $\qquad v(t)_{MAX} = wA$

ACCELERATION: $a(t) = -w^2 A\cos(wt + \phi)$ $\qquad a(t)_{MAX} = w^2 A$

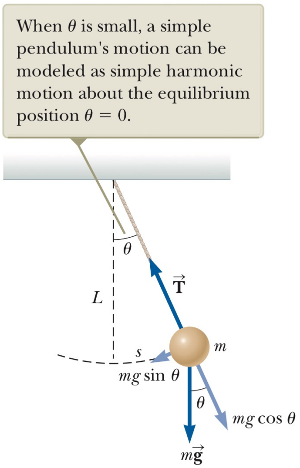
$$w = \frac{2\pi}{T} = 2\pi f \qquad \left(f = \frac{1}{T}\right)$$

ENERGY:

KINETIC $\quad K = \frac{1}{2}mv^2 = \frac{1}{2}mw^2A^2\,\mathrm{sen}^2(wt + \phi)$

ELASTIC POTENTIAL $\quad U_s = \frac{1}{2}Kx^2 = \frac{1}{2}KA^2\cos^2(wt + \phi)$

$$E_{TOT} = \frac{1}{2}KA^2$$



FOR PENDULUM $w = \sqrt{\frac{g}{L}}$ ← LENGTH PENDULUM

!! CAREFUL WITH TENSION (T) AND PERIOD (T)

$[N]$ $[s]$

PHYSICAL PENDULUM

$$w = \sqrt{\frac{I}{mgd}}$$

d: DISTANCE OF THE CENTER OF MASS FROM THE PIVOT (FULCRO)

I: MOMENT OF INERTIA ← COME SI CALCOLA?

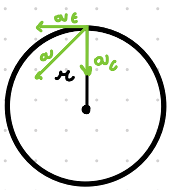
TORSIONAL PENDULUM

$$w = \sqrt{\frac{k}{I}}$$

K: TORSION CONSTANT

AMPLITUDE: $A = L \cdot \theta$ ← RADIANTS

$v_t = rw$



$$a_t = \frac{\Delta v}{\Delta t}$$

$$a_c = \frac{m \cdot v_T}{L} \quad \text{← TANGENTIAL VELOCITY}$$

L ← (r)

$$a_c = \frac{v^2}{r} = rw^2$$

$$a_c = mw\theta$$

$$a = \sqrt{a_t^2 + a_c^2}$$

$$T = \frac{2\pi r}{v}$$

ANGULAR MOMENTUM: $\vec{L} = \vec{r} \times \vec{p}$

SPRING	PENDULUM	PHYSICAL PENDULUM	TORSIONAL PENDULUM
$w = \sqrt{\frac{k}{m}}$	$w = \sqrt{\frac{g}{L}}$	$w = \sqrt{\frac{I}{mgd}}$	$w = \sqrt{\frac{k}{I}}$

WAVE MOTION

ANGULAR WAVE NUMBER: $k = \frac{2\pi}{\lambda}$ $v = f\lambda$

WAVE FUNCTION FOR A SINUSOIDAL WAVE: $y(x,t) = A\sin(kx - \omega t)$

SPEED OF A WAVE ON A STRETCHED STRING: $v = \sqrt{\frac{T}{\mu}}$ $\mu = \frac{m}{L}$

POWER OF A WAVE: $P = \frac{1}{2}\mu\omega^2 A^2 v$

INTENSITY OF A SOUND WAVE: $I = \frac{(\text{POWER})_{AVR}}{A}$; $I = \frac{(\text{POWER})_{AVR}}{4\pi r^2}$

↳ DISTIBUTED UNIFORMLY IN 3D

$I = \frac{(\Delta P_{MAX})^2}{2\rho v}$

SOUND LEVEL: $\beta = 10\log_{10}\left(\frac{I}{I_0}\right)$ $I_0 = 1.00 \cdot 10^{-12}\ \frac{W}{m^2}$

DOPPLER EFFECT:

$f' = f\left(\frac{v \pm v_1}{v \mp v_2}\right)$

FREQUENCE HEARD

FREQUENCE EMITTED

SPEED OF SOUND

v: 343 m/s

v_1: SPEED LISTENER

v_2: SPEED SPEAKER

SIGN? THE ONE ON TOP ($+v_1$ AND $-v_2$) WHEN GETTING CLOSER

THE ONE ON BOTTOM ($-v_1$ AND $+v_2$) WHEN GETTING FURTHER

SUPERPOSITION AND STANDING WAVE

LINEAR DENSITY: $\mu = \frac{m}{L}$

NUMBER OF ANTINODES

$$L = \frac{N\lambda}{2}$$

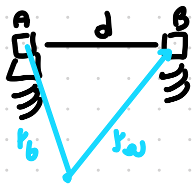
$$\lambda = \frac{v}{f}$$

$$v = \sqrt{\frac{T}{\mu}}$$

$$f_{BEAT} = |f_1 - f_2|$$

STANDING WAVES: $y = (2A\sin(kx))\cos(\omega t)$

INTERFERENCE OF WAVES:



$$|r_a - r_b| = \frac{N\lambda}{2} \qquad \lambda = \frac{v}{f} \qquad v = 343\,\frac{m}{s}$$

$$|r_a - r_b| \leq d$$

$N = 1, 2, 3\ldots \qquad N \leq \frac{2d}{\lambda}$

- N-EVEN: CONSTRUCTIVE INTERFERENCE
- N-ODD: DISTRUCTIVE INTERFERENCE