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Welcome!

Physics 194 - Lecture 13

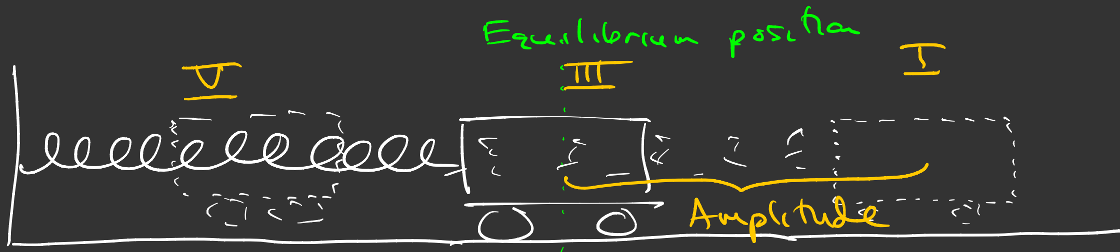
Have a question during class? Please ask it right away, even if it means interrupting in the middle of a thought. I want you to!

Agenda

- Frequency
- Kinematics of vibrational motion
- Pendulums

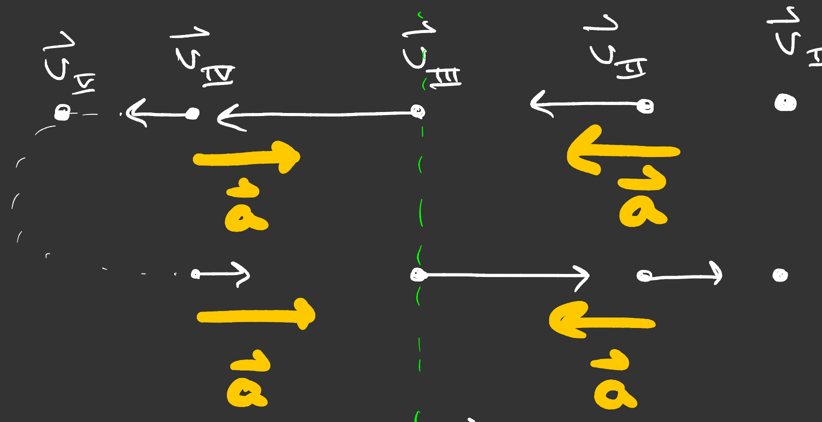
Class starts @2:15 pm

Vibrational motion (type of periodic motion)



The period of motion is how much time one cycle of motion takes, T, in seconds.

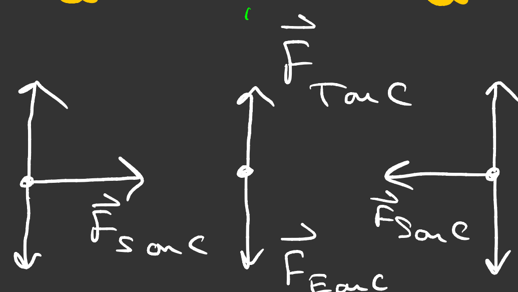
Motion diagram



Frequency is $f = \frac{1}{T}$, and is the # of cycles that complete in each second.

unit is s^{-1} = Hz (Hertz)

Force diagrams

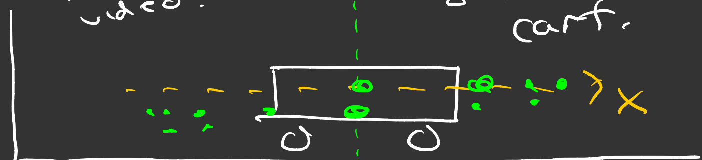


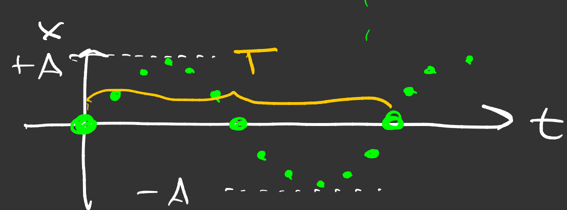
$$T = 2\pi\sqrt{\frac{m + \frac{1}{3}m_s}{K}}$$

What's the equivalent of kinematics for vibrational motion?

$x(t) =$

$v(t) =$





If an object has constant acceleration (vibrational motion doesn't)...

$$x(t) = x_0 + v_0 t + \frac{1}{2}at^2$$

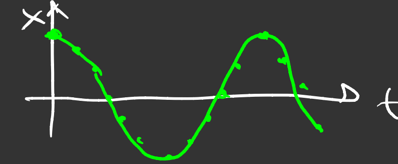
$$v(t) = v_0 + at$$

⋮

Vibrational motion needs 3 things

1) Equilibrium position
2) "Restoring force"
3) Add energy!

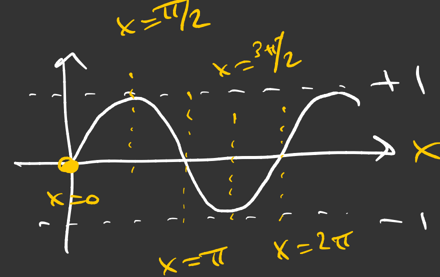
$x(t) = \pm A \sin\left(\frac{2\pi}{T}t\right)$ $\quad x(t) = \pm A \cos\left(\frac{2\pi}{T}t\right)$



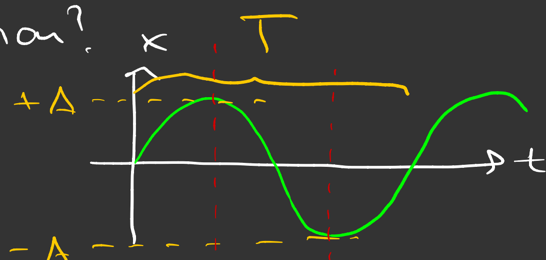
$f(x) = \sin(x)$

$= \sin\left(\frac{2\pi}{(2\pi)}x\right)$

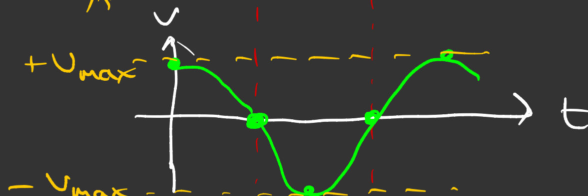
T



What about the velocity of an object in vibrational motion?

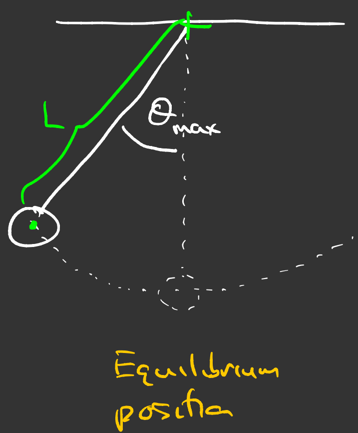


$x(t) = A \sin\left(\frac{2\pi}{T}t\right)$



$v(t) = v_{max} \cos\left(\frac{2\pi}{T}t\right)$

Pendulums



Simple pendulum

1) Compact object (pointlike!) attached to a "lightweight" cable
2) No "dissipative" interactions
3) Small vibrations.

Amplitude: Max angle from equilibrium.

Period: What does it depend on?

- L : When you ×4 the length, the period doubles. $T \propto \sqrt{L}$
- mass of pendulum → m : No dependence.
- θ_{max} : No dependence, until θ_{max} starts getting to around $\sim 10°$.

Small vibrations

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