X. SHM

(A) Conditions for SHM

1. $F \propto x$
2. Restoring force

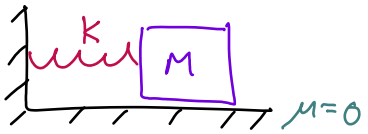
(B) Differential Equation for SHM

1. $\frac{d^2x}{dt^2} = -\omega^2 x$
2. has a solution of $x(t) = A\cos(\omega t + \phi)$
3. Ex $F = ma$

$$-Kx = m\frac{d^2x}{dt^2}$$

$$-\frac{K}{m}x = \frac{d^2x}{dt^2}$$

$$\omega^2 = \frac{K}{m}$$



4. $\phi = 0 \Rightarrow x_{MAX}$ @ $t=0$

$\phi = \frac{\pi}{2} \Rightarrow x=0$ @ $t=0$ & $v = v_{MAX}$ @ $t=0$

$0 < \phi < \frac{\pi}{2} \Rightarrow$ @ $t=0$, $x \neq x_{MAX}$ & $v \neq v_{MAX}$

(C) Period & frequency

1. $T = \frac{1}{f}$
2. $T = \frac{2\pi}{\omega} \Rightarrow f = \frac{\omega}{2\pi}$
3. $T = 2\pi\sqrt{\frac{l}{g}}$ & $T = 2\pi\sqrt{\frac{m}{k}}$

(D) Energy

1. $E = K + U$
2. max, min of each

XI. Resistive Forces

(A) $F = -bv^x$ ($-bv$ or $-bv^2$)

(B) Differential Equation

Ex

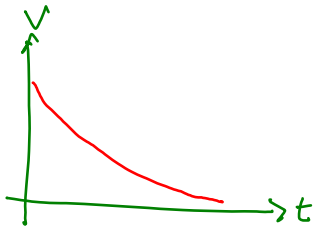
$$F = ma$$

$$-bv = m\frac{dv}{dt}$$

$$\int_0^{t_1} -\frac{b}{m}\,dt = \int_{V_0}^{V_1} \frac{dv}{v}$$

$$-\frac{bt_1}{m} = \ln\left(\frac{V_1}{V_0}\right)$$

$$\boxed{V_0 e^{-\frac{bt_1}{m}} = V_1}$$



Ex Falling, $F_r = -bv^2$

(A) FBD

(B) Diff. eq.

(C) V_T

(D) sketch graph

(A) 

(B) $mg - bv^2 = m\frac{dv}{dt}$

(C) $mg - bV_T^2 = 0$

$$\boxed{V_T = \sqrt{\frac{mg}{b}}}$$

(D)