Newtons Laws: $\vec{F} = m\vec{a}$.

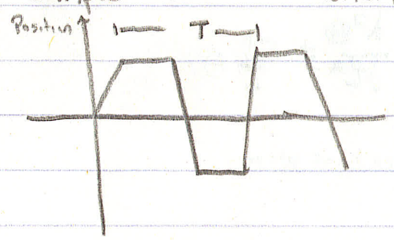
Energy, momentum, conservation

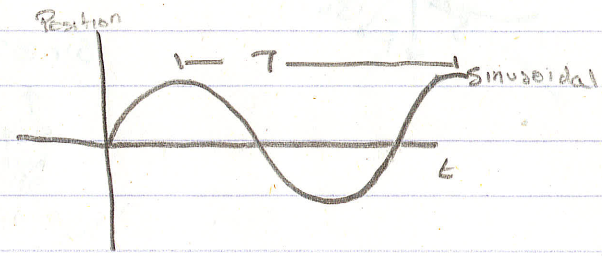
Coulombs Law for Electrical Force

9/2 Lectures

Oscilations:

Simple Harmonic Motion:





Mass on a spring $\quad F = ma \quad a = \frac{d^2x}{dt^2}$

$F = -kx \quad k(N/m)$

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

$\ddot{x} = -\left(\frac{k}{m}\right)x \qquad x(t) = A\cos(\omega t + \phi)$ $\qquad \omega = \omega_0 \quad \omega_0^2 = k/m$

amplitude (A) — phase shift (ϕ)

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

$f = \frac{1}{T}$

$\omega = 2\pi f$

$v(t) = \frac{dx}{dt} = -v_{max}\sin(\omega_0 t + \phi) \qquad v_{max} = \omega_0 A$

$x = A$ @ $t = 0 \quad v(0) = 0$

$$\left.\begin{aligned} v(0) &= -\omega_0 A\sin\phi = 0 \\ x(0) &= A\cos\phi = A \end{aligned}\right\} \phi = 0$$

Energy:

Kinetic: $K = \frac{1}{2}mv^2$ $\qquad \boxed{K + U = \text{const.}}$

Potential: $U = \frac{1}{2}kx^2$

$\frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \text{const} = \frac{1}{2}mv_{max}^2 = \frac{1}{2}kA^2$

$$v(x)^2 = \frac{k}{m}(A^2 - x^2)$$