$\delta = \frac{F}{A}, \varepsilon = \frac{\Delta L}{L_0}, E = \frac{\delta}{\varepsilon}$

UCM, SHM, Deformation of Solids

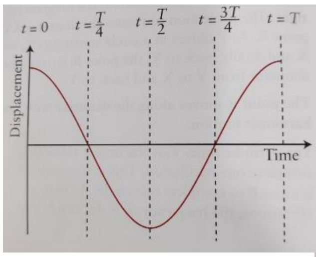
F is restoring force

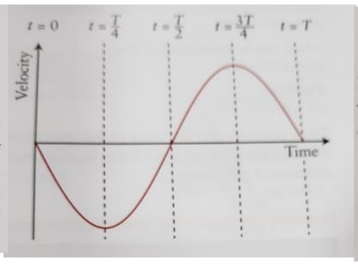
s=rθ, $\omega = \frac{2\pi}{T}$, v=r ω, $a = \frac{v^2}{r} = v\omega = r\omega^2$

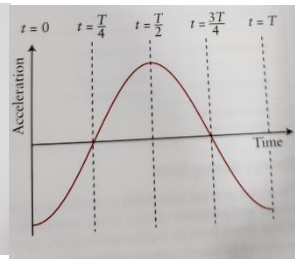
$E_k = \frac{1}{2}m\omega^2 A^2 sin^2\omega t, T = 2\pi\sqrt{\frac{L}{g}} = 2\pi\sqrt{\frac{m}{k}}$, Tension = ke, F=kx, E=kA^2

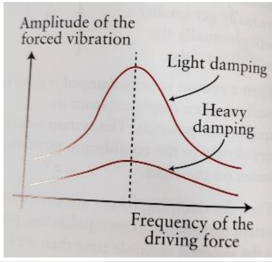
	Displacement	Velocity	Acceleration
Variation w/ t	$Acos\omega t$	$-\omega Asin\omega t$	$-\omega^2 Acos\omega t$
Max	Amplitude=A	At fixed point (equilibrium) x=0, v=ωA	Extremity of x, $a = \omega^2 A$
Min	At fixed point (equilibrium), 0	Extremity of x, 0	At fixed point, 0
Variation w/ x		$\omega\sqrt{(A^2 - x^2)}$	$\omega^2 x$

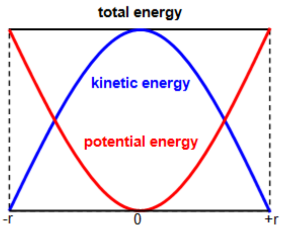
Free vibration/undamped – no E transfer to/from system, Forced vibration (ex Barton's Pendulums) – forced to oscillate at freq. of eternal oscillator which is giving it E, Condition for resonance: driving freq. = natural freq. Example of resonating system: singer and class, how to damp this system: fill with water, Oscillate in water to increase damping

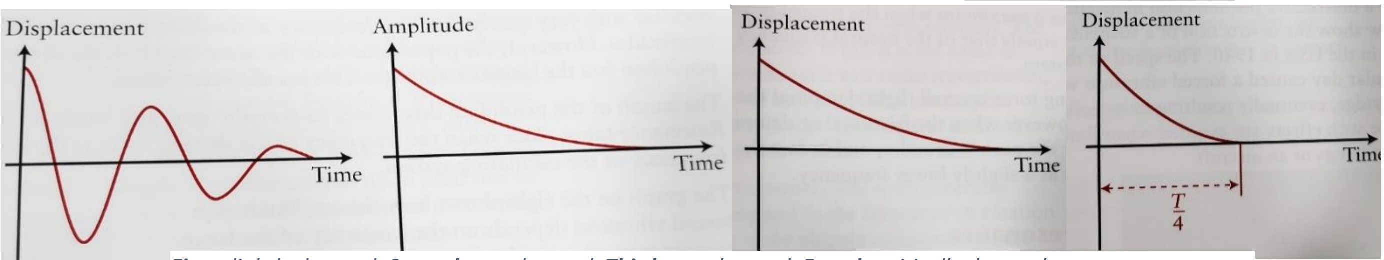








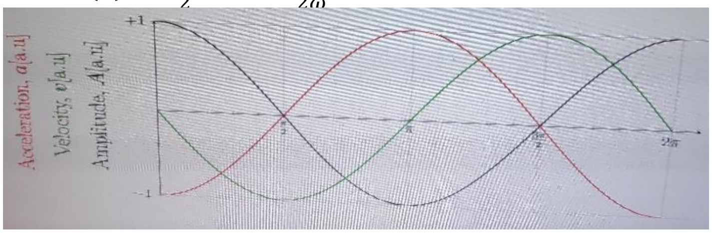




First: *lightly damped,* ***Second***: *overdamped,* ***Third***: *overdamped,* ***Fourth***: *critically damped*

Cyclist on bend has ω as they sweep an angle over time, Fr between tyres&road permit the UCM. **SHM**: a directly proportional to d from fixed point & direted towards fixed point**. Cause of damping** for moving obj is fr, effect is E loss and <A, **how travel in circle at const speed but have a?** direction & thus v changing, a is rate of change of v. **When obj first reaches equilibrium**: $x(t) = Acos\omega t, A\ can't\ be\ 0\ \therefore\ cos\omega t = 0, \omega t = \cos^{-1}(0) = \frac{\pi}{2}, \therefore\ t = \frac{\pi}{2\omega}$

	SHM	UCM
T	T for one oscillation	T for one revolution/orbit
F	Acts toward equilibrium	Acts toward centre of circle
	Varies depending on position of object	Const.



Both overdamped and critically damped systems lose E and return to equilibrium position without oscillating, Critically damped does so in the quickest possible time, **Total E of system is not conserved** as E leaves the system to move air particles/ due to air resistance

Why chain w/ hammer can't be horz: W_hammer acts downwards and must be balanced by vertical tension component

Hooke's Law: F directly proportional to x produced provided proportional limit not exceeded, F=-kx

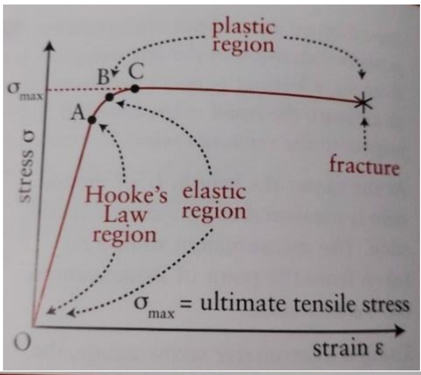
Elastic Limit: max load specimen can experience and return to original length when deforming F removed. **Elastic Deformation,** after this is **Plastic Deformation**

UTS: max stress applied to wire without breaking/fracturing

Elastic Strain Energy: Es = $\frac{1}{2}kx^2$ (work done in stretching material held as Ep)

Strain gauge to measure crack width in walls

Experiment: measure unstretched L. Measure x for range of F, L with metre rule clamped to pointer, x with ruler, d of wire at several places with micrometre gauge and avg, wear goggles as wire could break under tension



Combined spring constant: Series: $x_T = x_1 + x_2 = \frac{F}{k_T} = \frac{F}{k_1} + \frac{F}{k_2} \therefore \frac{1}{k_T} = \frac{1}{k_1} + \frac{1}{k_2} \therefore k_T = \frac{k_1 k_2}{k_{1+k_2}}$ // F is same for all springs. **Parallel**: $F_T = F_1 + F_2 = k_1 x + k_2 x = k_T x \therefore k_1 + k_2 = k_T$ // x is the same for all springs