WORK, ENERGY & POWER

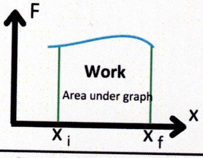
Work

$W = F.s = Fs\cos\theta$

$(\theta < 90°, W = +ve)$

$(\theta > 90°, W = -ve)$

$(\theta = 90°, W = 0)$



If force is variable

$$W = \int_{x_i}^{x_f} F(x)dx$$

Area under the graph

$$\text{Work} = \text{area}$$

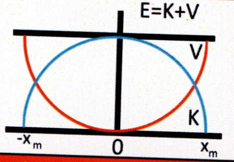
$$\Delta A = F(x)\Delta x$$

work done by conservative force	$W.D. = V_i - V_f$

Energy

Kinetic Energy	$KE = \frac{1}{2}mv^2 = \frac{p^2}{2m}$
Potential Energy	$\Delta U = -F(x)\Delta x$
	$PE = mgh$
	$\text{PE of spring} = \frac{1}{2}kx^2$
Relation b/w PE and F	$\int_{x_i}^{x_f} F(x)dx = -\int_{V_i}^{V_f} dV$

Total Energy is conserved



Work - Energy Theorem

Work done by force in displacing a body is equal to its change in kinetic energy.

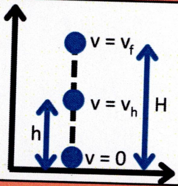
$$W = \Delta KE$$

Conservation of Mechanical Energy

The total mech energy of a system is conserved if the forces, doing work on it, are conservative.

$$K_i + V(x_i) = K_f V(x_f)$$

Mechanical Energy for ball at diff. heights



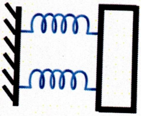
$$E_H = mgh$$

$$E_H = mgh + \frac{1}{2}mv_h^2$$

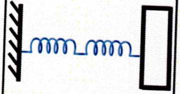
$$E_0 = \frac{1}{2}mv_f^2$$

For freely falling body	K.E. = P.E.

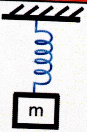
Springs



$$K_{eq} = K_1 + K_2$$



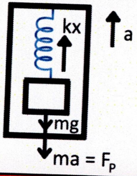
$$\frac{1}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2}$$



$$x_{max} = \frac{2mg}{K}$$

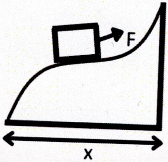
$$W = \frac{1}{2} K_{eq} x^2$$

Max. elongation for sudden force



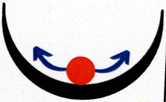
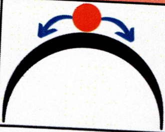
$$F_{max} = \frac{mg}{K} + \frac{2ma}{K}$$

Work done by friction on curved surface

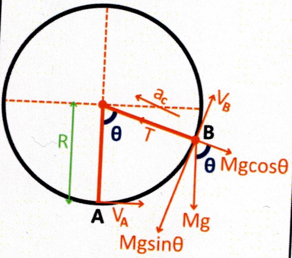


$$W = -\mu mg . \chi$$

χ = horizon displacement b/w initial and final position

Equilibrium	$F = -\frac{dU}{dx}$	$\frac{dU}{dx} = 0$
Stable	**Unstable**	**Neutral**
		
Minima of U-X curve	Maxima of U-X curve	Stable line, no curve
$\frac{d^2U}{dx^2} > 0$	$\frac{d^2U}{dx^2} < 0$	$\frac{d^2U}{dx^2} = 0$

Vertical Circular Motion



$$T_A - mg = \frac{mV_A^2}{r}$$

$$T_B - mg\cos\theta = \frac{mV_B^2}{r}$$

$$V_B^2 = V_A^2 + 2gR(\cos\theta - 1)$$

Tangential Acceleration

$$a_t = \frac{d\omega}{dt} r$$