Topic 4A: Energy Work and Power

Skill 29: Work Energy Theorem

Work done equals energy change

$W = Fd$ where direction of force agrees with displacement

Identify Axis or scenario

- Work done vertically equals work done against gravity, ie gravitational potential energy

$W_{vertical} = F_g d = F_g h = mgh = PE$ (for a ramp use only height)

$W = PE$, $F_g d = mgh$

- Work done horizontally to increase the speed of an object equals kinetic Energy (assume frictionless)

$W_{horizontal} = F_{net_x} d = (ma)d = m(ad) = \frac{1}{2}mv^2$

$v_f^2 = v_i^2 + 2ad$ ($v_i = 0$)

$v^2 = 2ad$

$ad = \frac{v^2}{2}$ or $\frac{1}{2}v^2$

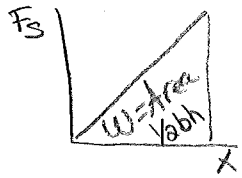
$W = KE$, $F_x d = \frac{1}{2}mv^2$

- Work done on a spring is equal to Elastic Potential Energy

$W_{spring} = \overline{F_s} d = \overline{F_s} x = (\frac{1}{2}kx)(x) = \frac{1}{2}kx^2$ ($\overline{F_s}$ = average spring force)

$W = PE_s$, $F_s d = \frac{1}{2}kx^2$

- Can also be found as area of F_s vs x graph

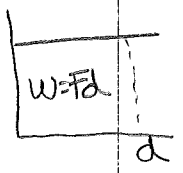


area $= \frac{1}{2} F_s x$ (where $F_s = kx$)

so $= \frac{1}{2}(kx)(x)$

$= \frac{1}{2}kx^2$

For Non-springs ON A Graph of F vs d (h) Work is area



- Work done by friction (Q) -aka. Internal Energy

$W_{friction} = F_f d = Q$

$E_T = KE + PE + Q$

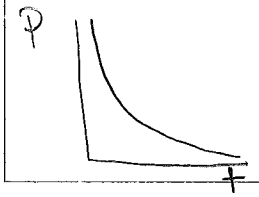
So $Q = E_T - (KE + PE)$

Skill 30: Power

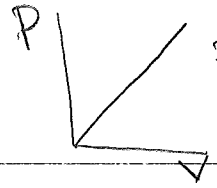
Power is the RATE at which energy is used or work is done

$P = \frac{W}{t} = \frac{Ed}{t} = Fv$

Scalar quantity measured in Watts $= \frac{\text{Joule}}{\text{second}} = \frac{Nm}{s}$



Power and time are inversely related for a fixed (constant) work value



Power is directly related to speed at which a fixed work is done