

Work Done and Energy

Work done is **maximum** when $\cos 0 = 1$ (the force and distance travelled are therefore parallel)

Work done is **minimum** when $\cos 0 = 0$ (the force and distance travelled are therefore perpendicular)

types of energy:

- kinetic energy
- potential energy
- thermal energy (not covered in this spec point)

for example:

a ball held at a height will have E_p , when dropped and landing on the ground (assuming there is no energy loss) all the energy will be converted into E_k .

$\Delta E = W \rightarrow$ change in energy in a system = work done on a system

Derivations

Gravitational Potential Energy:

$$\Delta E = W$$

$$\Delta E = Fx \cos 0$$

(work done is force x distance x angle)

where $F = ma$ (in this case a is g)

and distance is height travelled

$$\Delta E = mgh \cos 0$$

as $\cos 0$ where 0 is 0° $\cos 0 = 1$ so

$$\Delta E = mgh$$

Kinetic Energy:

$$\Delta E = W$$

$$\Delta E = Fx \cos 0$$

(work done is force x distance x angle)

$$\Delta E = Fs$$

($\cos 0 = 1$)

$$\Delta E = mas$$

$$\text{as } v^2 = u^2 + 2as$$

rearrange where $u = 0$

$$\text{as } v^2 = 2as$$

therefore

$$\Delta E = \frac{1}{2} mv^2$$

Definitions

Work done: product of the force and the distance moved in this direction

power: rate of work done

rate of energy transferred

Equations

Work done: $Fx \cos 0$ --- (where x is distance and 0 is theta between f and x)

change in energy: $\Delta E = W$

power: W/t

$$Fx/t$$

$$Fv$$

efficiency: useful/total (x100)

Conversion of energy

example of finding resistive forces going down hill

--top | $v=0$

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--bottom | $v=8$

a ball is roll down from the top to the bottom

-length of the ramp is 7m

-height is 5m

as $\Delta E = W$

energy at top (E_p no E_k) then energy at bottom (E_k no E_p)

from this we know it is all transferred (assuming no loss to heat)

therefore

$$\Delta E = mgh - \frac{1}{2} mv^2$$

$$mgh - \frac{1}{2} mv^2 = Fx$$

(where x is length of ramp)

then just put in numbers to solve for F



By MostAncientDream

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