AP Physics - Chapter 6 Notes

Work and Energy

Work examples:




Non work examples:




Work = a force that causes displacement along axis of force

> Work is a SCALAR

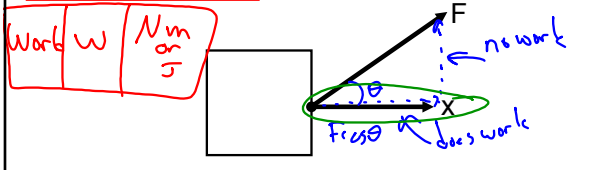
> Can only be + or -...direction DOES NOT MATTER

+ W = displacement and force in SAME direction

- W = displacement and force in OPPOSITE direction

W = Fxcosθ

units = Nm = Joules = J

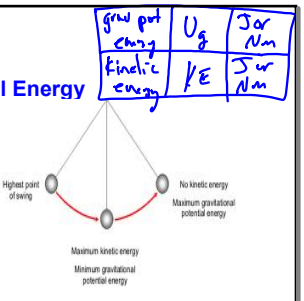


*** only the component parallel to x does work

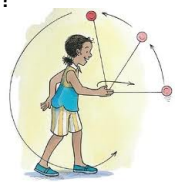
*** path DOES NOT MATTER

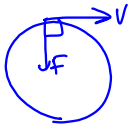
Types of Energy

1. **Gravitational Potential Energy**
   - U_g = mgh
   - STORED energy
   - Due to position
2. **Kinetic Energy**
   - KE = 1/2mv²
   - Energy due to MOTION



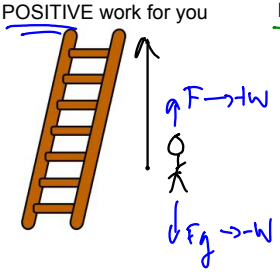
Check question - How much work is done by string on a yoyo as it is twirled in a circle?





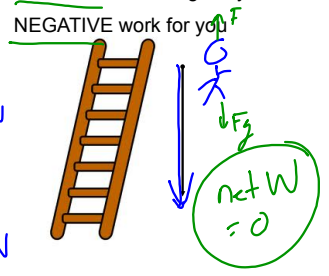
Moving UP the ladder = NEGATIVE work for gravity

POSITIVE work for you



Moving DOWN the ladder = POSITIVE work for gravity

NEGATIVE work for you



Power - the rate at which work is done

P = W/t

Units = J/s = watts

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

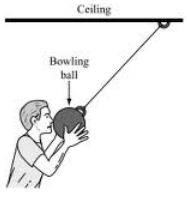
$\frac{J}{s} = \frac{N\,m}{s}$
$= N(m/s)$

$P = Fv$

Horsepower = power of ONE horse

1 hp = 746 w

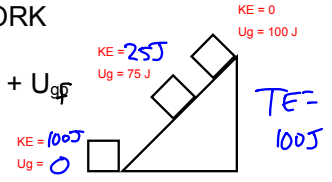
Bowling Ball Demo



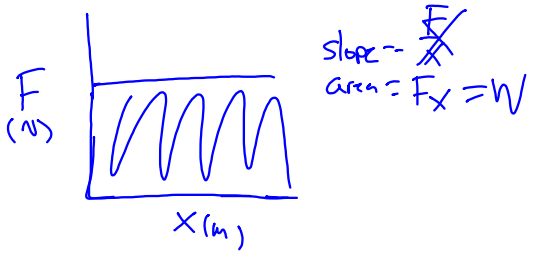
Conservation of Energy

Energy is always conserved if there is no outside NET WORK

$KE_o + U_{go} = KE_f + U_{gf}$



*note gravity is NOT outside net work since it is part of U_g



Work Energy Theorem

Outside net work can cause a change in KE

$W = \triangle KE = 1/2m(v_f^2 - v_o^2)$

Conservative Work = U_g and KE

- > Can be + or -
- > Get energy back when return to start

Nonconservative Work = fx and Rx

- > Always takes away energy = -
- > Never get energy back, negative when moves away or comes back

Full energy conservation equations

$W + KE_o + U_{go} = KE_f + U_{gf} + fx + Rx$

OR

$W - fx - Rx = \Delta U_g + \Delta KE$

Examples:

A girl jumps off a 2 m tall cliff into the water. What is her velocity when she lands?

G: $h_o = 2m$

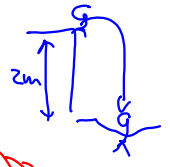
F: $v_f = ?$

E: $U_{go} = KE_f$

M: $mgh_o = \frac{1}{2}mv_f^2$

$v_f = \sqrt{2gh_o}$

A: $v_f = \sqrt{2(10 m/s^2)(2m)} = 6.3 m/s$



$v = 10 m/s$ → 25m → $v = 0$

A 200 kg car is moving at 100 m/s and comes to a complete stop, how much work is done by friction stopping the car? If it stops in 25 m, what is the frictional force?

G: $m = 200 kg$, $v_o = 100 m/s$, $v_f = 0$, $x = 25m$

F: $W_f = ?$, $f = ?$

E: $W_f = fx$ $KE_i = W_f$

M: $W_f = \frac{1}{2}mv^2 = \frac{1}{2}(200kg)(100 m/s)^2 = 1 \times 10^6 J$

$f = \frac{W_f}{x} = \frac{1 \times 10^6 J}{25m} = 4 \times 10^4 N$

A 80 kg man runs up a 12 m tall ladder, how much work does he do to reach the top?

G: $m = 80 kg$, $h_f = 12m$

F: $W = ?$

E: $W = U_{gf}$

M: $W = mgh_f$

A: $W = (80kg)(10 m/s^2)(12m) = 9600 J$

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