Notes 1/27

$$W = Fd\cos\theta$$

θ is angle between Force & Distance

Work = Force · Distance · Cos θ

Example) 50 N force @ 30° above horizontal. Box pulled a distance of 3.0 m

$$W = Fd\cos\theta = (50N)(3.0m)\cos 30° = 130 J$$

The sign of work is important!

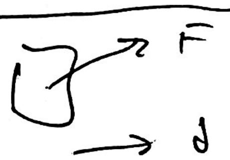
When the force & distance traveled are in opposite directions, the work is negative. Like with friction.

When the force & distance travelled are in the same direction, the work is positive

When work is positive, the object will speed up. It will slow down when work is negative.

Negative work

Positive work



Notes 1/30

Kinetic energy: The energy of motion, measured in Joules (J)

$$KE = \frac{1}{2} mv^2$$

kinetic energy = $\frac{1}{2}$ mass · velocity^2

Remember, the velocity is squared

~~ex) How fast must a 2.45 g table tennis ball tennis ball move in order to have~~

ex 1) A 7.0 kg bowling ball is traveling with a velocity of 3.0 m/s. How much kinetic energy does the bowling ball have?

$$KE = \frac{1}{2} mv^2 = \frac{1}{2}(7.0\,kg)(3.0\,m/s)^2 = 31.5\,J$$

ex 2) How fast must a 2.45 g table tennis ball move in order to have the same amount of kinetic energy as the bowling ball? Is this speed reasonable for a tennis ball?

$KE = 31.5\,J$ $\quad m = 0.00245\,kg$

$KE = \frac{1}{2} mv^2$ $\quad v = \sqrt{\frac{2\,KE}{m}} = \sqrt{\frac{2(31.5\,J)}{0.00245\,kg}} = 160\,m/s$

about 360 miles per hour, way too fast super sonic (faster than speed of sound)

Notes 1/31

Work energy theorem: The net work done on a body equals its change in kinetic energy

$W = \Delta KE$ $= KE_f - KE_o$ $W = Fd\cos\theta$

ex) On a frozen pond, A 10 kg sled is moving with a velocity of 2.2 m/s

a) How much kinetic energy does the sled have?

$KE = \frac{1}{2}mv^2 = \frac{1}{2}(10\ kg)(2.2\ m/s)^2 = 24.2\ J$

b) There is friction & eventually the sled slows to a stop. How much work is done on the sled?

$W = \Delta KE$ $KE_f = 0$ because it stopped

$KE_o = 24.2\ J$ $W = 0 - 24.2\ J = -24.2\ J$

c) The sled travels a distance of 2.5 m. How much is the force of friction?

$W = Fd\cos\theta$ $f(-)$ → d $\theta = 180$ $\cos 180° = -1$

$W = -fd = -24.2\ J$ $f = \frac{-24.2\ J}{-2.5\ m} = 9.68\ N$

ex) A 75 kg bobsled is pushed with a constant force for 4.5 m, The final velocity is 6.0 m/s. It started at rest, what was the magnitude of the force?

$W = \Delta KE$ $KE_o = 0$ $KE_f = \frac{1}{2}mv_f^2 = \frac{1}{2}(75\ kg)(6.0\ m/s)^2$

$KE_f = 1350\ J$ $W = 1350\ J - 0$ $= 1350$

$W = F \cdot d$ $F = \frac{1350\ J}{4.5\ m} = 300\ N$

Notes 2/1

Potential energy: Energy stored in an object

Gravitational potential energy: Energy of an object based on it's mass, height, & strength of gravity.

$$PE = mgh$$

Potential energy = mass · gravity · height

measured in Joules

ex)

$PE = mgh = (1\,kg)(9.8\,m/s^2)(1.5\,m)$

$$PE = 14.7\,J$$

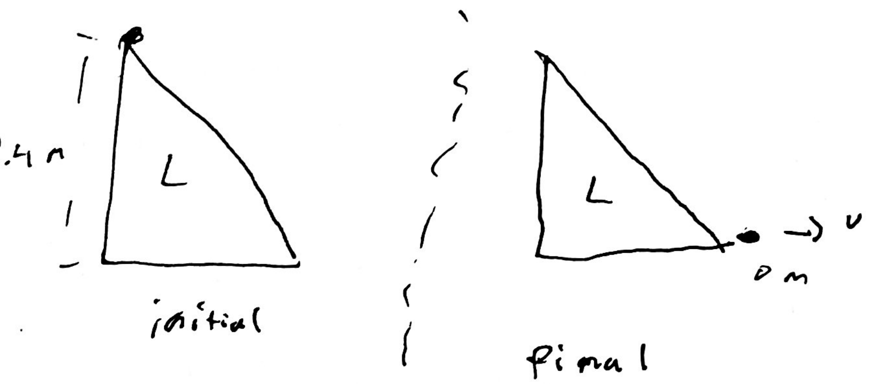
Conservation of Energy: $E_0 = E_f$

Initial energy = final energy

$E = KE + PE$

$KE_0 + PE_0 = KE_f + PE_f$

Marble ramp experiment



$\cancel{KE_0}^{\,0} + PE_0 = KE_f + \cancel{PE_f}^{\,0}$

$\cancel{m}gh_0 = \frac{1}{2}\cancel{m}V_f^2$

$gh_0 = \frac{1}{2}V_f^2$

$V_f = \sqrt{2gh_0}$

$V_f = \sqrt{2(9.8\,m/s^2)(0.4\,m)}$

$$V_f = 2.8\,m/s$$