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4.1 Work, Kinetic, Potential Energy Review

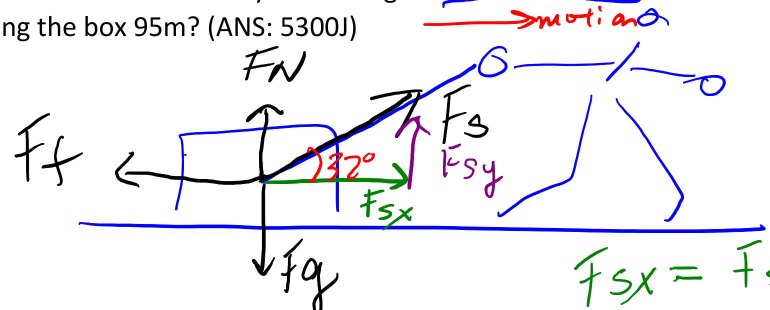
Last year, you learned about energy of a system changes as work is being done, namely the Work-Energy Theorem. You also learned about kinetic and potential energy.

Starting from the basics:

W = $F \times d$ (scalar) (Joules)

**Note that F is a constant force AND is the component of the force that is parallel with the direction of d.*

Ex 1: ___Seb___ is pulling on ___his___ box of toys (1.4kg) with a force of 66N at 32° above the horizontal. If the box of toys is moving at constant velocity, how much work does ___Seb___ do after moving the box 95m? (ANS: 5300J)



$F_{sx} = F_s \cos 32$

$W = F_{sx} \times d$
$= F_s \cos 32 \times 95m$
$= 66 \cos 32 (95)$
$= 5300 J$

Further questions: how much work does the frictional force do? What does it mean when the work done is negative? Does the vertical component of the pulling force do any work?

Recall from last year:

$E_k = \frac{1}{2}mv^2$ $E_p = mgh$ W = ΔE

(Work-Energy Theorem, also known as $\Delta E_k = F_{net} \times d$

Where *m* is mass, *v* is speed, *g* is acceleration due to gravity, and *h* is height above the Earth's surface.

Ex. 2: Chewbacca lifts Han Solo (79kg) upwards with a constant speed to a height of 2.0m.

a) How much work did Chewbacca do? (ANS: 1500J)

b) How much potential energy does Han Solo have at this point? (ANS: 1500J)

c) At 2.0m Han wriggled too much so Chewbacca accidentally dropped him. How fast is Han moving before hitting the ground? (ANS: 6.3m/s)

a) $W = F \times d = F_g d = mgh = 79(9.8)2.0 = 1500 J$

b) $E_p = mgh = 79(9.8)2.0 = 1500 J$

c) $E_p \longrightarrow E_K$

$E_p = E_K$

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

$v = \sqrt{2gh} = \sqrt{2(9.8)(2.0)}$
$= 6.3 m/s$

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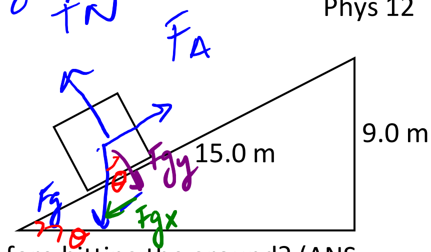
Ex. 3:

$F_A = F_{gx} = F_g \sin\theta$



A 1.2kg block is pushed up the incline at a constant speed from the base of the incline. *assume the incline is frictionless*

a) How much work was done in pushing the box up the incline? (ANS: 110J)

b) How much potential energy did the box gain? What do you notice? (ANS: 110J)

c) If the block was dropped at the top of the incline, how much speed would it have before hitting the ground? (ANS: 13m/s)

If the same block was dropped off the incline, how much speed would it have before hitting the ground ~~assuming the~~ incline is frictionless?

a) $W = F_A d = F_{gx} d$

$\sin\theta = \dfrac{9.0\text{m}}{15.0\text{m}}$

$= F_g \sin\theta \, d = mg \frac{9}{15}(15) = 1.2(9.8)9$

$= 110\text{J}$

b) $E_p = mgh = 1.2(9.8)9 = 110\text{J}$

c) $E_p \rightarrow E_k \qquad E_p = E_k$

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

$v = \sqrt{2gh}$

$= \sqrt{2(9.8)(9)}$

$= 13\text{m/s}$

HW: Worksheet 4.1 pg 1 (odds), pg 2 (evens)