Seating for PHYS 1020 Term Test, 2007
Tuesday, October 23, 7-9 pm

Student numbers		Room
From	To	
6504394	6842355	200 Fletcher-Argue
6842547	6852067	200 Armes
6852080	6852939	206 Tier
6852942	6855233	306 Tier
6855256	7607350	223 Wallace

Mastering Physics Assignment 3

Assignment 3 is available on the Mastering Physics website

It is due Friday, October 26 at 11 pm

It covers material from chapters 4 and 5 as preparation for the term test on Tuesday

There are 7 questions for practice and 6 for credit

GENERAL PHYSICS I: PHYS 10

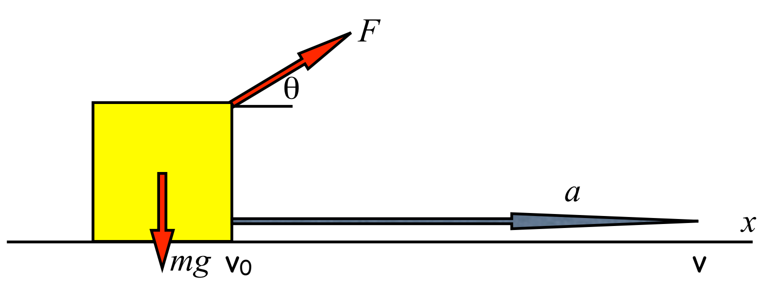
Schedule - Fall 2007
(lecture schedule is approximate)

	W	3	12	Chapter 5	Uniform circular motion	(chapters 1, 2, 3)
	F	5	13			
6	M	8	Thanksgiving Day			Experiment 2: Measurement of *g* by free fall
	W	10	14	Chapter 5	Uniform circular motion	
	F	12	15	Chapter 6	Work and energy	
7	M	15	16			Tutorial and Test 2 (chapters 4, 5)
	W	17	17			
	F	19	18	Chapter 7	Impulse and momentum	
8	M	22	19			No lab or tutorial
	Tue	23	MID-TERM TEST, Ch 1-5, Tuesday, October 23, 7-9 pm			
	W	24	20	Chapter 7	Impulse and momentum	
	F	26	21	Chapter 8,		

Week of October 15: Tutorial and test 2: ch. 4, 5

Tuesday, October 23, 7-9 pm, midterm: ch. 1-5
(20 multiple-choice questions)

Work-Energy Theorem

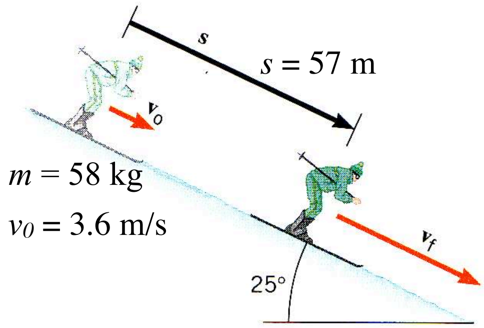


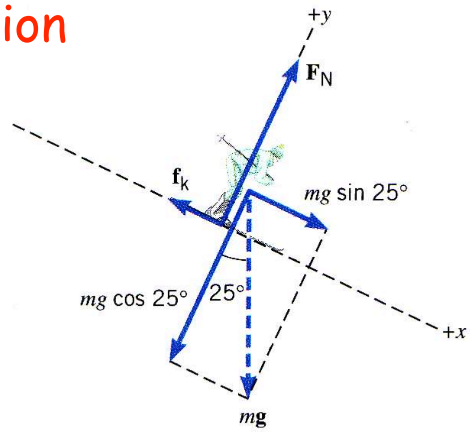
$$\text{Work done, } W = Fx\cos\theta = \frac{mv^2}{2} - \frac{mv_0^2}{2} = \Delta KE$$

Work done = (force in direction of displacement) × (displacement) = ΔKE

Unit of work: 1 Joule (J) = 1 N.m

Friction



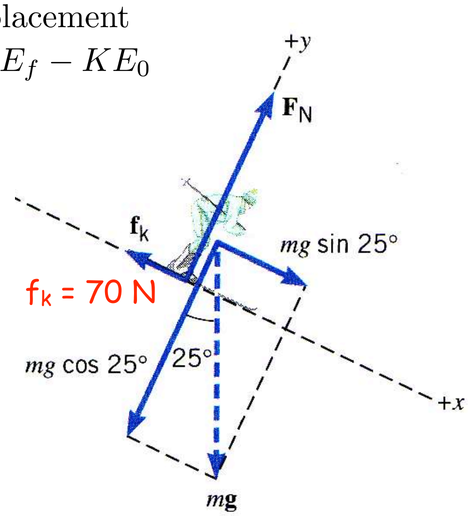


A friction force f_k = 70 N acts on the skis.
Initial speed, v_0 = 3.6 m/s
Find final speed, v_f , after skiing 57 m down the slope

Work-energy theorem: W = F_{net} x displacement = ΔKE

F_{net} = mg sin25^0 - f_k = net force down the slope

Work-energy theorem: $W = F_{net} \times \text{displacement}$
$= \Delta KE = KE_f - KE_0$



$F_{net} = mg\sin 25° - f_k$
$= (58\text{ kg}) \times g\sin 25° - 70\text{ N} = \underline{170\text{ N}}$

Displacement, $\underline{s = 57\text{ m}}$

So $\underline{W = F_{net} \times s = 170 \times 57 = 9690\text{ J}}$

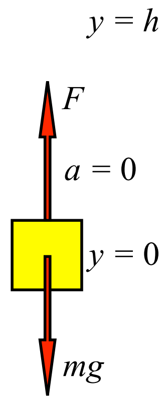
$m = 58$ kg, $v_0 = 3.6$ m/s

$\underline{KE_0 = mv_0^2/2 = 375.8\text{ J}}$

So, $W = 9690\text{ J} = KE_f - 375.8\text{ J} \rightarrow \underline{KE_f = 10{,}066\text{ J}}$ (= $mv_f^2/2$)
$\rightarrow \underline{v_f = 18.6\text{ m/s}}$

Check: $v_f^2 = v_0^2 + 2ax = v_0^2 + 2(F_{net}/m)x = 3.6^2 + 2(170/58)\times 57$
$v_f = 18.6$ m/s

Work done in lifting an object



A force F lifts the mass at constant speed through a height h.

The displacement is h.

The applied force in the direction of the displacement is:

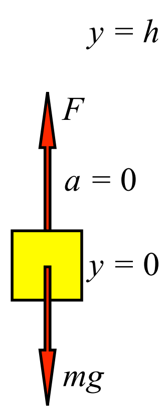
F = mg (no acceleration)

The work done by the force F is:

W = Fh = mgh

But the kinetic energy has not changed – the gravity force mg has done an equal amount of negative work so that the net work done on the mass by all forces (F and mg) is zero.

Work done in lifting an object



Alternative view: define a different form of energy –

Gravitational potential energy, PE = mgy

Define:

Mechanical energy = kinetic energy + potential energy

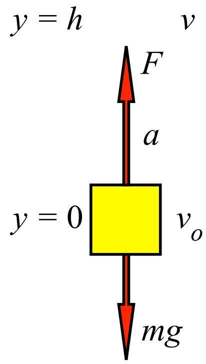
Mechanical energy, E = $mv^2/2$ + mgy

Then:

Work done **by applied force**, F, is (change in KE) + (change in PE)

So $W = Fh = \Delta\mathrm{KE} + \Delta\mathrm{PE}$

Check, using forces and acceleration



Net upward force on the mass is F – mg

Apply Newton's second law to find the acceleration:

F – mg = ma,

so, a = (F – mg)/m

One of famous four equations –

$v^2 = v_0^2 + 2ah$

$$\text{So, } v^2 = v_0^2 + \frac{2(F - mg)h}{m}$$

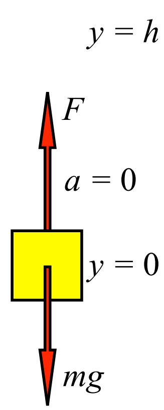
$(\times m/2)$

$$\frac{mv^2}{2} - \frac{mv_0^2}{2} = Fh - mgh$$

That is, $\Delta KE = Fh - \Delta PE$

Or, $W = Fh = \Delta KE + \Delta PE$

Two viewpoints



1) A net upward force (F - mg) does work and moves the mass upward and changes its kinetic energy:

(F - mg) x h = ΔKE (work-energy theorem)

2) An **applied force F** does work and changes the kinetic and potential energies of the mass:

W = Fh = ΔKE + mgh = ΔKE + ΔPE

The second is more powerful as it can be turned into a general principle that:

Work done by applied force = change in mechanical energy

If no work is done, then mechanical energy is conserved!

Conservation of Mechanical Energy

In the absence of applied forces and friction:

Work done by applied force = 0

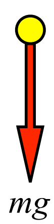
So, 0 = (change in KE) + (change in PE)

And KE + PE = E = mechanical energy = constant

Other kinds of potential energy:

- elastic (stretched spring)
- electrostatic (charge moving in an electric field)

6.28/26



$m = 0.6$ kg, $y_o = 6.1$ m

Ball is caught at $y = 1.5$ m

a) Work done on ball by its weight?

Weight force is in same direction as the displacement so,

Work = $mg \times$ displacement = $0.6g \times (6.1 - 1.5 \text{ m}) = 27$ J

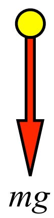
b) PE of ball relative to ground when released?

PE = $mgy_o = 0.6g \times (6.1 \text{ m}) = 35.9$ J

c) PE of ball when caught?

PE = $mgy = 0.6\text{g} \times (1.5 \text{ m}) = 8.8$ J

From last page:



$m = 0.6$ kg, $y_o = 6.1$ m

Ball is caught at $y = 1.5$ m

b) PE of ball when released = $mgy_o = 35.9$ J

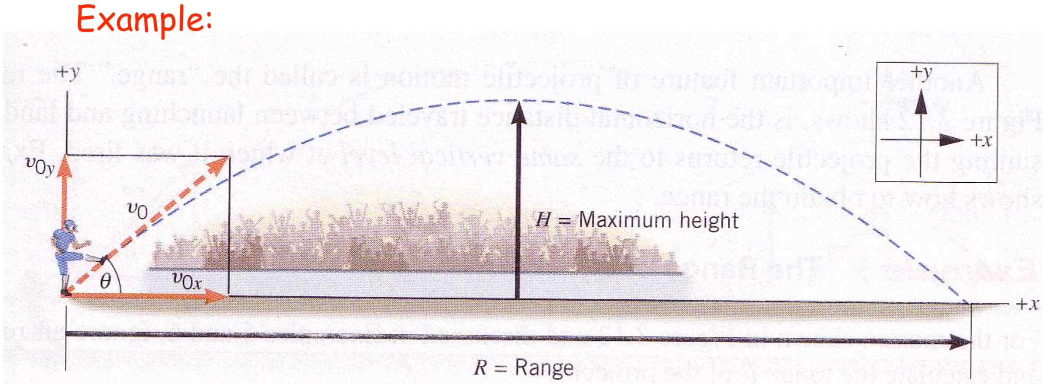
c) PE of ball when caught = $mgy = 8.8$ J

d) How is the change in the ball's PE related to the work done by its weight?

Change in PE = $mg(y - y_o)$ (final minus initial)

Work done by weight = $mg \times$(displacement) = $mg(y_o - y) = -\Delta$PE

Example:



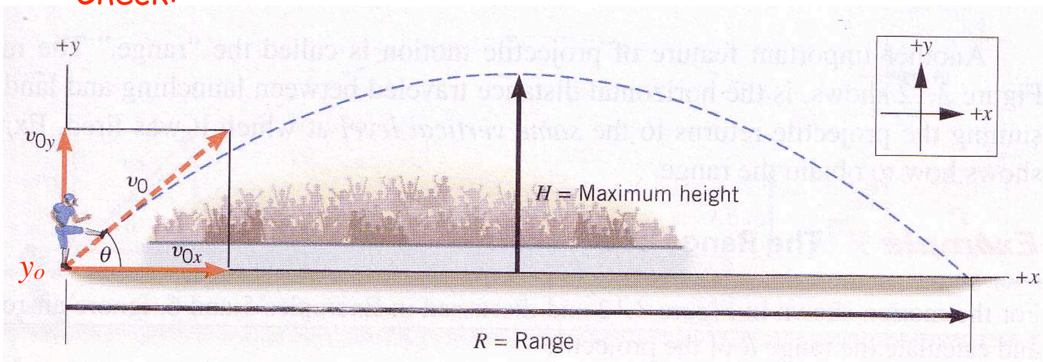
No applied (i.e. external) forces

$E = KE + PE =$ constant

$KE = mv^2/2$
$PE = mgy$

So $E = mv^2/2 + mgy =$ constant, until the ball hits the ground

Check:



$$v_x = v_0 \cos\theta = \text{constant, in absence of air resistance}$$

$$v_y^2 = v_{0y}^2 - 2g(y - y_0) = (v_0 \sin\theta)^2 - 2g(y - y_0) \text{ object at height } y$$

$$v^2 = v_x^2 + v_y^2 = (v_0 \cos\theta)^2 + (v_0 \sin\theta)^2 - 2g(y - y_0)$$

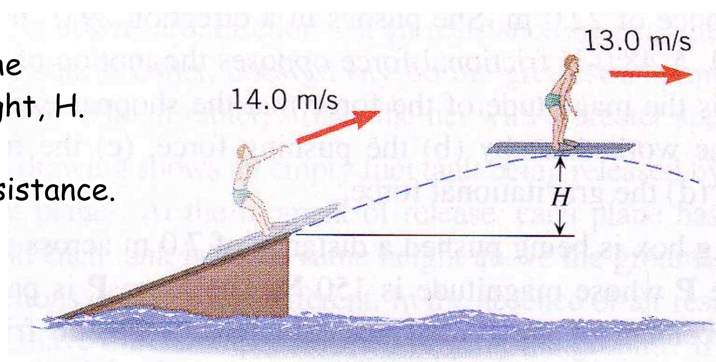
$$v^2 = v_0^2 - 2g(y - y_0), \text{ as } \sin^2\theta + \cos^2\theta = 1$$

$(\times m/2)$ (= constant)

$$mv_0^2/2 + mgy_0 = mv^2/2 + mgy \text{ and } KE_0 + PE_0 = KE + PE$$

6.-/34: Find the maximum height, H.

Ignore air resistance.



Conservation of mechanical energy: KE + PE = constant

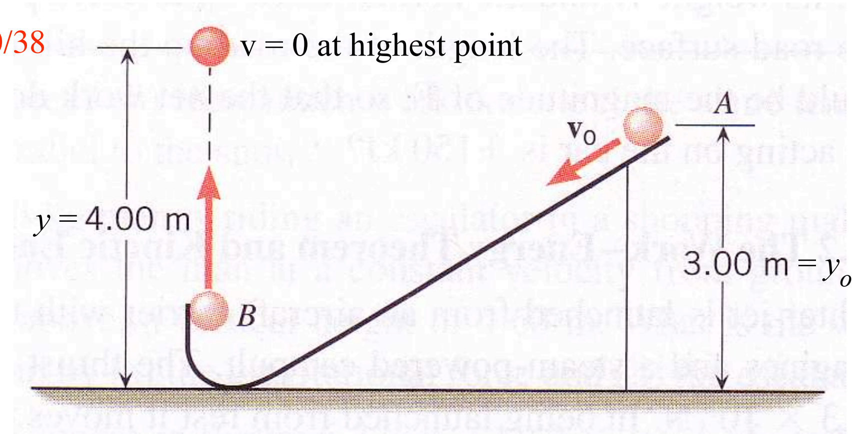
At take-off, set $y = 0$: $E = mv_0^2/2 + 0$

At highest point, $y = H$: $E = mv^2/2 + mgH$

So, $E = mv_0^2/2 = mv^2/2 + mgH$

$$H = \frac{(v_0^2 - v^2)/2}{g} = \frac{(14^2 - 13^2)/2}{9.8} = 1.38 \text{ m}$$

6.40/38



Find the speed of the particle at A (v_o). There is no friction.

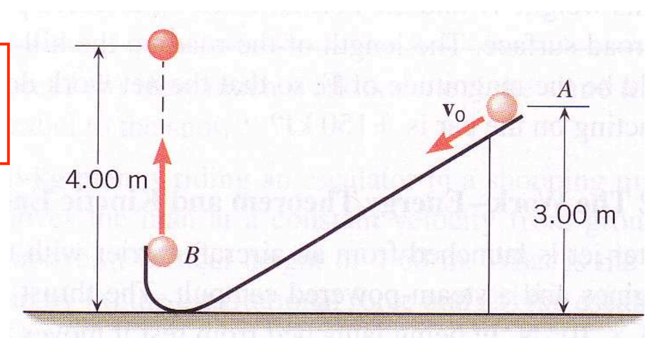
Conservation of mechanical energy: E = KE + PE = constant

At A: $E = mv_0^2/2 + mgy_0 = mv_0^2/2 + 3mg$

At highest point: $E = KE + mgy = 0 + 4mg$

At A: $E = mv_0^2/2 + 3mg$

At highest point: $E = 4mg$



So, $E = mv_0^2/2 + 3mg = 4mg$

$mv_0^2/2 = mg$

$v_0 = \sqrt{2g} = 4.43$ m/s

What happens at B doesn't matter, provided there is no loss of energy due to friction!