Motion in a Plane Notes

I. 2-Dimensional Motion and Trajectories

What kinds of objects have a 2-dimensional motion?

- Objects moving along Earth's surface (projectiles)
- Planets around the sun
- Pendulums

A) Objects moving along the Earth's surface (projectiles)

1. Projectile fired horizontally

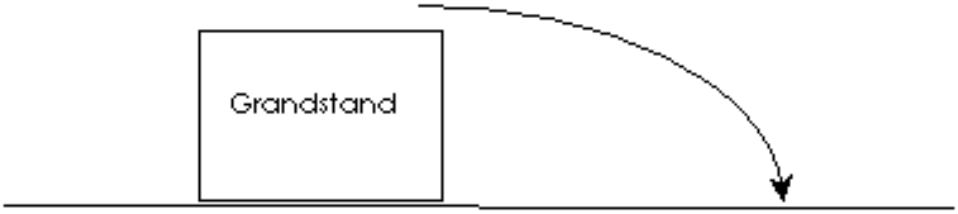
What you need to know before solving this type of problem:

B) Projectile fired horizontally - Solving Word Problems

Use all the same motion equations you used before

Ex) A baseball is thrown horizontally from a grandstand 20. m above ground at a speed of 10. m/s.

(a) How long will the ball remain in flight before reaching the ground?



(b) What is the projectile's maximum range before it hits the ground?

2. Projectile fired at an angle

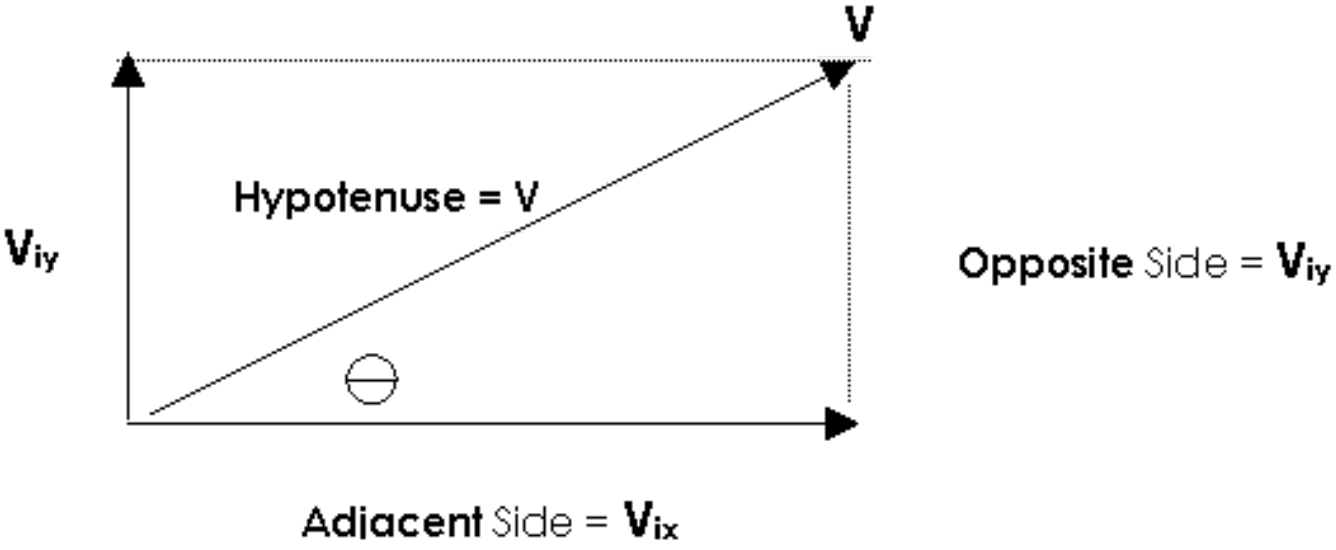
Projectiles move in a _____path

Angle and Initial Velocities

Projectile fired at 5 m/s**:** if Θ = 0 _____ if Θ = 90 _____

If the angle not 0 or 90 the initial velocity is _____

Finding the horizontal and vertical components parts



V - _____that projectile is fired

V_{ix} - initial V in _____ direction V_{iy} - initial V in _____ direction

Vx= _____ Vy = _____

Ex) A baseball is thrown upward at an angle of 30.° and a velocity of 6.0 m/s.

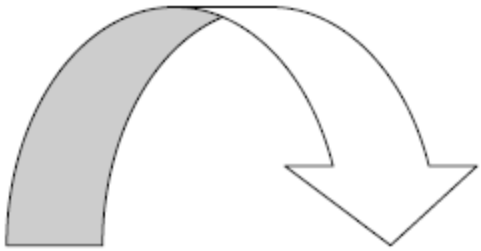
Find the initial horizontal & vertical components of the baseball's velocity.

3. Other important facts about projectile motion

$d_x = V_x t$ (memorize)

a_y = _____ ascending

a_y = _____ descending



Angles and Ranges

Max Range _____ Minimum Range _____

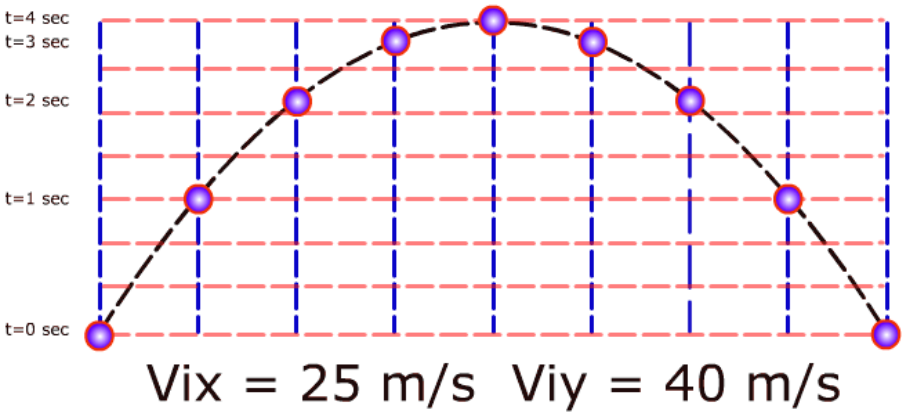
What angle would have the same Range as 55 degrees? _____

Angle with the longest time in the air? _____

Ex) Which projection angle causes a projectile to stay in the air longer?

50 or 70 degrees? Why?

Projectile projected upward at an angle. Where V_{ix} = 25 m/s V_{iy} = 40 m/s



t (sec)	V_x (m/s)	V_y(m/s)
0	25	40
1		
2		
3		
4		
5		
6		
7		
8		

4. Projectile Fired at an Angle - Word Problems

Ex) An athlete doing a running jump leaves the ground at an angle of 25° and a velocity of 10. m/s.

(a) What is the athlete's velocity's initial vertical component (Viy)?

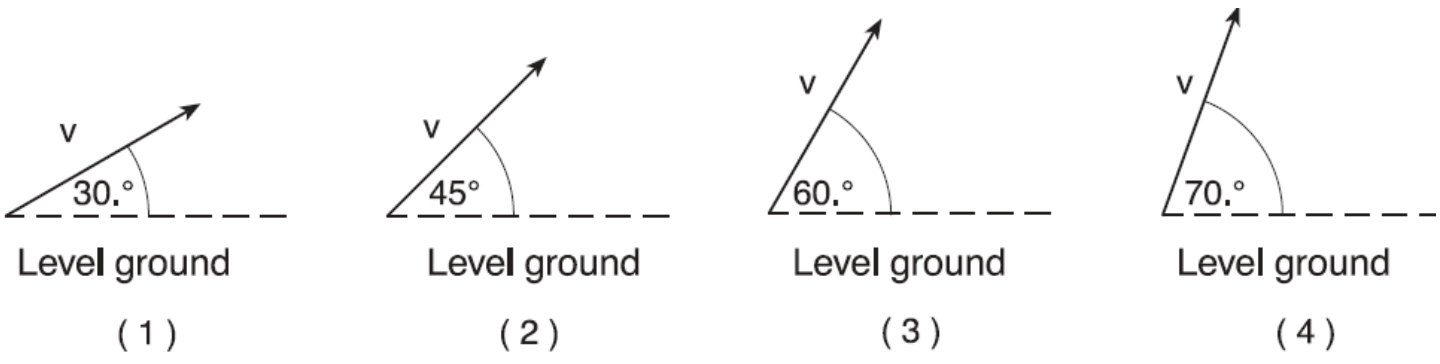
(b) How long does it take for the athlete to reach her maximum height?

(c) How long did it take for the athlete to complete the entire jump? _____

Total time equals _____

(d) How far did she jump?

Ex) Rank the horizontal displacements from **least to greatest**.

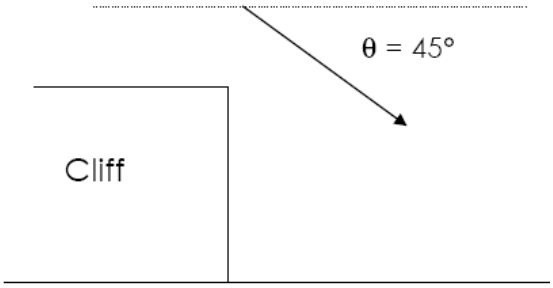


Ex) A projectile leaves the ground at an angle of 60° and a speed of 100. m/s.

(a) Find the initial vertical component of the object's velocity

(b) Find the object's maximum height.

Ex) A rock is thrown from a cliff with an initial speed of 40m/s at an angle of 45° below the horizontal.



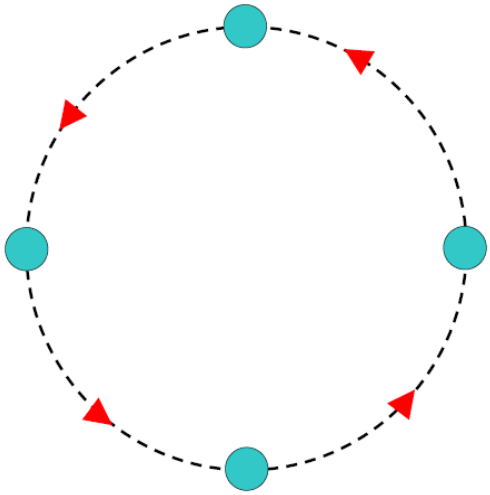
(a) What is the vertical component of the initial velocity?

(b) If the rock strikes the ground in 1.0 sec what is the height of the cliff?

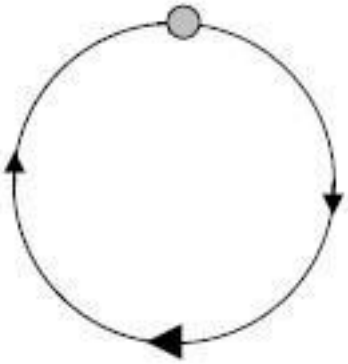
I. Uniform Circular Motion

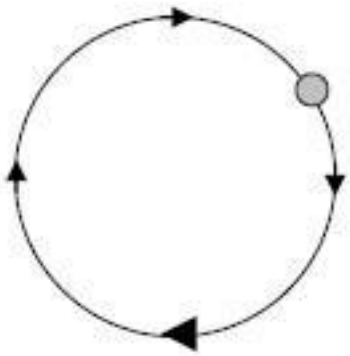
For an object to move at constant speed in a circle, an outside _____

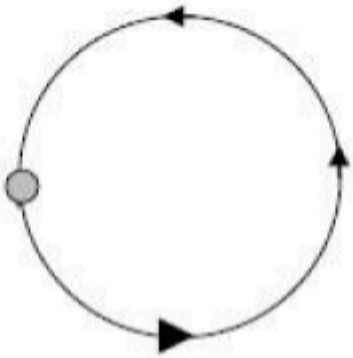
must constantly pull the object toward _____of a circular path.

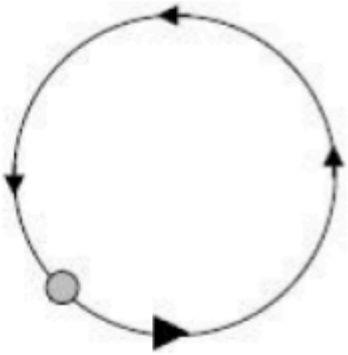


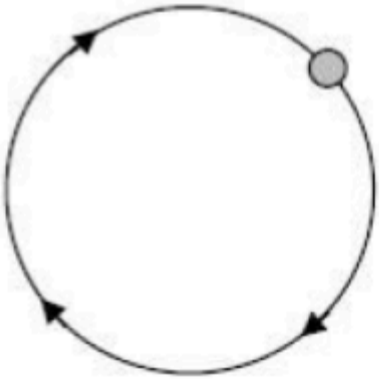
1. Draw the centripetal force on each sphere **2.** Draw the tangential velocity











Instructional Video

Motion in a Plane Notes

A. The Equations and Vectors

1. _____ (ac) –

Mass moving with circular motion.

a Equation: _____ (On reference table)

Units

a) (v) _____ velocity - _____

to circle, in the direction of the motion

b) _____ acceleration - directed toward the

_____ of the circle

Example Problem

Ex) A car moving in a circular path with a radius of 2.0 m has a velocity of 8.0 m/s. What is the centripetal acceleration of this car?

B. Different ways we can change centripetal acceleration

1. How does acceleration change with velocity?

$$a_c = v^2/r$$

- ***Answer - _____ Relationship
  (Both variables on top, one is squared)

V	ac
X2	X
X3	X
X4	

1. How does acceleration change with the radius of the circle?

- *** Answer - _____ Relationship

ac	R
X	X2
X	X3
	X4

C. More Circular Motion Word Problems

Example: A 2 kg cart travels in a horizontal circle at a constant speed of 6m/s. If the radius of the circle is 3m, what is the centripetal acceleration?

Equation:

Challenge Example: Calculate the speed an earth satellite must have to enter a circular orbit at an altitude of 200 km where the acceleration due to gravity at 200,000 m is 9.2 m/s^2 and the radius of the earth is 6,400,000 m

Centripetal Force (Fc) - _____ directed toward _____

which keeps an object moving in a _____path

$F_c = ma_c =$

Force units (_____) or

Ex) A 5.0 kg object moves in a circle at a constant speed of 10. m/s. What is the radius of the object's circular path if the object's centripetal force is 1000. Newtons?

D. Changing the Centripetal Force

1. How does centripetal force change with mass?

m	Fc
X2	X
X3	X
	X4

2. How does centripetal force change with radius?

¨ _____ Relationship (One variable on top, other on bottom)

F_c	r
X	X2
X	X3
	X4

3. How does centripetal force change with velocity?

_____Relationship (Both variables on top, one is squared)

v	Fc
X2	X
X3	X
X4	

Motion in a Plane Notes

I. Satellite Motion

Satellite - _____

Natural Satellites - ex) Moon, all 8 planets, comet

Artificial Satellites - weather, spy, communications

A. Satellite Motion

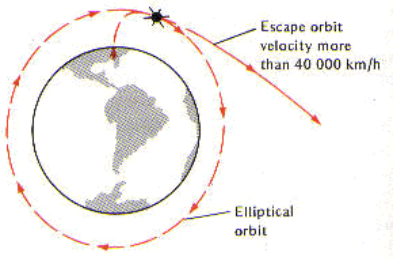
1. To send artificial satellite _____

around the earth, it must first achieve a speed of _____

- ¨ If greater than 7900 m/s satellite has an _____ orbit

- If velocity is greater than 11 km/s then the satellite _____

Escape Velocity



2. Air resistance slows down satellites and _____

B. Geosynchronous Orbits -

A. When a satellite orbits _____with the earth's rotation it is called _____.

B. Time for one revolution - _____

C. A satellite at a distance of _____

from Earth's center will orbit the Earth every _____ hrs.

D. Since both satellite and Earth _____