Vectors Mini-Unit! Name_____

Day	*In Class*	*Homework*
1	Introduction to Vectors Definitions Adding Right Angle Vectors	WS1: Trig and Adding 1D Vectors
2	Whiteboard: WS1 Vector Components	
3	Adding Non-Right Angle Vectors PVL Introduction/Teams	WS2: Adding Non-Right Angle Vectors Begin PVL scouting
4	Whiteboard: WS2	WS3: Adding 2D Vectors
5	Whiteboard: WS3	Finish PVL scouting
6	PVL	Study for **QUIZ**
7	**QUIZ**	WS4: Free Fall Review

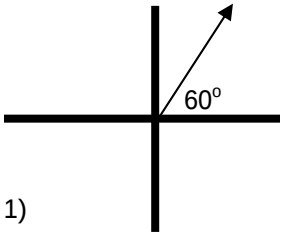
2D Motion!

Day	*In Class*	*Homework*
1	Whiteboard: WS4: Free Fall Review	
2	Video Analysis Lab Day 1: Using *Logger Pro*, reading graphs, interpreting data, using vectors	Begin lab report
3	Lab Discussion: 2D Motion: X and Y are independent! Constant velocity X Accelerated Y	WS6: Pig Cannon Part 1
4	Whiteboard: WS6 Horizontal off a Cliff Practice	WS7: Horizontal off a Cliff
5	*Lab Report Due* Whiteboard: WS7	Study for **QUIZ**
6	**QUIZ**	
7	Dart Gun Lab	
8	Dart Gun Lab Day 2	Complete Lab WS6: Pig Cannon Part 2
9	Whiteboard: WS6 Angle from Ground Problems	WS8: Cannon Problems
10	Whiteboard: WS8	WS 9: 2D Graphing
11	Tennis Ball Cannon	Study for **TEST**
12	Whiteboard: WS9 Review	Study for **TEST**
13	**TEST**	

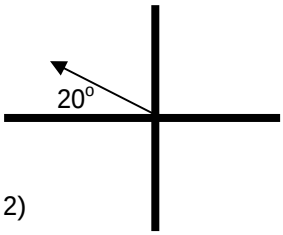
Physics Unit 3: Vectors and 2D Kinematics
Trig Review and 1D Vectors

Name:_____
1 2 3 4 5 6 7 8

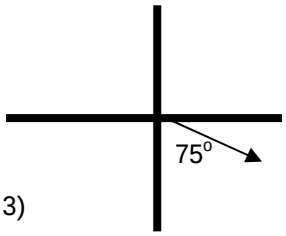
Part I: Name the angles two different ways



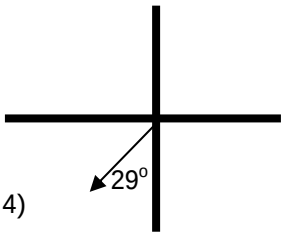
1)



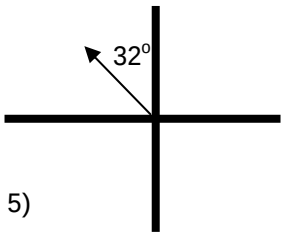
2)



3)



4)

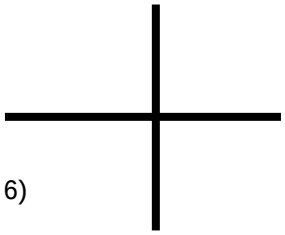


5)

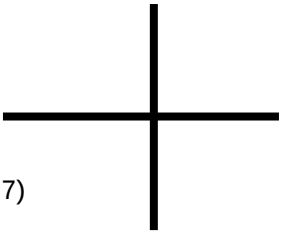
_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

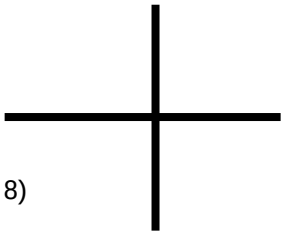
Part II: Draw the following angles



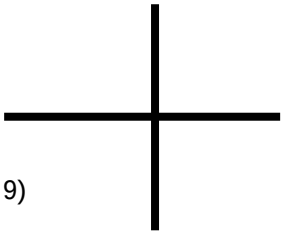
6)



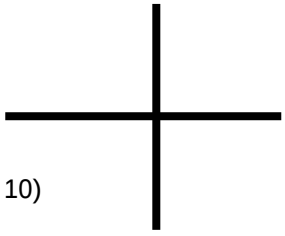
7)



8)



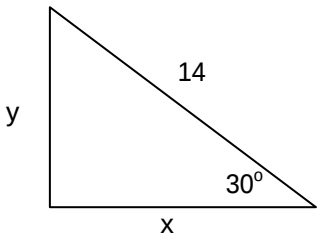
9)

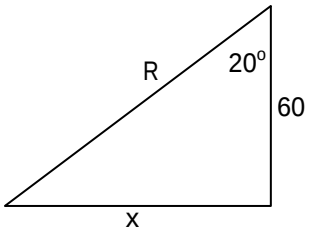


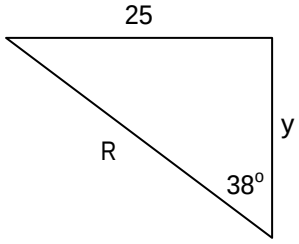
10)

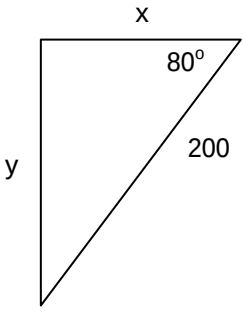
42^o S of W 70^o E of N 28^o W of N 5^o E of S 30^o N of W

Part III: Trig review-Finding Sides





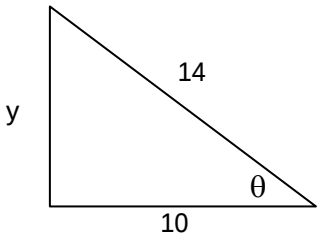


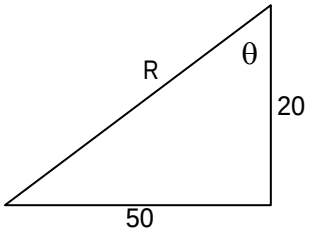


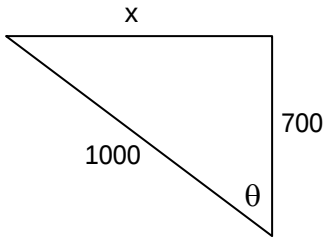
x=_____ x=_____ R=_____ x=_____

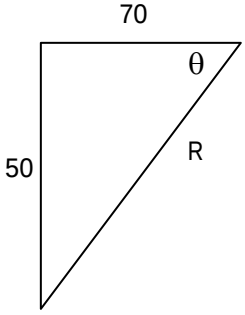
y=_____ R=_____ y=_____ y=_____

Part IV: Finding Angles and Sides









θ= _____ R=_____ x=_____ R=_____

y=_____ θ=_____ θ=_____ θ=_____

Part V: 1D Vector Addition – For each of these problems, draw the vectors!

1. While searching for barbarians, Maximus walks 8 km N, and then 10 km E. What is his distance traveled? What is his overall displacement? What is the direction of his displacement?

2. Maximus has found barbarians! He chases them 12 km E, but they outsmart him and get past his lines. He has to chase them back 7 km W. What is his distance traveled? What is his overall displacement? Include a direction!

3. The barbarians have retreated! They run 15 km N, but the Phoenix Legion catches up with them. The barbarians keep running and run 8 more km N. What distance did their retreat cover? What was their displacement? Remember to include a direction!

4. Finally, Maximus has achieved victory and is allowed to go home. His home is 25 km E and 55 km S of the battlefield. What is the shortest distance and direction Maximus can travel to get home?

Physics: Vectors Mini-Unit
Component Method Addition

Name_____
1 2 3 4 5 6 7 8

Part I: Construct the vectors using their "x" and "y" components. Draw a diagram and find the magnitude and direction of the resultant.

1) x= 80m y=60m

R=_____

θ=_____

2) x=-3m/s y=7m/s

R=_____

θ=_____

3) x=-800km y=-1000km

R=_____

θ=_____

4) x= -10m y=10m

R=_____

θ=_____

5) x=20m/s y=-30m/s

R=_____

θ=_____

6) x=-4 km y=10km

R=_____

θ=_____

Part II: Add the vectors using the component method. Sketch a diagram, set up an "x-y chart," and show your work.

A=10 m E **B**=20 m E **C**=15 m S **D**=20 m W **E**=10m N

F=20 m @ 30° E of S **G**=30 m @ 45° W of N **H**=40 m @ 73° S of E **I**=10 m @ 10° W of S **J**=20 m NE

7) A + B + C

Sketch

x	y

R = _____

θ = _____

8) D + E + A

Sketch

x y

R = _____

θ = _____

9) A + F + G

Sketch

x y

R = _____

θ = _____

10) H + J + B

Sketch

x y

R = _____

θ = _____

11) A + B + C + I

Sketch

x y

R = _____

θ = _____

Vector Draft Name _____

Physics 432 1 2 3 4 5 6 7 8

The vector draft is a group activity where you and your group choose vectors so that when added together, your vectors will have the smallest resultant. A perfect score would be a displacement of 0 meters.

Vector Draft Rules

1- You must choose a name for your team that uses your team color.

2- You must choose a team of vectors so that, when added, you have the smallest resultant.

3- Your team will start with two random vectors to start.

4- There are five rounds in which you will choose an available vector from the draft list.

5- You must choose an available vector each round.

6- You will have one minute to announce your choice at your turn.

7- There will be a two minute preparation period between each class round of choosing.

8- Final decisions are made by the teacher regarding any conflicts that arise.

Scoring:

After the final vector, each team will have their total amount announced. The results will be based on this final announcement.

1^{st} place – 10 points
2^{nd} place – 9 points
3^{rd} place – 8 points
4^{th} place – 7 points
5^{th} place – 6 points
6^{th} place – 6 points
7^{th} place – 6 points

If you finish in 4th or worse, you can earn points back to boost you to 8 total points. In order to do this, show your work for adding all your vectors, and create an "undrafted free agent" who will help you get to a displacement of zero.

Extra Credit: you may earn two points of extra credit by designing a logo for your vector draft team. This logo must be in color, and must reflect effort. You must email a copy of this logo to your teacher for it to be worth points.

	Mag.		Angle	
1	10	@	30	N of W
2	20	@	45	N of E
3	30	@	60	S of W
4	40	@	30	S of E
5	50	@	45	N of W
6	5	@	60	N of E
7	10	@	30	S of W
8	15	@	45	S of E
9	20	@	60	N of W
10	1	@	30	N of E
11	2	@	45	S of W
12	3	@	60	S of E
13	4	@	30	N of W
14	5	@	45	N of E
15	21	@	60	S of W
16	22	@	30	S of E
17	23	@	45	E of N
18	45	@	60	W of N
19	5	@	30	E of S
20	15	@	45	W of S
21	25	@	60	E of N
22	35	@	30	W of N
23	45	@	45	E of S
24	55	@	60	W of S
25	10	@	30	E of N
26	11	@	45	W of N
27	12	@	60	E of S
28	13	@	30	W of S
29	14	@	45	E of N
30	15	@	60	W of N
31	31	@	30	E of S
32	32	@	45	W of S
33	33	@	60	S of W
34	34	@	30	S of E
35	35	@	45	N of W
36	36	@	60	N of E
37	2	@	30	N of E
38	4	@	45	S of W
39	6	@	60	S of E
40	8	@	30	N of W
41	10	@	45	S of E
42	13	@	60	S of W
43	5	@		N
44	10	@		S
45	15	@		E
46	20	@		W
47	20	@		N
48	15	@		S
49	10	@		E
50	5	@		W
51	16	@		N
52	20	@		S
53	8	@		E
54	14	@		W
55	6	@		N
56	18	@		S

The vectors at left are available to be chosen in the vector draft. Once a vector is chosen, it may not be used by any other team. All choices are final, and vectors may not be traded.

Show your work below:

Pre-Draft Vectors-

Round 1 Vector-

Round 2 Vector-

Round 3 Vector-

Round 4 Vector-

Round 5 Vector-

Physics: Vectors Mini-Unit Name:_____
Worksheet 3: Vector Addition Word Problems 1 2 3 4 5 6 7 8

Remember: 1) Make a quick sketch, 2) Break vectors into components, 3) Construct an "x-y" chart 4) Draw the resultant, 5) Find the resultant's magnitude and direction

1) Two people are pushing a disabled car. One exerts a force of 200 N east, the other a force of 150 N east. What is the net force exerted on the car? (Assume friction to be negligible.)

2) Two soccer players kick a ball simultaneously from opposite sides. Red #3 kicks with 50 N of force while Blue #5 kicks with 63 N of force. What is the net force on the ball?

3) An airplane flies due north at 100 m/s through a 30 m/s cross wind blowing from the east to the west. Determine the resultant velocity (mag and dir) of the airplane.

4) A mountain climbing expedition establishes a base camp and two intermediate camps, A and B. Camp A is 11,200 m east of and 3,200 m above base camp. Camp B is 8,400 m east of and 1,700 m higher than Camp A. Determine the displacement between base camp and Camp B. (mag and dir)

5) A plane flies with a velocity of 52 m/s east through a 12 m/s cross wind blowing the plane south. Find the magnitude and direction (relative to due east) of the resultant velocity at which it travels. (mag and dir)

6) An ambitious hiker walks 25 km west and then 35 km south in a day. Find the magnitude and direction (relative to due west) of the hiker's resultant displacement. (mag and dir)

7) A boat heads directly across a river with a velocity of 12 m/s. If the river flows at 6.0 m/s find the magnitude and direction (with respect to the shore) of the boat's resultant velocity. (mag and dir)

8) I went for a walk the other day. I went four avenues east (0.80 miles), then twenty-four streets south (1.20 miles), then one avenue west (0.20 miles), and finally eight streets north (0.40 miles).
   a) What distance did I travel?
   b) What's my resultant displacement? (mag and dir)

9) A plane intends to fly north with a speed of 250 m/s relative to the ground through a high altitude cross wind of 50 m/s coming from the east. Determine …
   a) the bearing that the plane should take (relative to due north) and
   b) the plane's speed with respect to the air.

10) A cyclist heads out on a straight road with a bearing of 60^{o} east of north. A wind from the southwest is blowing at 10 m/s.
   a) Is this wind more like a headwind or a tailwind?
   b) What is the velocity of the cyclist? (mag and dir)

11) A roller coaster moves 200 ft horizontally, then rises 135.0 ft at an angle of 30.0˚ degrees above the horizontal. It then travels 150.0 ft at an angle of 40˚ downward from the horizontal. Find the displacement of the roller coaster from its starting point.

12) While exploring a cave, a spelunker starts at the entrance and moves the following distances. She goes 75.0m north, 250.0m east, 125.0m at and angle of 30˚ north of east, and 150.0 m south. Find the resulting displacement from the cave entrance.

13) A quarterback takes the ball from the line of scrimmage, runs backward for 10 yards, then sideways parallel to the line of scrimmage for 15 yards. At this point he throws a 50 yards forward pass straight downfield perpendicular to the line of scrimmage. What is the magnitude of the football's displacement from the snap?

14) Huck Finn walks at a speed of 1.0 m/s across his raft (that is, he walks perpendicular to the raft's motion relative to the shore). The raft is travelling down the Mississippi river at a speed of 2.7 m/s relative to the river bank. What is the velocity (speed and direction) of Huck relative to the river bank?

Unit 3: 2D Kinematics Name_____

WS1: Free Fall Review 1 2 3 4 5 6 7 8

For each of these problems, write the mathematical model you need to use. Then, rearrange the model to solve for your unknown(s) before plugging in any numbers. Use an extra sheet of paper if you need one.

1. A body falls freely from rest on Earth. Find:
   a. its displacement at t = 3s
   b. the time for it to reach a speed of 25 m/s
   c. the time required for it to fall 300 m
   d. its speed after falling 70 m

2. Repeat question 1 for a body falling freely on the moon. The acceleration due to gravity there is 1.7 m/s^2.

3. A ball is dropped from rest at a height of 80 m above the ground.
   a. What is its speed just as it hits the ground?
   b. How long does it take for it to reach the ground?

4. A marble dropped from a bridge strikes the water in 6.0 s. Calculate:
   a. the speed with which it strikes the water
   b. the height of the bridge

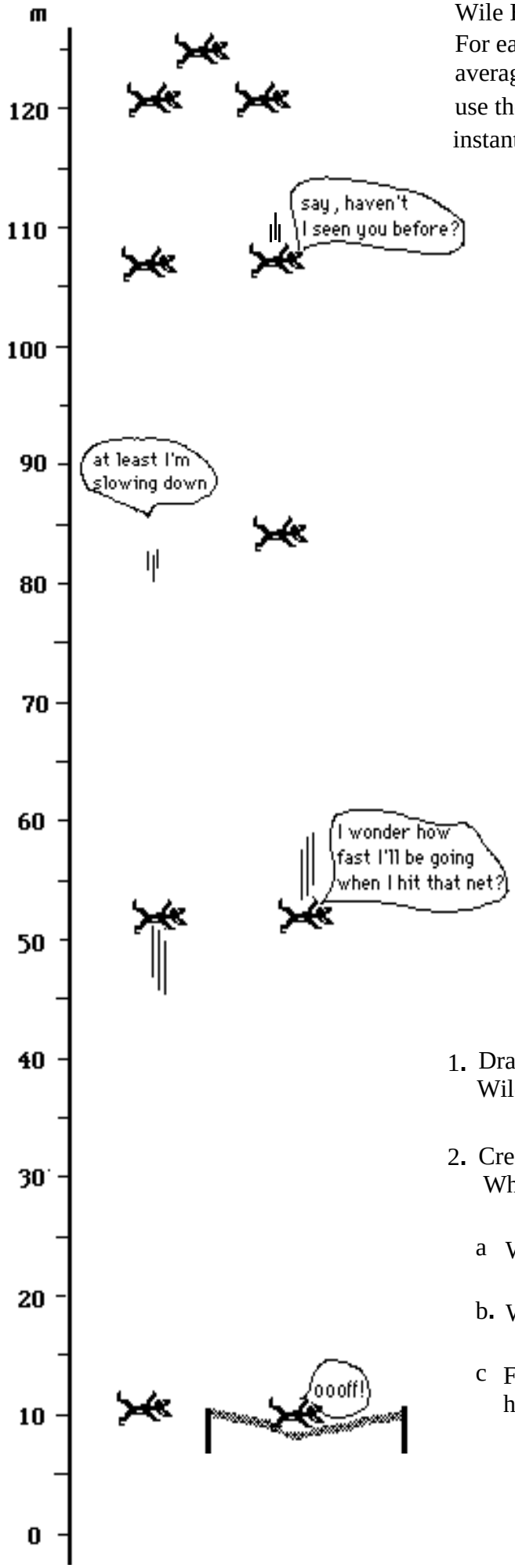
Free Fall with $v_0 \neq 0$

5. A body is thrown downward with an initial speed of 20 m/s on Earth. What is the:
   a. acceleration of the object
   b. displacement after 4 s
   c. time required to reach a speed of 50 m/s
   d. time required to fall 300 m (Hint: factor the quadratic)
   e. speed after falling 100 m

6. A student throws his worthless lab partner off a 120 m high bridge with an initial downward speed of 10 m/s
   a. How long does it take the deadbeat to hit the ground below?
   b. How fast is he going at the moment of impact?

7. When a kid *drops* a rock off the edge of a cliff, it takes 4.0 s to reach the ground below. When he *throws* the rock down, it strikes the ground in 3.0 s. What initial speed did he give the rock?

Wile E. Coyote Shot from a Cannon on Earth



Wile E. is shot upward from a cannon with V_i = 50m/s. For each second, determine the displacement and the average velocity over the interval to that point. Then, use the derivation below to help you calculate the instantaneous velocity, V_f, at each second.

$$\bar{v} = \frac{v_i + v_f}{2}$$

$$2\bar{v} = v_i + v_f$$

$$2\bar{v} - v_i = v_f$$

T (s)	Y (m)	$\bar{V}$ (m/s)	V_f (m/s)
0	0	xxxx	50
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

1. Draw velocity and acceleration vectors on each picture of Wile E.

2. Create a Velocity vs. Time graph for Wile E's flight. Which velocity do you use? Explain.

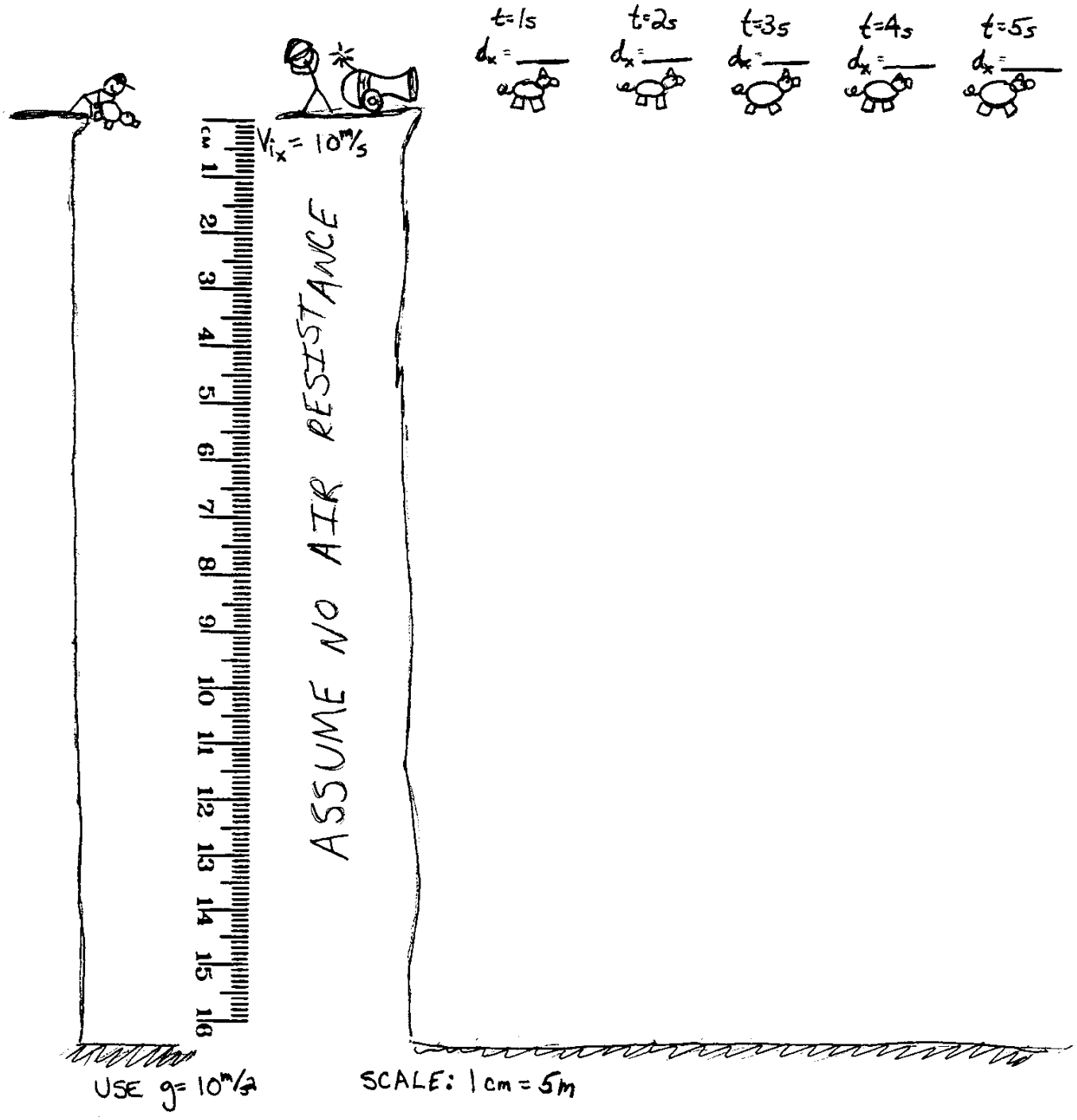
   a What is Wile E's velocity at 5

   b. What is his acceleration at 5

   c From the graph, determine his displacement for each half of the trip

Physics
Pig Cannon Part I

Name:_____
1 2 3 4 5 6 7 8

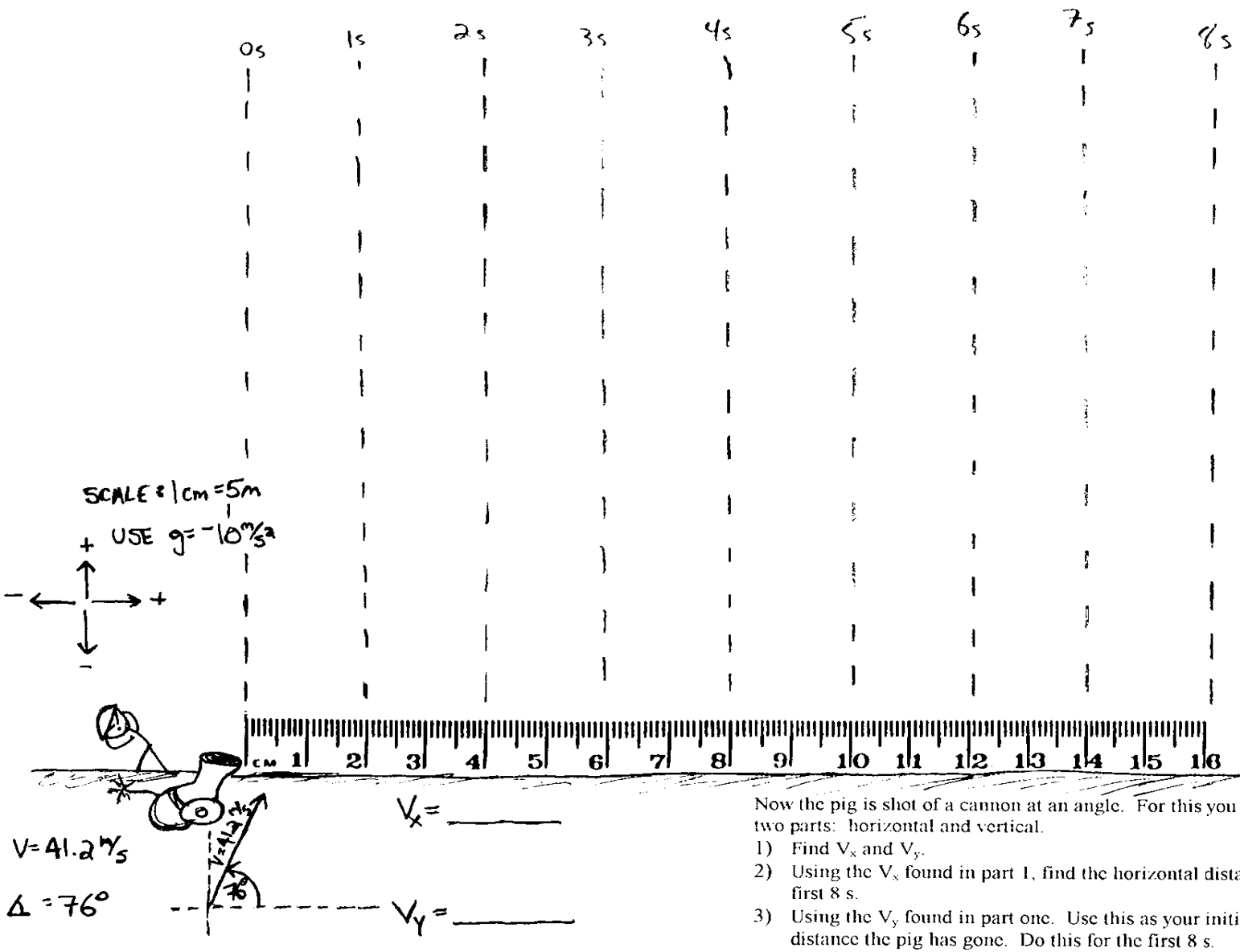


1) Above left: A pig is dropped from a cliff. Calculate and draw the position it has fallen at 1 s intervals. Do this until the pig has safely hit the ground and use the scale provided.

2) Above right: Now the pig is shot horizontally out of a cannon. The pictures shown are if gravity was not acting on the pig. First, calculate the horizontal distance the pig will travel if it is launched with an initial V_x = 10 m/s. Second, if gravity is turned back on, calculate and draw the position it has fallen for each picture. Redraw the pig at this position, then connect the pigs with a smooth curve to show the true path of flight.

No pigs were injured in the making of this worksheet.

Pig Cannon Part II



Now the pig is shot of a cannon at an angle. For this you must break the motion of the pig into two parts: horizontal and vertical.

1) Find V_x and V_y.
2) Using the V_x found in part 1, find the horizontal distance the pig has gone. Do this for the first 8 s.
3) Using the V_y found in part one. Use this as your initial velocity and calculate the vertical distance the pig has gone. Do this for the first 8 s.
4) Use the rulers and draw the correct positions of the pig at each second.

Horizontal Shooting

Physics

Name _____

1 2 3 4 5 6 7 8

1. A giraffe is wearing leg warmers and rollerblades as he approaches the edge of a cliff. If he rolls off horizontally at 7 m/s, fill in the following table for the giraffe's motion in the next five seconds.

Time	V_x	ΔX	V_y	ΔY
0 sec				
1 sec				
2 sec				
3 sec				
4 sec				
5 sec				

2. A large bear wearing undersized clothing is riding a skateboard. He rolls horizontally off of a cliff and spends 1.67 seconds in the air. If he lands 23 meters from the edge of this cliff, how fast was he initially moving?

3. A small platypus is wearing gold chains and saggy jeans. If he bowls a bowling ball horizontally off a 14m cliff, and notes that the ball lands 20 meters from the base of the cliff, how long did the bowling ball spend in the air?

4. A snooty owl drives his fancy car while texting. If he drives horizontally off a cliff at 34 meters per second, and lands 15 meters from the base, how tall was the cliff that he drove off of?

5. A hipster hippo rides his vintage bike toward a cliff. If he wants to land in a record store that is 75 meters from the bottom of a 100 meter tall cliff, how fast should he ride horizontally off the cliff?

6. A turtle riding a tank is driving toward a horizontal cliff at 12 m/s. How high should the cliff be if the turtle wants to spend 10 seconds in the air?

Dart Gun Lab Name _____

Physics: 2D Motion

In this lab, we will use physics and dart guns to hit a target in the atrium.
You will need a protractor, a dart gun with a dart, a meter stick, and a timing device.

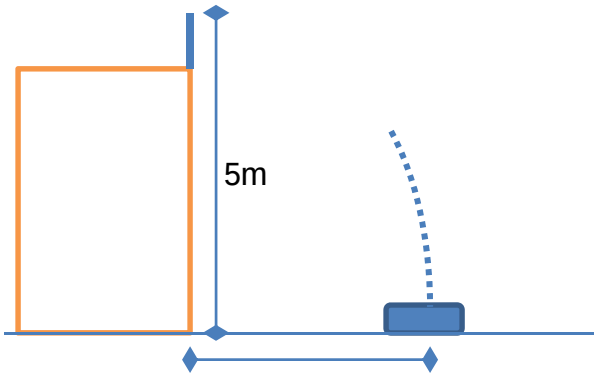
Part I: In the classroom

You will have to calculate the speed that the gun fires in the classroom. You must do this in an accurate way, because any mistakes here will cause you to miss your target in the atrium. In the space below, calculate the launching speed of the dart gun in two different ways.

Launch Speed	Launch Speed

Part II: Calculate it

Now given your launching speed of the dart gun, you must calculate the location of your target in the atrium. Your target will be a bucket given to you. Use the picture and the space below to calculate the location of the bucket. Make sure to determine your launching angle.



Part III: Test it

Test your launcher in the atrium. You will record the results of your first shot only. Put this in the box below.

Now, if you did not hit your bucket, change the location of your bucket so that you do hit it.
Percent difference is ((actual-expected)/expected)x100

Dart Location	Calculated Location	Percent Difference

On the back of this paper, justify your percent error. You need to indicate why your shot was too short or long.

Worksheet 9: 2D Graphing

Physics: 2D Motion

Name _____

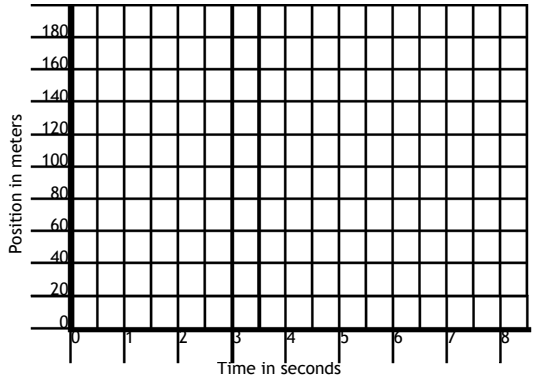
1 2 3 4 5 6 7 8

1. A Bowling ball named Justin is rolled horizontally off of a cliff at 6 m/s. On the following table, fill in the missing information for the next 6 seconds.

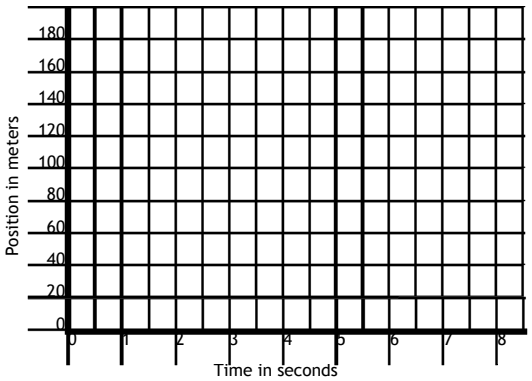
Time	V_x	ΔX	V_y	ΔY
0 sec				
1 sec				
2 sec				
3 sec				
4 sec				
5 sec				
6 sec				

2. Now, with your information from above, create a **Position** vs time graph for both the x and the y direction.

X-Position Graph

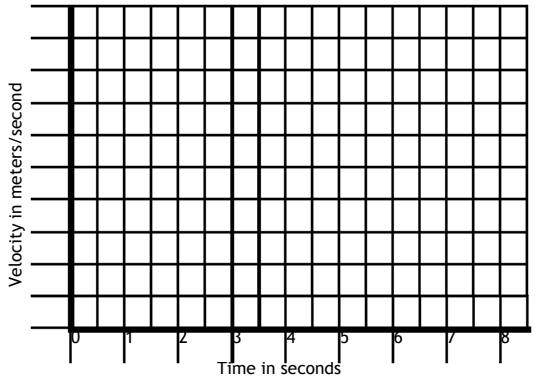


Y-Position Graph

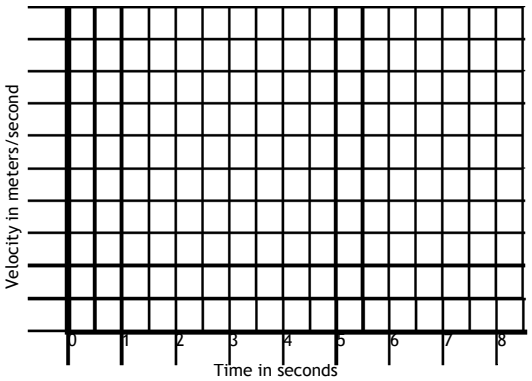


2. Now, with your information from above, create a **Velocity** vs time graph for both the x and the y direction.

X-Velocity Graph



Y-Velocity Graph

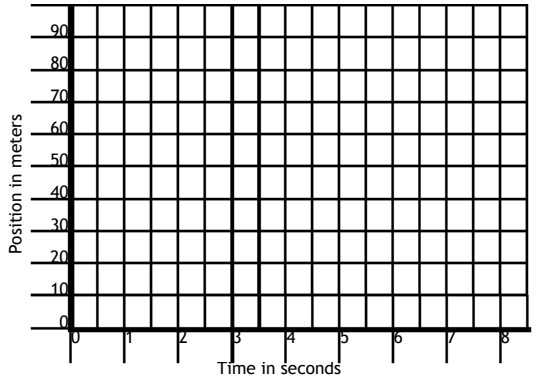


1. A Bowling ball named Justin is rolled launched from ground level at 6m/s at 30 degrees. On the following table, fill in the missing information for the next 6 seconds.

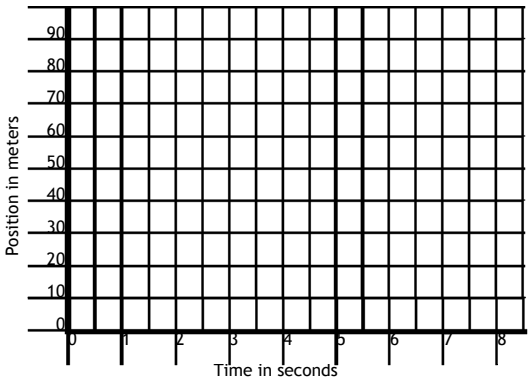
Time	V_x	ΔX	V_y	ΔY
0 sec				
1 sec				
2 sec				
3 sec				
4 sec				
5 sec				
6 sec				

2. Now, with your information from above, create a **Position** vs time graph for both the x and the y direction.

X-Position Graph

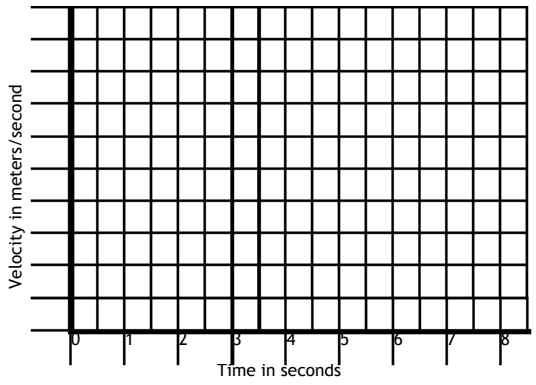


Y-Position Graph



2. Now, with your information from above, create a **Velocity** vs time graph for both the x and the y direction.

X-Velocity Graph



Y-Velocity Graph