Happy Lost and Found Day!

- Park your phones

- Start the warm up

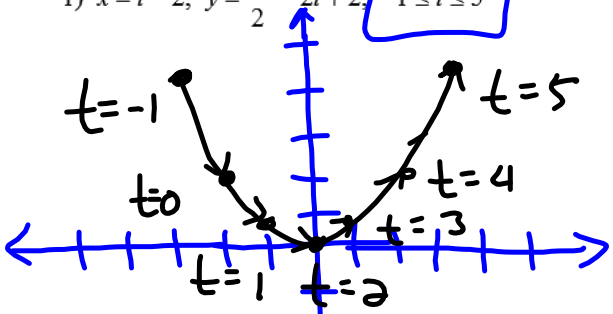
(on circle table)

Honors Pre-Calculus Name_____

Parametric Warmup

Create a table using the given parameter to help you sketch the curve. Then, eliminate the parameter and write a rectangular equation for the curve.

1) $x = t - 2,\ y = \frac{t^2}{2} - 2t + 2,\ -1 \le t \le 5$



t	x	y
-1	-3	4.5
0	-2	2
1	-1	0.5
2	0	0
3	1	0.5
4	2	2
5	3	4.5

Eliminate Parameter

$x = t - 2$

$t = x + 2$

Substitution

$y = \frac{(x+2)^2}{2} - 2(x+2) + 2$

$y = \frac{1}{2}x^2$

Write the rectangular equation as a set of parametric equations. Give two different parameterizations.

2) $y = 3x^2 + 2x + 1$

$\begin{cases} x = t \\ y = 3t^2 + 2t + 1 \end{cases}$

$\begin{cases} x = t + 4 \\ y = 3(t+4)^2 + 2(t+4) + 1 \end{cases}$

Crashing Planes .....or do they? **name**_____

1. At time t (in hours), one airplane is located at $x = 20t$ *and* $y = 10t + 35$, where x and y are measured in miles. Another airplane is flying at the same altitude and its position is $x = 25t$ and $y = 20t + 5$.

Eliminate the parameter for airplane 1:

Eliminate the parameter for airplane 2:

Find the intersection of the planes paths:

Do the planes crash?

2. At time t (in hours), one airplane is located at $x = 10t + 30$ *and* $y = 40t - 15$, where x and y are measured in miles. Another airplane is flying at the same altitude and its position is $x = 20t$ and $y = 30t + 15$. $t =$

Eliminate the parameter for airplane 1:

Eliminate the parameter for airplane 2:

Find the intersection of the planes paths:

Do the planes crash?

* 2 Decimal Accuracy

Projectile Motion and Parametric Equations

In calculus, a model for projectile motion with no friction is considered, and a "parabolic trajectory" is obtained. If the initial velocity is v_0 and θ is the initial angle to the horizontal, then the parametric equations for the horizontal and vertical components are:

$x(t) = v_0 \cos(\theta) t$ horizontal

$y(t) = -\frac{1}{2} g t^2 + v_o \sin(\theta)\, t + h$ Vertical ← starting height

$gravity\ (g) = 32 \frac{ft}{sec^2}$ or $9.8 \frac{m}{sec^2}$

Example 1: Cam Newton is looking to hit his wide receiver. We know the ball leaves his hand from a 38^o angle at 22 m/sec from a height of 1.9 meters above the ground.

Write a set of parametric equations to model this motion:

time parameter

$g = 9.8$

$X = 22 \cdot \cos(38^\circ) \cdot t$

$Y = \left(-\frac{1}{2}\right)(9.8)t^2 + 22 \cdot \sin(38^\circ)\, t + 1.9$

a) How high is the ball after 1.5 seconds?

Vertical, $y =$

$y = \left(\frac{1}{2}\right)(9.8)(1.5)^2 + 22 \sin(38^\circ)(1.5) + 1.9$

$y = 11.19$ meters.

b) How far away is the ball after 2.75 seconds?

horizontal, $x =$

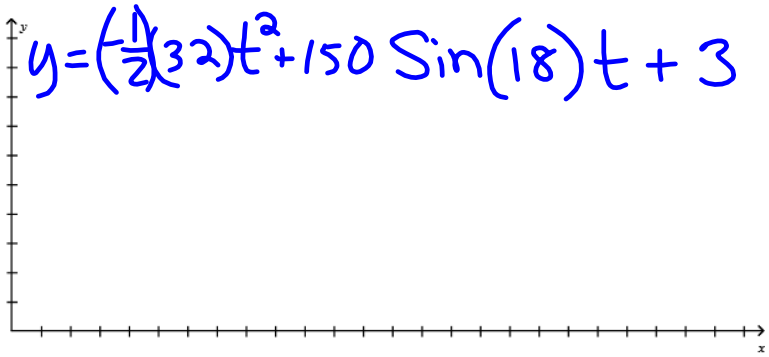
$x = 22 \cdot \cos(38)(2.75)$

$X = 47.67$ meters

Example 2: Hoping for a homerun, Chris hits a baseball at 3-ft above the ground with an initial velocity of 150 ft/sec at an angle of 18° with the horizontal.

$x = 150\cos(18)t$

$y = \left(-\frac{1}{2}\right)(32)t^2 + 150\sin(18)t + 3$



t $\quad x = 225$

After how many seconds will the ball be 225 feet away from home plate?

$225 = 150\cos(18)\cdot t$

$\frac{225}{150\cos(18)} = \frac{150\cos(18)}{150\cos(18)}t$

$t = 1.58$ sec

When will the ball finally hit the ground?

$0 = \left(-\frac{1}{2}\right)(32)t^2 + 150\sin(18)t + 3$

Graph

$t = 2.96$ sec.

Since Chris was hoping for a homerun, how do we know whether the ball will clear a 20-ft wall that is 400 ft away?

horizontal $x = 400$ vertical $y = 20$

(400, 20)

1. Hayden kicks for points in a rugby game. He place-kicks the ball with an initial speed of 63 ft/sec at an angle of 46° with the horizontal.

Write a set of parametric equations for the path of the football.

x = _____ y = _____

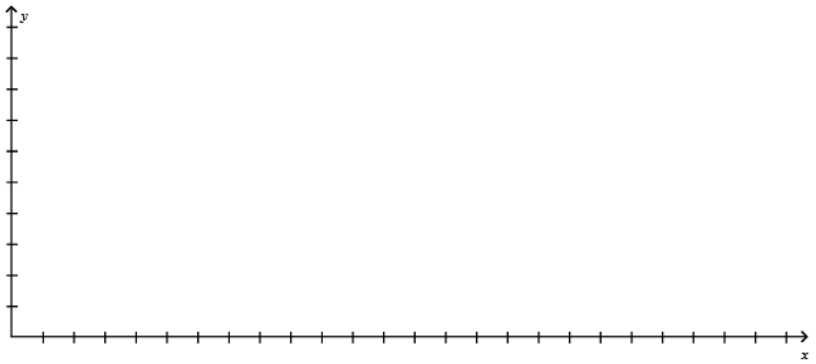
a. How long will it take before the ball hits the ground?

b. After 1.4 seconds, how far away has the ball traveled?

c. After 1.4 seconds, how high is the ball?

d. If the ball heads directly towards the 10-ft high crossbar that is 116 ft from Hayden, will the ball clear the crossbar? How do you know?

<u>Sketch</u> the graph: Make note of the y-int, x-int, and maximum!



2. The center-field fence in a ballpark is 10 feet high and 400 feet from home plate. The baseball is hit 3 feet above the ground. It leaves the bat at an angle θ degrees with the horizontal at a speed of 145 ft/sec

Write a set of parametric equations for the path of the football.

x = _____ y = _____

If he hits the ball at an angle of 18°,

a) After 1 second, how far has the ball traveled away from home plate?

b) After 1.3 seconds, how high is the ball?

c) What is the maximum height the ball reaches and how long after contact does the ball reach this height?

d) Will he hit a homerun?

e) If he hits the ball at an angle of 23°, will he hit a homerun?

f) Find the minimum angle required for the hit to be a homerun. (I'm ok if you guess and check!)

3. The quarterback of a football team releases the ball from a height of 7 feet above the playing field. The pass is released at an angle of 35° with the horizontal at a speed of 55 ft/sec.

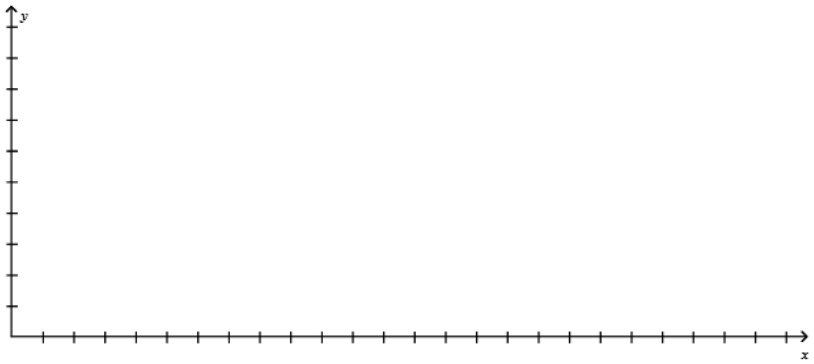
Write a set of parametric equations for the path of the football.

x = _____ y = _____

a) Find the height of the ball after 1.7 seconds.

b) Assuming the receiver misses the pass, how many **yards** down field did the ball travel?

c) Use your calculator to graph the path of the football, label the x-intercept, y-intercept, and approximate its maximum height.



d) If the receiver can catch a pass between 3ft and 7ft off the ground, how far will he need to run down field to make the catch?

e) How many seconds does the receiver have to run that distance assuming the quarterback throws the pass immediately?

4. A baseball player hits a line drive to the outfield. The ball leaves his bat at 30 m/sec at an angle of 25° from a height of 1.1 meters. Write a set of parametric equations.

a) How much time would it take before the ball is 56 meters away from home plate?

try solving this algebraically

b) How high is the ball after 1.4 seconds?

c) How long does it take for the ball to hit the ground?