Honors Advanced Math Name:_____
2D and 3D Parametric Problems 29 April 2010

Directions: Each of the following problems involves parametric equations in two or three dimensions. Some of them involve two things moving in different directions at the same time. It might help to draw the situations for the three perspectives of the *xy*-plane, the *yz*-plane, and the *xz*-plane.

1. A stuntman jumps off a building. The equation describing his motion is $< 3,\ \frac{1}{2}t,\ -4.9t^2 + t + 6 >$.

a) Where should the crash mat be placed for him to land safely?

b) He practices the jump so he will be ready to jump off the building into the back of a truck full of trash. The equation for the truck's motion is $< 3t,\ 4.5 - 4t,\ 2 + 0.2t >$. Will he land in the back of the truck? If so, at what time *t*?

2. A baseball is hit into left field. Set up the coordinates so that home plate is the origin, first base is on the positive *y*-axis and third base is on the negative *x*-axis. The equation of the baseball's motion is $< -30t,\ -5t^2 + 60t,\ -16t^2 + 100t + 4 >$. The left fielder runs from (-180, 45, 0) parallel to the third base line at a speed of 20 feet per second. Will he catch the ball? If so, at what time *t*?

3. **a)** You are given the equation $v(t) = \langle \cos(t),\ \sin(t),\ t \rangle$

i. What is the shape of the curve? Can you think of anything natural that looks like this?

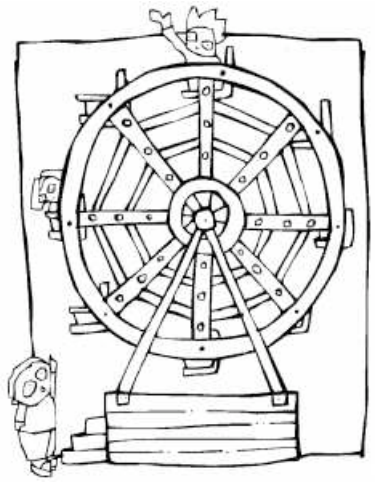
ii. Make it go twice as fast.

b) You are given the equation $v(t) = \langle \frac{t}{2}\cos(t),\ \frac{t}{2}\sin(t),\ t \rangle$

i. What is the shape of the curve? Can you think of anything natural that looks like this?

ii. What is the equation of motion that is 2 seconds behind this one?

4. Matt is on a Ferris wheel of radius 35 ft that turns counterclockwise at the rate of one revolution every 12 seconds. The lowest point of the Ferris wheel (6 o'clock) is 15 feet above ground level at the point (0, 15) on a rectangular coordinate system. (You may use the plane of the Ferris wheel as the *xy*-plane.) Find parametric equations for Matt's position as a function of time *t* (in seconds) if the Ferris wheel starts (*t* = 0) with Matt at (35, 50).



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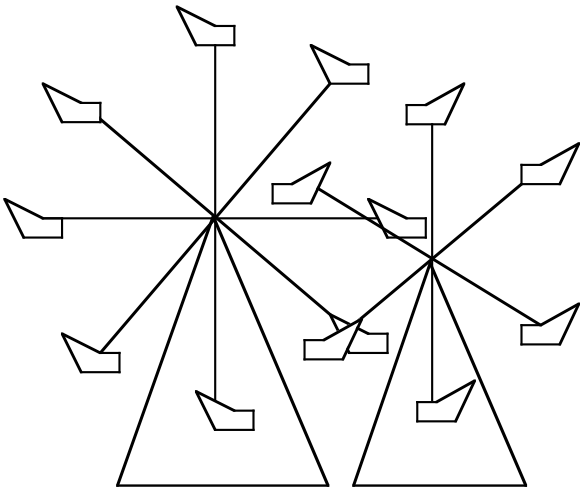
5. A 71-ft radius Ferris wheel turns clockwise one revolution every 20 seconds. Max stands at a point 90 ft to the left of the base of the wheel (stay in the plane of the wheel). At the instant Ben is at the 9 o'clock position, Max throws a ball toward the Ferris wheel with an initial velocity of 88 ft/sec at an angle with the horizontal of 100°. Find the minimum distance between the ball and Ben. Could Ben catch the ball?

6. Olivia and Emma are on a ride that is like two Ferris wheels turning towards each other. Olivia is on a wheel of center (0, 20) and radius 20 ft turning clockwise at the rate of one revolution every 12 seconds. Emma is on another wheel of center (15, 15) and radius 15 ft turning counterclockwise at the rate of one revolution ever 8 seconds.

a) Find the minimum distance between Olivia and Emma if both start out ($t = 0$) at the 3 o'clock position.

b) Find the minimum distance between Olivia and Emma if Olivia starts out at 3 o'clock and Emma is at the 6 o'clock position.



7. Carlo and Russell are on two Ferris wheels that are next to each other. Carlo is on a Ferris wheel of center (0, 20, 0) and radius 20 ft turning counterclockwise at the rate of one revolution every 12 seconds. Russell is on another Ferris wheel of center (15, 15, 25) and radius 15 ft turning counterclockwise at the rate of one revolution ever 8 seconds. If both boys start at the 3 o'clock position, what is the closest and farthest they get from each other?