



Part 1 – Parametric equations – Kinematics

Press play on page 1.2 and observe the motion of the two points.

1. Describe the motion. Do the two points start out at the same location? Which point is furthest from the origin when the time is 10? If this was a race, is there ever a time between 0 and 10 that team diamond and team square are neck and neck? If so, how many times? If you knew the equation for $x(t)$, how could you find out when and where they were at the same location?

2. a. When the time is 3.5, which point is moving faster?

- b. When the time is 8, which point is moving faster?

3. The parametric equations are defined as follows:

$$\mathbf{x1}(t) = 0.05t^3 - 0.2t^2 - 0.5t - 5 \quad \text{and} \quad \mathbf{x2}(t) = t - 7\sin(t)$$

Which equation models the movement of the square and which models the diamond? Find the velocity of each at $t = 3.5$ and $t = 8$. Show your work. You may use the Scratchpad (press =) or press ctrl 0) to get a decimal approximation. Give your answers to three decimal places.

4. Find the acceleration for both objects at $t = 3.5$ and $t = 8$.

5. Using calculus terms, explain what the sign of the answers in Exercises 3 and 4 implies for the motion.



Part 2 – Parametric Equations – Slope

Rotate the open dot on the circle to investigate the graph on page 2.2.

6. What 'times' (or angle measures) does the graph form a cusp? What is the derivative at a cusp?
7. What are the x- and y-coordinates where the slope is zero?
8. Using calculus, how would you find where the slope is zero?
9. Use calculus to find when $\frac{dy}{dx} = 1$. Show your work.

Part 3 – Homework/Extension

On page 3.2, try to graph a set of parametric equations that match the scatter plot.

Select **MENU > Graph Type > Parametric** to change the graph style to parametric. The values of t are between 0 and 9.

If you create your own new graph, use calculus to find the horizontal and vertical tangent.

Write your parametric equations and show some work to demonstrate understanding of slopes of parametric equations.