1. You are given three points on a parabola. Find an equation for the parabola in two ways, using matrices and using regression. Do you get the same answer? Could you use difference columns to do the problem? If so, do it the third way, if not, say why.
   a) $(2, -1), (5, 34), (6, 58)$
   b) $(-1, 5), (4, 5), (9, 55)$
   c) $(2, -1), (1, -3), (3, 9)$
2. For each equation you found in the previous problem, rewrite your answer in the standard form that shows the vertex and axis of symmetry.
3. You are given three points that are believed to lie on a circle. Use matrices to determine an equation of the circle. Then rewrite the equation in standard form and give the radius and center of the circle. Can you use the matrix method to find a circle through each set of points? If not, explain why?
   a) $(8, 14), (-10, 2), (3, 15)$
   b) $(2, 7), (3, 0), (-1, 8)$
   c) $(-11, -1), (10, -22), (6, -10 + 10\sqrt{2})$
   d) $(3, -2), (-1, -22), (4, 3)$
4. A woodworker traced a circle on a square piece of wood and wishes to use a lathe to cut out the circle. In order to use the lathe, she must locate the center of the circle. To do this, she locates three points on the circle as indicated in the chart below:

Distance From Left Side	Distance From Bottom
10 mm	42 mm
60 mm	69 mm
50 mm	26 mm

   a) Use the matrix method to locate the center of the circle.
   b) On a sheet of paper, measure and mark the three points as indicated in the chart. Use geometry to construct the circle through the three points. Measure the location of the center of the constructed circle and check that it fits your answer to part a).
   c) If you were the woodworker, which method would you use to locate the center, the matrix method or geometry?
5. How many points on the graph of a polynomial of degree n are needed to determine the coefficients for the polynomial? Explain.
6. A curve is defined parametrically by $x = 5t + 8$ and $y = t^2 + 3t - 1$.
   a) Plot the given parametric equation. (Scale and label the axes.)
   b) What range of t values does it take to generate the entire figure exactly once? Support your answer and write it in precise interval notation.

c) Find an equation involving only x and y that gives the same graph. Simplify your answer and put it in a standard form if possible.

d) What is the name of the graph?

7. A curve is defined parametrically by $x = 2 + 4\cos(\pi t)$ and $y = 4 + 3\sin(\pi t)$.

   a) Plot the given parametric equation. (Scale and label the axes.)

   b) What range of t values does it take to generate the entire figure exactly once? Support your answer and write it in precise interval notation.

   c) Find an equation involving only x and y that gives the same graph. Simplify your answer and put it in standard form if possible.

   d) What is the name of the graph?

8. A curve is defined parametrically by $x = 3 + \sec^2(t)$ and $y = 4 + \tan^2(t)$.

   a) Find an equation involving only x and y that the graph lies on. Simplify your answer as much as possible.

   b) What is the name of the graph?

9. An astroid graph is given by $x = 8\cos^3 t$ and $y = 8\sin^3 t$.

   a) Plot the astroid graph.

   b) Convert the parametric equation of the astroid to rectangular form.

10. A baseball was hit at home base from ground level. The ball approximately followed a parabola. From two pictures taken of the ball in flight, it was determined that the ball was 34 feet off the ground when the ball was a horizontal distance of 100 feet from home plate and the ball was 39 feet off the ground when it was a horizontal distance of 150 feet from the plate. Using home plate as the origin, find an equation of the path the ball followed.

11. A formula is needed to model a function with the property that the function has a local maximum at the point $(2, 10)$, a local minimum at the point $(5, 3)$, and between 2 and 5 the function decreases. Furthermore, the function is continuous and the derivative of the function is continuous.

    a) Use a cubic polynomial to model the function.

    b) Use a cosine function to model the function.

    c) Use a function define piecewise with each piece a quadratic to model the function.

12. Recall that an exploration in class asked you to design a roller coaster using a piecewise defined function. For x between 0 and 15, it only had local maxima and minima at the points $(0, 10)$, $(15, 0)$, $(4, 2)$ and $(8, 8)$. Suppose you were trying to find one polynomial (not defined piecewise) to define the roller coaster. What degree polynomial would you try? Explain.