

2.5 – The Chain Rule  
2.6 – Implicit Differentiation  
2.7 – Rates of Change in Science

Be sure to follow [College Algebra formatting guidelines](#) in your work. They're the same for us as they are for College Algebra, except we're "2410" and not "1340," so "2410" in the top left corner of your work, not "1340."

1. Differentiate each of the following with respect to  $x$ .

a. (5 pts)  $f(x) = \sin(x^3)$

b. (5 pts)  $f(x) = \sin^3(x)$

c. (5 pts)  $f(x) = \sin^3(x^3)$

d. (5 pts)  $f(x) = \frac{\sec^5(x)}{\sqrt{x^2 \sin^3(x) + 1}}$

2. Find  $y' = \frac{dy}{dx}$  for the equation  $(x-2)^2 + (y+7)^2 = 25$  in two ways:

a. (5 pts) Solve the equation for  $y$ . Differentiate directly. Assume you're looking at the *bottom* half of the circle.

b. (5 pts) Use implicit differentiation.

c. (5 pts) Find an equation of the tangent line to the circle at the point  $(x_1, y_1) = (-2, -10)$ .

d. (5 pts) Sketch the circle and the tangent line you found, above. Show any and all  $x$ - or  $y$ -intercepts and label them as ordered pairs. No tick-marks. Just the circle and a few key points.

3. Use implicit differentiation to find  $y' = \frac{dy}{dx}$  for the following equations:

a. (5 pts)  $x^2 + 4xy + y^2 = 4$

b. (5 pts)  $xy \sin(xy) + y^2 = 5$

4. (10 pts) The figure shows a lamp located three units to the right of the  $y$ -axis and a shadow created by the elliptical region  $x^2 + 4y^2 \leq 5$ . If the point  $(-5, 0)$  is on the edge of the shadow, how far above the  $x$ -axis is the lamp located? Do the best writeup possible for this exercise.

