Directions

1. Use the definition of the derivative to compute $f'(x)$
2. Compute the given limits
3. Determine if the given function is continuous at the given point
4. Compute the derivative of the given functions using any rules you know
5. Solve for $\frac{dy}{dx}$
6. Solve the problem given the information
7. Find the indicated quantity
8. Use what you know about derivatives to graph the given function
9. Create your own derivative problem that requires the given rule(s) and solve it
Group 1

1. \( f(x) = x^2 + 3x + 4 \)

2. \( \lim_{x \to 9} \sqrt[3]{x - 3} \), \( \lim_{x \to \infty} \frac{x^{1/3} - 2\sqrt{x}}{4x^{1/6} + 3x^{1/3}} \)

3. \( f(x) = \frac{(x + 2)(x - 1)}{x + 3}, \quad x = 0 \)

4. \( f(x) = \frac{\cos(e^x)}{x^3 + 1}, \quad g(x) = \sec(e^{2x}) \)

5. \( xy = \sin(x^2) - y^2 \)

6. Suppose a truck and a prius leave the same city at the same time. The truck drives due North at 55 mph and the prius drives due West at 70 mph. How fast is the distance between the truck and the prius changing when the truck is 5 miles from the city and the prius is 12 miles from the city?

7. If a rectangle has perimeter of 16 meters, what is the largest area it can have?

8. \( y = x^3 - 3x \)

9. Product and Quotient

Group 2

1. \( f(x) = 3x + 14 \)

2. \( \lim_{x \to \infty} \frac{3x^2 + 2x - 5}{1 - x^2 + 4x}, \quad \lim_{x \to \infty} \frac{\sqrt{x^6 + x^2}}{3x^3 - x} \)

3. \( f(x) = \frac{x^2}{x + 1}, \quad x = 1 \)

4. \( f(x) = \csc \left( \frac{1}{\sqrt{x} + x} \right), \quad g(x) = \frac{\tan(x^2)}{2x - \sin(3x)} \)

5. \( xy^3 + 2y = \sin(y) \)

6. If the side length of a cube is decreasing at a rate of 4 in/sec, how is the volume changing when the side length is 20 in?

7. Throughout a typical work day the volume of burritos made by the CoHo is modeled by the function \( B(t) = -t^2 + 9t \), where \( t \) is measured in hours and \( B(t) \) is the number of burritos being made at time \( t \). Find the time at which the Coho produces the most burritos.

8. \( y = -2x^2(2x - 3) \)

9. Chain and Quotient
Group 3

1. \(-2x^2 - x + 7\)
2. \(\lim_{x \to -1} \frac{x^4 - x^2}{x + 1}, \lim_{x \to \infty} \frac{\sqrt{4x^2 + 2}}{x + 1}\)
3. \(f(x) = \frac{x^2 + 2x - 15}{x + 5}, x = -5\)
4. \(f(x) = e^{\cos(x)} \cdot \sqrt{3x}, g(x) = 3\sin(\sec(e^x))\)
5. \(y^5 + 4\cos(xy) = x^5\)

6. The pupil of your eye contracts in bright light and dilates in darkness. It also dilates when you are suddenly scared. Assume that your pupil forms a perfect circle. If a lion is chasing you and makes the radius of your pupil expand at a rate of .1 cm/sec, how fast is the area changing when your pupil is 1 cm in diameter?

7. A contractor comes to you to build the bottom floor of a rectangular building. They want the room to have an area of 96ft\(^2\), but they don’t care about the shape of it. In order to save them money, you decide to use the least perimeter possible. Find the dimensions of the building that give the smallest perimeter.

8. \(y = \frac{x^3}{3} - x^2\)

Group 4

1. \(-x^2 - 12x + 5\)
2. \(\lim_{x \to 0} \frac{4x^7 - 8x^2}{5x^3 + 3x^2 - x^4}, \lim_{x \to \infty} \frac{-x^5}{2x^2 - 4x^3 + 5x^5 - 1}\)
3. \(f(x) = \frac{x^2 - 2x - 24}{x - 2}, x = 2\)
4. \(f(x) = \cot\left(\sqrt{x^5 + x}\right) \cdot e^{-9x}, g(x) = (x^2 - \pi x + e^{12x} + x^5)^{11}\)
5. \((x + 4y^2)^2 - 3x^4 = 3y^3\)

6. You decide to fly to Cape Canaveral to watch a rocket launch. The viewing platform is 5 km from the launch point. How fast is the distance between you and the rocket changing when the rocket is at an altitude of 12 km and is travelling at 7.9 km/sec? (Fun fact: 7.9 km/sec is the velocity needed to get to orbit around earth)

7. Cats like boxes. You have a spare 10ft by 10ft piece of cardboard sitting around, so you decide to make an open top box for your pet tiger. To do so, you cut congruent squares from each corner and then fold up the sides. What distance should you cut in from the corners to maximize the volume?

8. \(y = -x^3 + 3x^2\)

9. Chain and Product