

# Math 251

## Final Review

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In addition to the following problems, you should also be prepared to work through Related Rates problems, you should be able to find the Maximum or Minimum values of a function, and you should be able to sketch a derivative given the graph of a function.

1. Evaluate the limit, if it exists.

$$\lim_{x \rightarrow 1} \frac{x^3 - 1}{x^3 - 4x^2 + 3x}$$

2. Evaluate the limit, if it exists.

$$\lim_{s \rightarrow -\infty} \frac{\sin 3s}{\cos 2s}$$

3. Evaluate the limit, if it exists.

$$\lim_{y \rightarrow \frac{4}{3}} \frac{3y - 4}{|3y - 4|}$$

4. Find the equation of the line tangent to the curve  $y = \frac{12x}{x+3} - 12x^3 + 2$  at the point  $(1, -7)$ .

5. Find the equation of the line tangent to the curve  $y = \sin 2x + \cos 3x$  at the point  $(\frac{\pi}{2}, 0)$ .

6. Find the equation of the line tangent to the curve  $x^2 + 4xy + y^2 - 13 = 0$  at the point  $(2, 1)$ .

7. Differentiate  $f(x) = \left(\frac{e^2 x}{2-x}\right)^3$ .

8. Find the derivative of  $y = (x-3)^2 \sin(2x)$ .

9. Find the derivative of  $y = (4x^2 - 3x + 2)(\tan^2 x)$

10. Find the derivative of  $F(x) = \frac{\arctan x}{\sqrt{1-x^2}}$

11. Find  $f''(x)$  if  $f(x) = \sin x - 2x^2 + \ln x$ .

12. Find the derivative of  $f(t) = (\sin t - \cos t)^3 10^t$

13. A particle moves along a straight line. The position of a particle is given by  $s(t) = 3t^2 - 22t + 24$ , where  $s$  is measured in meters and  $t$  is measured in seconds. Find

(a) The velocity at time  $t$   $v(t) =$  \_\_\_\_\_

(b) The acceleration at time  $t$   $a(t) =$  \_\_\_\_\_

(c) The velocity of the particle at 3 seconds \_\_\_\_\_

(d) The time(s) when the particle is not moving \_\_\_\_\_

(e) The position of the object when the acceleration is 0 \_\_\_\_\_

14. Use logarithmic differentiation to find  $\frac{dy}{dx}$  if  $y = x^{\arctan x}$ , then differentiate.