

**Math 105: Review for Exam II**

1. Find  $dy/dx$  for each of the following.

(a)  $y = x^2 + 2^x + e^2 + e^{2x} + \ln 2 + \ln(2x) + (\ln 2)x + \arctan 2$

(b)  $y = \sqrt{x} \cdot \arctan(5x)$

(c)  $y = \ln(\tan(2^{\cos(x^2)}))$

(d)  $y = \frac{x + e^\pi}{\cos 4 + \sin^5(6x)}$

(e)  $y = (x^2 + 1)^{\sin x}$

Hint: use logarithmic differentiation.

2. Consider the curve defined by  $x^3 + y^3 = \frac{9}{2}xy$  (known as the Folium of Descartes).

(a) Find  $dy/dx$ .

(b) Verify that the point  $(1,2)$  is on the curve above.

(c) Find the equation of the tangent line at the point  $(1,2)$ .

3. Evaluate the following limits.

(a)  $\lim_{x \rightarrow 1} \frac{x^3 - 1}{7 - 7x}$

(b)  $\lim_{x \rightarrow 0} \frac{1 - \cos(2x)}{3^x}$

(c)  $\lim_{x \rightarrow 0} \frac{1 - \cos(4x)}{5x^2}$

(d)  $\lim_{x \rightarrow \infty} \frac{x^2}{2^x}$

4. Consider the function  $f(x) = x^4 e^x$  with domain all real numbers.

(a) Find the  $x$ -value(s) of all roots ( $x$ -intercepts) of  $f$ .

(b) Find the  $x$ - and  $y$ -value(s) of all critical points and identify each as a local max, local min, or neither.

(c) Find the  $x$ - and  $y$ -value(s) of all global extrema and identify each as a global max or global min.

(d) Find the  $x$ -value(s) of all inflection points.

(e) Sketch  $f$ .

5. How would your answers to the previous question change if the domain of  $f$  were  $[-10, 10]$ ?

6. Find an antiderivative of  $y = \frac{5}{\sqrt{1-9x^2}} + x^3 + \cos(2x) + e^3$ .

7. You are planning to build a box-shaped aquarium with no top and with two square ends. Your budget is \$288. If the glass for the sides costs \$12 per square foot and the opaque material for the bottom costs \$3 per square foot, what dimensions will maximize the volume? Be sure to show how you know you have found the maximum.