Final Exam, Thursday 19 May 3:30-5:45
Math 205

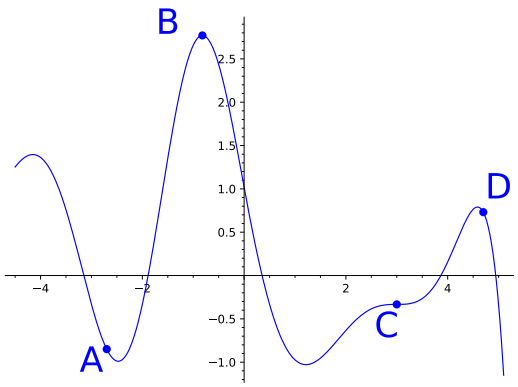
Name: _____ **Instructor:** _____

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	TOTAL

Please leave these boxes blank!

Instructions: Please answer **8 out of 10** of the following questions. Please write **SKIP** at the top of the page of the problems you would like to skip. Read each question carefully, show all work, and check afterwards that you have answered all of each question correctly. **Important: No books, calculators, blank papers or notes are allowed. Turn off cell phones, alarms, and anything else that makes noises.** You must show **all** your work to receive credit. Any crossed out work will be disregarded (even if correct). Write **one** clear answer with a coherent derivation for each question. Good luck!

[1] (20 pts) Below is the graph of a function $y = f(x)$. Fill in the chart with POS, NEG or 0 to indicate whether f, f' and f'' are positive, negative or zero at each of the indicated points A, B, C and D. (One point for each entry in first column and two points for each entry in 2nd and 3rd columns.)



	f	f'	f''
A			
B			
C			
D			

[1] (20 pts)

Please leave blank!

[2] Find the the following limits if they exist.

$$(a)\ \lim_{x\to 0}\frac{\sqrt{5+x}-\sqrt{5}}{x} \qquad\qquad (b)\ \lim_{x\to\infty}\frac{3x^4-4x^3+22x-7}{2x^4-2x^2-2x+22}$$

[2] (20 pts)

Please leave blank!

[3] (20 pts) Compute the derivatives of the functions below. Use the back of the page to continue your work if necessary.

(a) $f(x) = (3x^2 + x + 1)^{20}$, (b) $g(x) = \ln(1 + e^x)$

(c) $h(x) = \dfrac{\sqrt{1+x}}{1-x}$, (d) $j(x) = xe^{x^2}$

[3] (20 pts)

Please leave blank!

[4] (20 pts) Compute the following indefinite integrals. Continue on back if necessary.

$$\text{(a)} \int x^3 e^{x^4}\, dx, \qquad \text{(b)} \int \frac{(3x+4)^2}{x}\, dx$$

[4] (20 pts)

Please leave blank!

[5] (20 pts) Compute each of the integrals below. Simplify your answer as much as possible.

$$\text{(a)} \int_1^2 x^2\sqrt{x^3+1}\,dx, \qquad \text{(b)} \int_2^{10} \frac{x}{3x^2-11}\,dx$$

Continue on back if necessary.

[5] (20 pts)

Please leave blank!

[6] (20 pts) A curve is defined by the equation

$$x^2y - y^2 + 4x + 8 = 0.$$

(a) Use implicit differentiation to find dy/dx.

(b) Compute the slope of the tangent line to the curve at the point $(1, 4)$.

[6] (20 pts)

Please leave blank!

[7] (20 pts) An offshore oil well is leaking oil onto the ocean surface, forming a circular oil slick about 0.005 meter thick. If the radius of the slick is r meters, then the volume of the oil spilled is $0.005\pi r^2$ cubic meters. Suppose the oil is leaking at a constant rate of 20 cubic meters per hour. Find the rate at which the radius of the oil slick is increasing at a time when the radius of the oil slick is 50 meters.

[7] (20 pts)

Please leave blank!

[**8**] **(20 pts)** A certain airline requires that carry-on luggage be such that the sum of the three dimensions is at most 120 centimeters. Use calculus to find the dimension of the square-ended rectangular package of greatest volume that meets this requirement.

[**8**] (20 pts)

Please leave blank!

[9] (20 pts) Find absolute extrema for the function $f(x) = 9x - 3x^2 - x^3$ in the interval $[-4, 2]$.

[9] (20 pts)

Please leave blank!

[10] (20 pts) Use a Riemann sum with 4 subintervals and left endpoints to estimate the integral

$$\int_1^3 9^x \, dx.$$

Express your answer as a rational number in lowest terms.

[10] (20 pts)

Please leave blank!