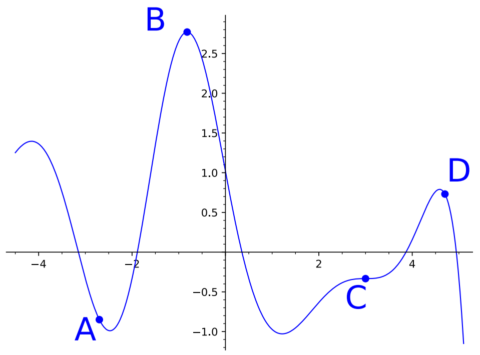
Final Exam Practice Problems

1. 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.



	f	f'	f''
A			
B			
C			
D			

2. Find the following limits if they exist.
   (a) $\displaystyle\lim_{x\to 0} \frac{\sqrt{5+x}-\sqrt{5}}{x}$
   (b) $\displaystyle\lim_{x\to 1} \frac{x^2-1}{1-x^4}$

3. Compute the derivatives of the functions below.
   (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) $j(x) = xe^{x^2}$

4. Compute the following indefinite integrals.
   (a) $\displaystyle\int x^3 e^{x^4}\, dx$
   (b) $\displaystyle\int \frac{(3x+4)^2}{x}\, dx$

5. Compute the following definite integrals.
   (a) $\displaystyle\int_1^2 x^2\sqrt{x^3+1}\, dx$
   (b) $\displaystyle\int_2^{10} \frac{x}{3x^2-11}\, dx$

6. An offshore oil well is leaking oil onto the ocean surface, forming a circular oil slick about 0.005 meters 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. Let
$$f(x) = 3 - \frac{2}{1+x}.$$
Use the definition of the derivative as a limit to find $f'(3)$.

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8. A bacteria culture starts with 500 bacteria and grows at a rate proportional to its size. After 3 hours there are 8000 bacteria.
   (a) Find an expression for the population after t hours.
   (b) After how many hours will the population reach 100,000?

9. A curve is defined by the equation
$$x^2 - y^2 + 4x + 8 = 0.$$
   Give an equation for the tangent line to the curve at the point $(1, 4)$.

10. Find the absolute maximum and minimum value for the function $f(x) = 9x - 3x^2 - x^3$ on the interval $[-4, 2]$.

11. Use a Riemann sum with 4 subintervals and left endpoints (L_4) to estimate the integral
$$\int_1^3 9^x \, dx.$$

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