

Name (print): \_\_\_\_\_

Signature: \_\_\_\_\_

Z-number: \_\_\_\_\_

Section: \_\_\_\_\_

**Show all work for credit!**  
**NO calculators are allowed to be used**  
**in conjunction with this exam.**

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1. [20 pts.] Find the derivative of each of the following functions. **(Do not simplify)**.

(a)  $f(x) = (x^3 + 3x^2 + 2)^{10} + \ln(1 - 5x) + e^{x+3}$

(b)  $f(x) = \left(\sqrt{x} + \frac{2}{\sqrt{x}}\right)^2 e^{(5x^2+2)}$

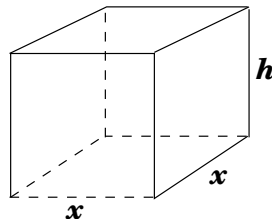
(c)  $f(x) = \left(3x^3 + 5x + \frac{2}{x}\right)^3 (x^2 + 2)^{10}$

(d)  $f(x) = \ln \left[ \left( \frac{x^2 + 2}{x^2 - 2} \right)^3 \right]$

2. [20 pts]. Find the equation of the tangent line to the curve

$$y = x^2e^x \text{ at } x = 1.$$

3. [20 pts.] A soup company is constructing a closed top, squared-based metal tank that will have volume 125 cubic ft. What dimensions will yield minimum surface area.



4. [15 pts.] Find the following limits (if exists):

$$(a) \lim_{x \rightarrow -2} \frac{(x^2 - 4)}{(x^2 + 5x + 6)}$$

$$(b) \lim_{x \rightarrow 1} \left( 3x^2 + e^x + 1 + \frac{2}{x} \right)^2$$

$$(c) \lim_{x \rightarrow \infty} \frac{6x^3 + 2x^2 + 3}{-2x^3 + 3x + 1}$$

5. [20 pts.] Using the limit definition of the derivative of a function, find  $f'(x)$  where

$$f(x) = \frac{1}{1-x}.$$

6. [25 pts.] Let  $f(x) = x^3 + 6x^2 + 9x + 1$

(a) Determine  $f'(x)$  and  $f''(x)$

(b) Find the critical point(s) of  $f(x)$ .

(c) Find the relative extrema of  $f(x)$ . Justify your answer.

(d) Find the inflection points. Justify your answer.

(e) Using the results of 5(a)-5(d), sketch the graph of  $f(x)$ .

7. [10 pts.] Evaluate the following integrals

(a)  $\int_1^3 \left( e^{2x} - \frac{2}{x} \right)$

(b)  $\int_1^3 (2x^2 + 3x + 2) dx$

8. [20 pts.] The power supply of a satellite is a radio-isotope. The power output  $P$ , in watts, decreases at a rate proportional to the amount present;  $P$  is given by  $P(t) = 100e^{-.002t}$  where  $t$  is in days.

(a) Find the decay-rate,  $k$ , for the radio-isotope.

(b) How much power is available after 500 days?

(c) What is the half-life of the power supply?

9. [15 pts.] Compute the following integrals:

(a)  $\int \left( \frac{2}{x^3} - 5x^2 + \frac{2}{x} + e^{-2x} + 2 \right) dx$

(b)  $\int x e^{5x^2+3} dx$

(c)  $\int (x+1)^5 dx$

10. [20 pts.] Find the area bounded by the curves  $y = x^2 + 2x - 2$  and  $y = x + 4$ .

**(Make a rough sketch of the graphs of the curves).**

11. [15 pts.] If  $f'(x) = \sqrt{x} + 1$  and  $f(4) = 0$ , find  $f(x)$ .