Name: _____

Math 1121 Exam #2

No calculators! Show all your work for everything.

Question 1. (5 points each) The zombie pandemic is spreading! On day t, the number of infected zombies is given by this formula:

$$i(t) = 40 \cdot 3^{0.2t}$$

(Yes this is a spooktacular Halloween-themed question!) For each part, you may not be able to simplify the numbers in your answer.

a) How many zombies are infected on day 5?

$i(5) = 40 \cdot 3^{.2 \cdot 5} = 40 \cdot 3^1 = 120$

b) On which day will there be 80 zombies infected?

$80 = 40 \cdot 3^{.2 \cdot t}$

$2 = 3^{.2t}$

$\ln 2 = \ln 3^{.2t}$

$\ln 2 = .2t \ln 3$

$\boxed{t = \frac{\ln 2}{.2 \ln 3}}$

c) Find $i'(t)$.

$40 \cdot 3^{0.2t} \ln 3 \cdot 0.2$

Question 2. (7 points) Please find any x-values where the slope is horizontal for $f(x) = x^2 - 4x + 3$.

$f'(x) = 2x - 4$

$2x - 4 = 0$

$2x = 4$

$\boxed{x = 2}$

Question 3. (8 points each) In each part, please find the derivative:

a) $\ln((x^2+1)\sqrt{x})$

$$\frac{1}{(x^2+1)\sqrt{x}} \cdot \left((x^2+1) \cdot \frac{1}{2} x^{-1/2} + \sqrt{x} \cdot 2x \right)$$

b) $x^4 - 2x^3 + 10^x + \sqrt{x}$

$$4x^3 - 6x^2 + 10^x \ln 10 + \frac{1}{2} x^{-1/2}$$

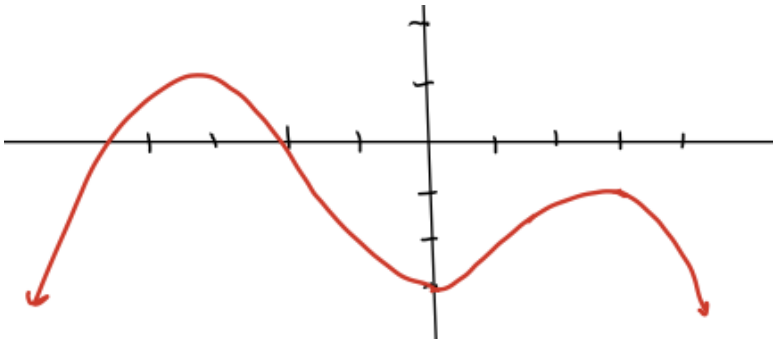
c) $\frac{x^2 - 5x^4}{xe^x}$

$$\frac{xe^x(2x - 20x^3) - (x^2 - 5x^4)(xe^x + e^x \cdot 1)}{(xe^x)^2}$$

d) $(4x+5)(x^2+x)$

$$(4x+5)(2x+1) + (x^2+x)(4)$$

Question 4. (5 points each)



For this question, $f(x)$ is the picture above.

a) Please give the x-values for any relative extrema, and say for each one if it is a maximum or minimum.

$x = -3$ & $x = 3$ are rel. max

$x = 0$ is rel. min

b) Please give intervals where $f(x)$ is increasing and decreasing.

increasing on $(-\infty, -3)$ & $(0, 3)$

decreasing on $(-3, 0)$ & $(3, \infty)$

Question 5. (12 points) Please find the x-values for any relative extrema, and say for each one if it is a maximum or minimum for this function:

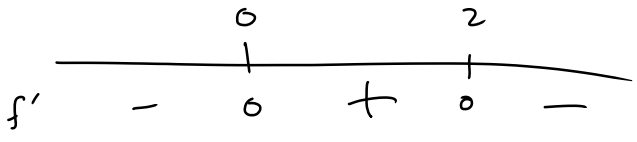
$$f(x) = 3x^2 - x^3 + 5$$

$f'(x) = 6x - 3x^2$

$f'(x) = 3x(2-x)$

$f' = 0$: $3x = 0$ $\quad 2 - x = 0$

$x = 0$ $\quad x = 2$



$f'(-1) = 3(-1)(2 - -1)$

$+ \quad - \quad +$

$f'(1) = 3(1)(2-1)$

$+ \quad + \quad +$

$f'(3) = 3(3)(2-3)$

$+ \quad + \quad -$

$x = 0$ is a rel min

$x = 2$ is a rel max

Question 6. (3 points each) In each part, give the value of the logarithm. One of these parts is impossible to do by hand— for that one, just say that it's impossible. For the ones you can answer, give some very brief explanation for why your answer is correct.

a) $\log_2 8$ $= 3$ since $2^3 = 8$

b) $\log 1000$ $= 3$ since $10^3 = 1000$

c) $\log_5 10$ impossible by hand, since nothing fits in $5^? = 10$ nicely

d) $\log_3 \frac{1}{9}$ $= -2$ since $3^{-2} = \frac{1}{9}$

Question 7. (12 points) Please give intervals where this function is increasing and decreasing:

$$f(x) = (4x+2)e^{2x-1}$$

$f'(x) = (4x+2)e^{2x-1} \cdot 2 + e^{2x-1} \cdot 4$

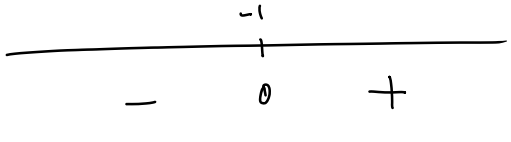
$= e^{2x-1}\left((4x+2)\cdot 2 + 4\right)$

$= e^{2x-1}(8x+4+4)$

$= e^{2x-1}(8x+8)$

$f' = 0$: $e^{2x-1} = 0$ (no solution) $\quad 8x+8=0$

$\boxed{x=-1}$



$f'(-2) = e^{2\cdot -2-1}(8\cdot -2+8)$

$+ \quad -$

$f'(0) = e^{2\cdot 0-1}(8\cdot 0+8)$

$+ \quad +$

increasing: $(-1, \infty)$

decreasing: $(-\infty, -1)$