

Instructions: Do not simplify unless indicated. Give units for all real-world problems. Any problem with the code (E,2) requires an exact answer and an approximation to two decimal digits. The code (E,4) means an exact answer and an approximation to four decimal digits. Any problem with no code requires an exact answer only.

Please put problem 1 on answer sheet 1

1. (a) Find $\frac{d}{dx} \frac{(x^2-3)e^{2x}}{5x+1}$ [8 pts]
(b) Suppose $f(x) = \sqrt{x+1}$. Find $\frac{d}{dx} xf(x^2)$ [7 pts]
-

Please put problem 2 on answer sheet 2

2. (a) Rewrite $y = 3^{2x}$ as e^{kx} and use this to find $y'(0)$. Simplify. [10 pts]
(b) Simplify $\ln \sqrt[3]{\frac{1}{e^2}}$ [5 pts]
-

Please put problem 3 on answer sheet 3

3. (a) Find the equation for the line tangent to the graph of $f(x) = \frac{x+3}{x-2}$ at $x = 7$.
Write this as $y = mx + b$ and simplify. [10 pts]
(b) Solve $4^{4x+1} = 8$. Simplify. [5 pts]
-

Please put problem 4 on answer sheet 4

4. (a) Find $f'(x)$ for $f(x) = \ln \left[\frac{(x+4)^7(2x+10)^3}{e^{4x}x^8} \right]$. [10 pts]
(b) Determine all solutions to the differential equation $y' = 3y$. [5 pts]
-

Please put problem 5 on answer sheet 5

5. (a) The value of a painting by Picasso grows exponentially following $A(t) = Ce^{rt}$, where r is the yearly growth rate. Suppose you inherit a painting by Picasso. It was painted at $t = 0$ (corresponding to the year 1900) and had an initial value of \$500. Currently (in 2008) its value is \$800,000. Find the growth rate r . (E,4) [5 pts]
(b) Suppose you memorize 100 cheat codes to your favorite video game. Then you quit playing and start to forget. Suppose after t weeks you only remember $f(t) = 83e^{-0.07t} + 17$ codes.
i. How many codes will you remember after 10 weeks? (E,2) [5 pts]
ii. After how many weeks will you be forgetting 2 codes per week? (E,2) [10 pts]
-

Please put problem 6 on answer sheet 6

6. Iodine-131 is used in the medical field to test how well the thyroid gland is functioning. Suppose that you are given a dose of Iodine-131. After t days you have $A(t) = 5e^{-0.086t}$ millicuries in your body. Note: The *millicurie* is just the unit name.
(a) How much Iodine-131 were you given initially? [2 pts]
(b) After one week, how much Iodine-131 will be in your body? (E,2) [3 pts]
(c) Suppose you need to be kept in the hospital until your body only contains 4 millicuries. How long will you be in the hospital? (E,2) [6 pts]
(d) What is the half-life of Iodine-131? (E,2) [6 pts]
(e) At the instant when you have 3 millicuries in your body, how fast is it decaying? [3 pts]
-