

Name: \_\_\_\_\_

Please read each question carefully to ensure that you are actually answering it. **Show all work.**  
All numerical answers should be left in **exact** form unless otherwise specified.

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|---------|----|----|----|----|----|----|-------|
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16 1. Find the derivatives of the following functions. You do not need to simplify your answer.

(a)  $f(x) = (\cos^{-1} x + x^2)^2$

(b)  $f(x) = \frac{\tan x}{1 - \sec x}$

(c)  $f(x) = e^{x^3 \ln x}$

(d)  $f(x) = 7^{(4x^3+x)}$

8 2. Find  $\frac{dy}{dx}$  by implicit differentiation.  $xy - \cos(xy) = 1$

3. A potato is launched vertically upward with an initial velocity of 160 ft/sec from the ground. The distance  $s$  in feet that the potato travels from the ground after  $t$  seconds is given by  $s(t) = -16t^2 + 160t$ . Answer the following questions with correct units.

4 (a) Determine the velocity of the potato after 4 sec and 6 sec.

4 (b) Determine when the potato reaches its maximum height.

5 (c) Determine the velocity of the potato upon hitting the ground.

- 9 4. Determine the absolute maximum and minimum of  $f$  on the given interval.

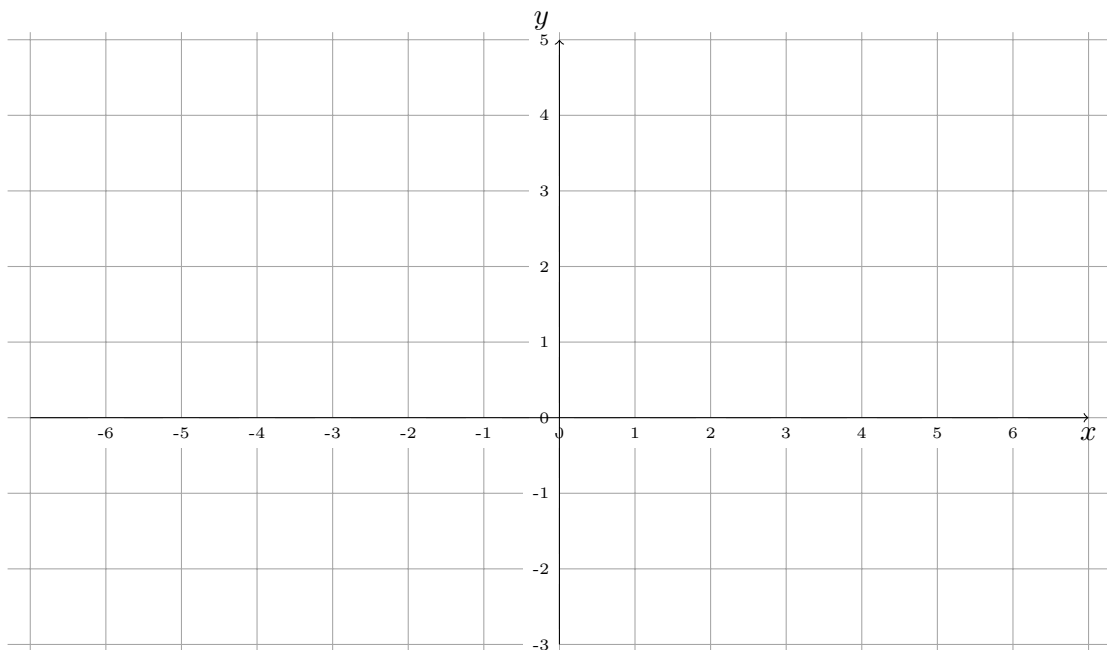
$$f(x) = x^3 - 6x^2 + 9x + 2, \quad [-2, 2]$$

- 8 5. Use a linear approximation to estimate  $(1.01)^3$ .

- 10 6. A 10 feet ladder is leaning against a vertical wall. If the top of the ladder slides down the wall at a rate of  $\sqrt{2}$  feet per second, how fast is the bottom of the ladder moving along the ground when the bottom of the ladder is 5 feet from the wall?

- 7 7. Sketch the graph of a function  $f$  that satisfies all of the given conditions.

1.  $f(-2) = 0$ ,  $f'(-2) = 0$ , and  $f(0) = 3$ ,
2.  $f'(x) < 0$  on the interval  $(-\infty, -2)$ , and  $f'(x) > 0$  on  $(-2, 0)$
3.  $f''(x) > 0$  on the interval  $(-\infty, -1)$ , and  $f''(x) < 0$  on  $(-1, 1)$
4. The graph has  $y$ -axis symmetry.



8. Consider the function  $f(x) = x^3 + 3x^2 - 24x + 10$ . Answer the following with your calculus work.

- 4 (a) Find the intervals on which  $f$  is increasing or decreasing.
- 2 (b) Find the local maximum and minimum **values** of  $f$ .
- 4 (c) Find the intervals on which  $f$  is concave up or concave down.
- 2 (d) Find the inflection point(s) of  $f$ .

- 8 9. The Mean Value Theorem guarantees the existence of a special number  $c$  in the interval  $(1, e)$  for the function  $f(x) = \ln(x)$ . Find the number  $c$ . Approximate your answer to two decimal places.

Circle the correct answer. You do not need to show your work. (No partial credit will be given.)

- 3 10. If  $f(x) = \log_5(2x)$ . Find the value of  $f'(3)$ .

- (a)  $\frac{1}{3}$       (b)  $\frac{1}{3} \ln 5$       (c)  $\frac{1}{6 \ln 5}$       (d)  $\frac{1}{3 \ln 5}$       (e) 1

- 3 11. The position of a bird flying along a straight line in  $t$  seconds is given by  $s(t) = -2t^2 + t$  meters. What is the acceleration (in *meters/sec*<sup>2</sup>) after 1 second?

- (a) 2      (b) -4      (c) 9      (d) 18      (e) 11

- 3 12. If  $y = f(x)$  is a function such that  $f' > 0$  for all  $x$  and  $f'' > 0$  for all  $x$ , which of the following could be part of the graph of  $y = f(x)$ ?

