

Name: _____

Section: _____

Last 4 digits of student ID #: _____

This is a two-hour exam. This exam has 12 multiple choice questions (five points each) and 4 free response questions (ten points each). Additional blank sheets are available if necessary for scratch work. No books or notes may be used. Turn off your cell phones and do not wear ear-buds during the exam. You may use a calculator, but not one which has symbolic manipulation capabilities.

On the multiple choice problems:

- Select your answer by placing an X in the appropriate square of the multiple choice answer box on the front page of the exam.
- Carefully check your answers. No credit will be given for answers other than those indicated on the *multiple choice answer box*.

On the free response problems:

- Clearly indicate your answer and the reasoning used to arrive at that answer (*unsupported answers may not receive credit*),
- Give exact answers, rather than decimal approximations to the answer (unless otherwise stated).

Each free response question is followed by space to write your answer. Please write your solutions neatly in the space below the question.

Multiple Choice Answers

Question					
1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E
11	A	B	C	D	E
12	A	B	C	D	E

Exam Scores

Question	Score	Total
MC		60
13		10
14		10
15		10
16		10
Total		100

1. Find the derivative of $\cos(e^{x^2})$.

- (A) $2xe^{x^2} \sin(e^{x^2})$
- (B) $e^{x^2} \sin(e^{x^2})$
- (C) $-2xe^{x^2} \sin(e^{x^2})$
- (D) $-2x \sin(e^{x^2}) + e^{x^2}$
- (E) None of the above

2. For $f(x) = x^8 - x^6 + 2x^5 - x^2 + 1$, find $f'''(x)$.

- (A) $336x^5 - 120x^3 + 120x^2$
- (B) $56x^6 - 30x^4 + 40x^3 - 2$
- (C) $1680x^4 - 360x^2 + 240x$
- (D) $168x^5 - 60x^3 + 60x^2$
- (E) None of the above

3. Find the derivative of $g(x) = \sin(4x) \tan(x)$.

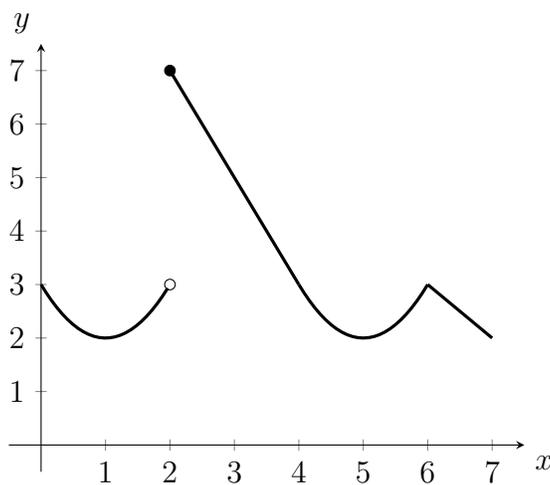
- (A) $\cos(4x) \tan(x) + \sin(4x) \sec^2(x)$
- (B) $4 \cos(4x) \tan(x) + \sin(4x) \sec^2(x)$
- (C) $-4 \cos(4x) \tan(x) + \sin(4x) \sec^2(x)$
- (D) $4 \cos(4x) \tan(x) + 4 \sin(4x) \sec^2(x)$
- (E) None of the above

Record the correct answer to the following problems on the front page of this exam.

4. If $y^3 + 2xy + x^3 = x^{1/2}$, find $\frac{dy}{dx}$.

- (A) $\frac{-3x^2 + x^{-1/2} - 2y}{4x + 6y^2}$
- (B) $\frac{-3x^2 + x^{-1/2} - 2y}{2x + 3y^2}$
- (C) $\frac{-6x^2 + x^{-1/2} - 4y}{4x + 6y^2}$
- (D) $\frac{-3x^2 - 2y}{2x + 3y^2}$
- (E) None of the above

5. Let $f(x)$ be the function whose graph is shown below. For which x -values in the interval $(0, 7)$ is $f(x)$ not differentiable?



- (A) 2 and 5 and 6
- (B) 6
- (C) 5
- (D) 2 and 6
- (E) None of the above.

Record the correct answer to the following problems on the front page of this exam.

6. Find the derivative of $g(x) = (\tan^{-1} x)^4$. (This is the same function as $(\arctan x)^4$.)
- (A) $\frac{4(\tan^{-1} x)^3}{1 + x^2}$
(B) $\frac{4(\tan^{-1} x)^3}{\sqrt{1 - x^2}}$
(C) $4(\tan^{-1} x)^3 \sec^2(x)$
(D) $4(\tan^{-1} x)^3(1 + x^2)$
(E) None of the above
7. Find the rate of change of the volume of a cube with respect to the length of its side s when $s = 4$.
- (A) 48
(B) 16
(C) 12
(D) 64
(E) None of the above.
8. A 5 meter ladder leans against a wall. The bottom of the ladder is 1 meter from the wall at time $t = 0$ and slides away from the wall at 1 meters per second. Find the velocity of the top of the ladder at time $t = 2$.
- (A) $\frac{-3}{\sqrt{6}}$
(B) $\frac{-1}{4}$
(C) $\frac{-3}{4}$
(D) $\frac{-1}{\sqrt{6}}$
(E) None of the above.
9. Find the derivative of $f(x) = \frac{\ln(x)}{x^2}$.
- (A) $\frac{2x \ln(x) - x}{x^4}$
(B) $\frac{1 - 2 \ln(x)}{x^3}$
(C) $\frac{1 - 2 \ln(x)}{x^4}$
(D) $\frac{x - 2x \ln(x)}{x^3}$
(E) None of the above

Record the correct answer to the following problems on the front page of this exam.

10. If $p(x) = ax^2 + bx + c$, find the values of a , b , and c if $p(0) = 0$, $p'(1) = 1$, and $p''(2) = 5$.

(A) $a = 5/2, b = -4, c = 0$

(B) $a = 5, b = -9, c = 0$

(C) $a = 5/2, b = -4, c = 1$

(D) $a = 2, b = 1, c = 0$

(E) None of the above

11. The limit $\lim_{h \rightarrow 0} \frac{e^{1+h} - e}{h}$ represents a derivative $f'(a)$. Find $f(x)$ and a .

(A) $f(x) = e^x, a = 0$

(B) $f(x) = e^x, a = 1$

(C) $f(x) = e^{1+x}, a = 1$

(D) $f(x) = e^{1+x}, a = h$

(E) None of the above.

12. Find the derivative of $e^x \cos(x) \ln(x)$.

(A) $e^x \cos(x) \ln(x) - e^x \sin(x) \ln(x)$

(B) $\frac{e^x \cos(x)}{x}$

(C) $\frac{e^x \cos(x) - e^x \sin(x)}{x}$

(D) $-\sin(x)$

(E) None of the above

Free Response Questions: Show your work!

13. A hot air balloon rising vertically is tracked by an observer located 7 km from the liftoff point.

(a) Find an equation to relate the height of the balloon and the angle of the observer's line-of-sight.

(b) At a certain moment, the angle between the observer's line-of-sight and the horizontal is $\frac{\pi}{6}$ and it is changing at a rate of 0.2 radians per minute. How fast is the balloon rising at that moment? Include units!!!

Free Response Questions: Show your work!

14. (a) Find the equation of the tangent line to $4x^6 + y^6 = 5$ at the point $(-1, 1)$.

(b) Find $\lim_{x \rightarrow 0} \frac{\sin^2(2x)}{5x^2}$.

Free Response Questions: Show your work!

15. Let $f(x) = x \cdot \ln(x^4 - x + e^2)$.

(a) Find the derivative $f'(x)$.

(b) Find the equation of the tangent line to $f(x)$ at the point where $x = 1$.

Free Response Questions: Show your work!

16. This problem concerns the definition of the derivative using limits.

- (a) State the formal definition of the derivative of a function $f(x)$ at the point $x = a$.
Hint: Your definition should involve a limit.

- (b) **Using the formal definition of derivative and the limit laws**, find the derivative of the function $f(x) = \frac{1}{3x}$. An answer that is unsupported or uses differentiation rules will receive **no credit**.