

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

Section and/or TA: \_\_\_\_\_

Do not remove this answer page. You will return the whole exam. You will be allowed two hours to complete this test. No books or notes may be used. You may use a graphing calculator during the exam, but NO calculator with a Computer Algebra System (CAS) or a QWERTY keyboard is permitted. You may not use a phone or other communication device during the exam.

The exam consists of 12 multiple choice questions that are worth 5 points each and 4 free response questions that are worth 10 points each. You should work the multiple choice questions on the question page. After you have checked your work carefully, record your answers by completely filling in the circle below that corresponds to your answer. If you must change your answer, make a note on the front of the exam. Be sure to check carefully when you transfer your answers to the cover sheet.

Show all work to receive full credit on the free response problems.

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Multiple Choice Questions

1     A     B     C     D     E7     A     B     C     D     E2     A     B     C     D     E8     A     B     C     D     E3     A     B     C     D     E9     A     B     C     D     E4     A     B     C     D     E10     A     B     C     D     E5     A     B     C     D     E11     A     B     C     D     E6     A     B     C     D     E12     A     B     C     D     E

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SCORE

Multiple Choice	13	14	15	16	Total Score
60	10	10	10	10	100

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## Multiple Choice Questions

1. (5 points) Let  $f(x) = xe^x$ . Find  $f'(1)$ .

A.  $3e$

B. 0

C.  $e$

D.  $2e$

E.  $4e$

2. (5 points) Find the derivative  $g'(1)$  for  $g(x) = \frac{1}{x^2 + 1}$ .

A. 2

B.  $1/2$

C.  $-1$

D. 1

E.  $-1/2$

3. (5 points) Let  $f(x) = \sqrt{4 - 2x}$ . Find  $f'(0)$ .

- A.  $1/4$
- B.  $1$
- C.  $1/2$
- D.  $-1/4$
- E.  $-1/2$

4. (5 points) Which of the expressions is equal to the limit  $\lim_{h \rightarrow 0} \frac{\sin(h)}{h}$ ?

- A.  $-\cos'(0) = -\left. \frac{d}{dx} \{\cos(x)\} \right|_{x=0}$
- B.  $\sin'(0) = \left. \frac{d}{dx} \{\sin(x)\} \right|_{x=0}$
- C.  $\cos'(0) = \left. \frac{d}{dx} \{\cos(x)\} \right|_{x=0}$
- D.  $-\sin'(0) = -\left. \frac{d}{dx} \{\sin(x)\} \right|_{x=0}$
- E. The limit does not exist

5. (5 points) Suppose  $f(1) = 2$  and  $f'(1) = 3$ ,  $f'(0) = 5$  and  $g(x) = f(\cos(2x))$  Find the derivative  $g'(0)$ .

- A. 0
- B.  $-6$
- C. 6
- D.  $-10$
- E. 10

6. (5 points) Suppose the position of an object at time  $t$  is  $p(t) = \sin(2t)$ . Select the time  $t$  where the velocity is positive and the acceleration is negative.

- A.  $\pi/4$
- B.  $\pi/8$
- C. 0
- D.  $\pi$
- E.  $\pi/2$

7. (5 points) Consider the triangle below. Give an expression for the angle  $u$ .

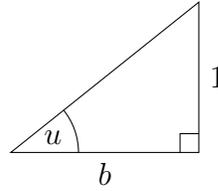
A.  $u = \operatorname{arcsec}(b)$

B.  $u = \arctan(b)$

C.  $u = \arctan(1/b)$

D.  $u = \arcsin(b)$

E.  $u = \arccos(b)$



8. (5 points) Find the smallest, positive value  $t$  for which the function  $f(t) = t + 2 \cos(t)$  has a horizontal tangent line.

A.  $\pi/2$

B.  $\pi/3$

C.  $2\pi/3$

D.  $\pi/4$

E.  $\pi/6$

9. (5 points) Let  $f(x) = \ln((x^2 + 1)(2x + 5))$ . Find the derivative  $f'(x)$ .

A.  $\frac{2x(2x + 5) - 2(x^2 + 1)}{(x^2 + 1)^2(2x + 5)^2}$

B.  $\frac{2x(2x + 5) - 2(x^2 + 1)}{(x^2 + 1)^2(2x + 5)}$

C.  $\frac{2x(2x + 5) + 2(x^2 + 1)}{(x^2 + 1)^2(2x + 5)}$

D.  $\frac{2x}{x^2 + 1} + \frac{2}{2x + 5}$ .

E.  $\frac{2x(2x + 5) + 2(x^2 + 1)}{(x^2 + 1)^2(2x + 5)^2}$

10. (5 points) If  $t = \sin(u)$  and  $u \in (-\pi/2, \pi/2)$ , find  $\tan(u)$ .

A.  $-\sqrt{1 - t^2}/t$

B.  $t/\sqrt{1 + t^2}$

C.  $t/\sqrt{1 - t^2}$

D.  $-t/\sqrt{1 - t^2}$

E.  $\sqrt{1 - t^2}/t$

11. (5 points) Consider the hyperbola defined by the equation  $\frac{x^2}{3} - \frac{y^2}{2} = 1$ . Find the slope of the tangent line to the hyperbola at the point  $(-3, 2)$ .

- A. 1
- B.  $-1$
- C.  $9/4$
- D.  $2/3$
- E.  $-2/3$

12. (5 points) Let  $f(x) = e^{2x}$ . Find the 20<sup>th</sup> derivative  $f^{(20)}(0)$ .

- A.  $e^{20}$
- B. 1
- C.  $2^{20}$
- D. 0
- E. 20

*Free response questions, show all work*

13. (10 points) Consider the curve defined by the equation

$$(x^2 + 1)y^3 - 2x = 14x^2.$$

- (a) Find the derivative  $\frac{dy}{dx}$  along the curve.
- (b) Let  $x_0 = 1$  and find the point  $(1, y_0)$  which lies on the curve.
- (c) Find the equation of the tangent line to the curve at  $x_0 = 1$ .

14. (10 points)

(a) State the mean value theorem.

(b) Suppose  $f$  is differentiable on  $(-\infty, \infty)$ ,  $f(2) = 3$  and  $f'(x) \leq 7$  for  $x$  in the interval  $(-\infty, \infty)$ . Use the mean value theorem to find a number  $M$  so that  $f(6) \leq M$ .

15. (10 points) Suppose that a ball is thrown into the air at time  $t = 0$  seconds so that its height above the ground after  $t$  seconds is  $h(t) = -5t^2 + 30t$  meters.
- (a) Find the velocity at the instant the ball is thrown.
  - (b) Find the time when the ball's velocity is zero.
  - (c) Find the velocity of the ball as it hits the ground.

16. (10 points) Let  $f(x) = 2/x$ .

- (a) Find the slope of the tangent line to the graph of  $f$  at the point  $(a, 2/a)$ .
- (b) Find the equation of the tangent line to the graph of  $f$  at the point  $(a, 2/a)$ .
- (c) Find  $a$  so that the tangent line to the graph of  $f$  at  $(a, 2/a)$  passes through the point  $(0, 6)$ .