

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 communication capabilities 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. You do not need to compute a decimal approximation to your answer. For example, the answer 4π is preferred to 12.57.

Multiple Choice Questions

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

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 $f(x) = x^2e^{-2x}$. Find $f'(x)$.
- A. $2xe^{-2x}(1 - x)$
 - B. $4xe^{-2x}(1 + x)$
 - C. $4xe^{-2x}(1 - x)$
 - D. $-4xe^{-2x}$
 - E. $2xe^{-2x}(1 + x)$
2. (5 points) Find the derivative $f'(0)$ for $f(x) = \frac{4}{(3x^2 - 2x + 1)^2}$.
- A. 16
 - B. 8
 - C. -16
 - D. 32
 - E. -8

3. (5 points) Let $f(x) = \ln(\ln(2x + 1))$. Find $f'(x)$.

- A. $\frac{2}{\ln(2x + 1)}$
- B. $4 \ln(2x + 1)$
- C. $\frac{\ln(2x + 1)}{2x + 1}$
- D. $\frac{1}{\ln(2x + 1)}$
- E. $\frac{2}{(2x + 1) \ln(2x + 1)}$

4. (5 points) Which of the expressions is equal to the limit $\lim_{h \rightarrow 0} \frac{\cos(h) - 1}{h}$?

- 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. $\cos'(1) = \left. \frac{d}{dx} \{\cos(x)\} \right|_{x=1}$
- D. $\sin'(0) = \left. \frac{d}{dx} \{\sin(x)\} \right|_{x=0}$
- E. The limit does not exist

5. (5 points) Let $F(x) = f(f(x))$ and $G(x) = (F(x))^2$ and suppose that

$$f(5) = 3, \quad f(7) = 5, \quad f'(5) = 8, \quad f'(7) = 13.$$

Find $F'(7)$ and $G'(7)$.

- A. $F'(7) = 104$ and $G'(7) = 1040$
 - B. $F'(7) = 40$ and $G'(7) = 624$
 - C. $F'(7) = 104$ and $G'(7) = 624$
 - D. $F'(7) = 40$ and $G'(7) = 1040$
 - E. $F'(7) = 3$ and $G'(7) = 169$
6. (5 points) Suppose that the equation of motion for a particle (where s is in meters and t in seconds) is

$$s(t) = \frac{t^3}{3} - 4t^2 + 16t + 6.$$

Find the acceleration at the instant when the velocity is 0.

- A. 0
- B. 1
- C. 8
- D. 16
- E. 4

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

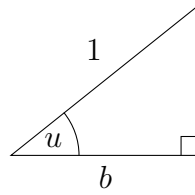
A. $u = \arcsin(b)$

B. $u = \arccos(1/b)$

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

D. $u = \arctan(b)$

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. $\pi/6$

B. $2\pi/3$

C. $\pi/3$

D. $\pi/2$

E. $\pi/4$

9. (5 points) Let $h(x) = (x^2 + 3x)f(x)$. Find the derivative $h'(2)$ if $f(2) = 6$ and $f'(2) = -1$.

A. $h'(2) = -7$

B. $h'(2) = 32$

C. $h'(2) = 52$

D. $h'(2) = 16$

E. $h'(2) = 8$

10. (5 points) If $t = \sin(u)$ and $u \in (-\pi/2, \pi/2)$, then $u = \arcsin(t)$. Find the derivative u' as a function of t .

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

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

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

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

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

11. (5 points) Consider the ellipse defined by the equation $4x^2 + 9y^2 = 36$. Find the slope of the tangent line to the ellipse at the point $(\sqrt{5}, 4/3)$.

- A. $-2/3$
- B. $2/3$
- C. $-\sqrt{5}/3$
- D. 0
- E. $\sqrt{5}/3$

12. (5 points) Let $f(x) = \sin(x)$. Find the 4th derivative $f^{(4)}(x)$.

- A. $\arcsin(x)$
- B. $-\cos(x)$
- C. $\cos(x)$
- D. $\sin(x)$
- E. $-\sin(x)$

Free response questions: Show all work clearly using proper notation.

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

$$x^3 + y^3 = 9xy.$$

- (a) Find the derivative $\frac{dy}{dx}$ along the curve.
- (b) Find the slope of the tangent line at the point $(2, 4)$.

14. (10 points)

(a) State the mean value theorem.

(b) Let $f(x) = x^3 - 4x + 1$ on the interval $[-2, 2]$. **Use the mean value theorem** to conclude that there is a number c such that $f'(c) = 0$.

15. (10 points) Suppose that a ball is thrown into the air at time $t = 0$ so that its height above the ground after t seconds is $h(t) = -\frac{7t^2}{2} + 42t$ meters. Include the correct units for each of your answers.
- (a) Find the velocity at the instant the ball is thrown.
 - (b) Find the time when the velocity of the ball is zero.
 - (c) Find the velocity of the ball as it hits the ground.

16. (10 points) Let $f(x) = \sin(5x)$.

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

(b) Find the equation of the tangent line to the graph of f at $x = 0$.

(c) Find the equation of the tangent line to the graph of f at $x = \frac{\pi}{10}$.