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 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
2 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
3 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
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12 Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

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) Find the value of the limit $\lim_{x \to 2} \dfrac{x-2}{x^2-4}$.

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

2. (5 points) Let $f(x) = \dfrac{(x+1)(x+2)}{(x+3)(x+4)}$. Find the set of all points x where f is continuous at x.

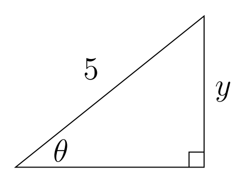
   A. $(-\infty, -1) \cup (-1, \infty)$
   B. $(-\infty, -4) \cup (-4, -2) \cup (-2, \infty)$
   C. $(-\infty, -2) \cup (-2, -1) \cup (-1, \infty)$
   D. $(-\infty, -3) \cup (-3, -2) \cup (-2, \infty)$
   E. $(-\infty, -4) \cup (-4, -3) \cup (-3, \infty)$

3. (5 points) Consider the curve defined by the equation $3x^2 + xy + y^2 = 9$. Find the slope of the tangent line to this curve at the point $(1, 2)$.

   A. $-5/8$ B. $5/8$ C. $8/5$ D. $-8/5$ E. -2

4. (5 points)

   Consider the right triangle pictured. The length of the hypotenuse is 5 units and is fixed. Find the rate of change of the angle θ with respect to the sidelength y.



   A. $\dfrac{d\theta}{dy} = \dfrac{5}{\sqrt{1 - y^2/25}}$

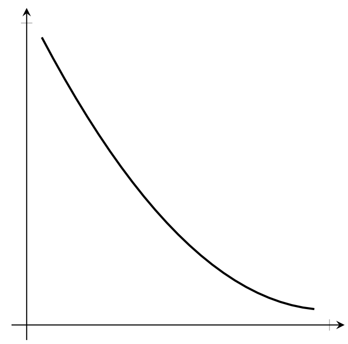
   B. $\dfrac{d\theta}{dy} = \dfrac{-1}{\sqrt{1 - y^2/25}}$

   C. $\dfrac{d\theta}{dy} = \dfrac{1}{\sqrt{1 - y^2/25}}$

   D. $\dfrac{d\theta}{dy} = \dfrac{-1}{5\sqrt{1 - y^2/25}}$

   E. $\dfrac{d\theta}{dy} = \dfrac{1}{5\sqrt{1 - y^2/25}}$

5. (5 points)
Consider the function f whose graph appears to the right. Select the correct statement about the derivatives of f.



A. $f'(x) < 0$ and $f''(x) > 0$.

B. $f'(x) > 0$ and $f''(x) < 0$

C. $f'(x) < 0$ and $f''(x) < 0$

D. $f'(x) > 0$ and $f''(x) > 0$

E. $f'(x) < 0$ and $f''(x) = 0$

6. (5 points) The function P defined by $P(t) = 8e^{3t}$ is growing exponentially. What is the doubling time?

A. $\ln(2)/3$ B. $\ln(3)/2$ C. $\ln(8)/2$ D. $\ln(16)/3$ E. $\ln(2)/8$

7. (5 points) Consider the integral $\int_0^{\pi/2} \sin(x)\,dx$. Give the value of the left Riemann sum formed using three equal subintervals and the left endpoint of each subinterval as the sample points.

   A. $\frac{\pi}{12}(1+\sqrt{3})$
   B. $\frac{\pi}{6}(1+\sqrt{3}+2)$
   C. $\frac{\pi}{6}(1+\sqrt{3})$
   D. $\frac{\pi}{3}(1+\sqrt{3}+2)$
   E. $\frac{\pi}{12}(1+\sqrt{3}+2)$

8. (5 points) We have $\int_1^4 f(x)\,dx = M$ and $\int_2^1 f(x)\,dx = N$. Find $\int_2^4 f(x)\,dx$.

   A. $M+N$
   B. M^2+N^2
   C. $-M+N$
   D. $-M-N$
   E. $M-N$

9. (5 points) Suppose $\int_{-3}^{4} f(x)\,dx = -8$. Find $\int_{-3}^{4} (2f(x) + x)\,dx$.

A. -10

B. -15

C. $-35/2$

D. $-25/2$

E. $-5/2$

10. (5 points) Let $F(x) = \int_{0}^{x} \sin(\pi t^2)\,dt$. Select the correct statement.

A. $F'(1) = 0$, but F does not have a local extreme at $x = 1$.

B. $F'(1) < 0$

C. F has a local maximum at 1

D. $F'(1) > 0$

E. F has a local minimum at 1

11. (5 points) Find the integral $\int_0^3 |x-1|\,dx$.

Hint: You may find the area of the region between the graph of $y = |x-1|$ and the x-axis.

A. 2 B. 3/2 C. 1/2 D. 1 E. 5/2

12. (5 points) Evaluate the integral $\int_0^1 t\sin(\pi t^2)\,dt$.

A. $1/(2\pi)$

B. $-1/\pi$

C. $-1/(2\pi)$

D. 0

E. $1/\pi$

Free response questions, show all work

13. (10 points) Let $F(x) = -x^3 + 6x^2 + 15x + 11$
    (a) Compute $F'(x)$ and $F''(x)$.
    (b) Use calculus to find the interval(s) on which F is increasing and on which F is decreasing.
    (c) Use calculus to find the interval(s) on which F is concave up and on which F is concave down.

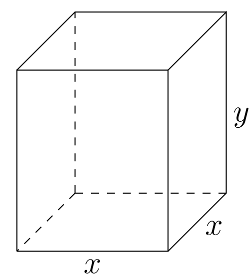
14. (10 points)

We consider a box with a square base and an open top. The box has a volume of 108 cubic centimeters.

(a) Write an expression for the total surface area of the bottom and the four sides in terms of x, the sidelength of the square base.

(b) Find the lengths x and y which give box with smallest surface area.

(c) Use calculus to explain why the sidelength you find in part b) gives the box with the smallest surface area.



15. (10 points) (a) Find the indefinite integral $\int \sin(x)\cos(x)\,dx$. Hint: You may use the substitution $u = \sin(x)$.

(b) Find the indefinite integral $\int 4x\sqrt{2x+1}\,dx$. Hint: You may use the substitution $u = 2x + 1$.

16. (10 points) Consider the region R enclosed by the parabola $y = x^2 - 1$ and the line $y = 2x + 2$.

   (a) Express the area of R as an integral.

   (b) Evaluate the integral from part a) and give the area of R.