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GOOD LUCK!

| 3. \( a \) \( b \) \( c \) \( d \) \( e \) | 12. \( a \) \( b \) \( c \) \( d \) \( e \) |
| 4. \( a \) \( b \) \( c \) \( d \) \( e \) | 13. \( a \) \( b \) \( c \) \( d \) \( e \) |
| 5. \( a \) \( b \) \( c \) \( d \) \( e \) | 14. \( a \) \( b \) \( c \) \( d \) \( e \) |
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| 10. \( a \) \( b \) \( c \) \( d \) \( e \) | 19. \( a \) \( b \) \( c \) \( d \) \( e \) |
| 11. \( a \) \( b \) \( c \) \( d \) \( e \) | 20. \( a \) \( b \) \( c \) \( d \) \( e \) |

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<th>Multiple Choice</th>
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1
1. Evaluate $\int_0^3 \sqrt{3x+10} \, dx$. Show steps clearly and circle your answer. You do NOT need to simplify your final answer.

2. If the derivative of a function $g(x)$ is given by $g'(x) = (x+2)(x+5)$, find interval(s) where $g(x)$ is concave up. Show work clearly.

Answer: _________________________________
Multiple Choice Questions

Show all your work on the page where the question appears. Clearly mark your answer both on the cover page on this exam and in the corresponding questions that follow.

3. Find the limit as \( n \) tends to infinity. Here \( C \) is a fixed real number.

\[
\lim_{n \to \infty} \frac{(Cn + 1)^2}{4n^2 + 3n + 7}
\]

Possibilities:
(a) \( \frac{1}{4}C^2 \)
(b) \( \infty \)
(c) \( \frac{1}{16}C^2 \)
(d) \( \frac{1}{14}C \)
(e) 0

4. Evaluate the limit as \( n \) tends to infinity. Note: you will have to use some of the summation formulas (see formula sheet on backpage) to simplify.

\[
\lim_{n \to \infty} \frac{1}{n} \sum_{k=1}^{n} \frac{6k^2}{n^2}
\]

Possibilities:
(a) 2
(b) 1
(c) 3
(d) 4
(e) 5
5. Assuming \( x > 0 \), evaluate the definite integral
\[
\int_{7}^{x} \frac{6}{t} \, dt
\]

**Possibilities:**
(a) \(-\frac{6}{x^2} + \frac{6}{49}\)
(b) \(12\sqrt{x} - 12\sqrt{7}\)
(c) \(6\sqrt{x}\)
(d) \(6\ln(|x|) - 6\ln(7)\)
(e) \(\frac{6}{2x^2} - \frac{12}{49}\)

6. Use the Fundamental Theorem of Calculus to compute the derivative, \( F'(x) \), of \( F(x) \), if
\[
F(x) = \int_{1}^{x+9} (t^2 + 7t + 3) \, dt
\]

**Possibilities:**
(a) \(2x + 7\)
(b) \(\frac{1}{3}x^3 + \frac{7}{2}x^2 + 3x - \left(\frac{1}{3}1^3 + \frac{7}{2}1^2 + 3(1)\right)\)
(c) \(x^2 + 7x + 3\)
(d) \(\frac{1}{3}(x+9)^3 + \frac{7}{2}(x+9)^2 + 3(x+9) - \left(\frac{1}{3}1^3 + \frac{7}{2}1^2 + 3(1)\right)\)
(e) \((x+9)^2 + 7(x+9) + 3\)
7. Find the value of $x$ at which
\[ F(x) = \int_{3}^{x} (-t^4 - t^2 - 7) \, dt \]
takes its minimum value on the interval $[9, 800]$.

**Possibilities:**
(a) 3  
(b) 97  
(c) $\frac{393}{5}$  
(d) 9  
(e) 800

8. Evaluate the integral
\[ \int_{0}^{x} (7t + 9)^{15} \, dt \]

**Possibilities:**
(a) $\frac{1}{7(16)}(7x + 9)^{16} - \frac{9^{16}}{7(16)}$  
(b) $\frac{1}{15}(7x + 9)^{15} - \frac{9^{15}}{15}$  
(c) $\frac{1}{16}(7x + 9)^{16} - \frac{9^{16}}{16}$  
(d) $16(7x + 9)^{16} - 15 \cdot 9^{16}$  
(e) $\frac{1}{16}x^{16} - \frac{9^{16}}{16}$
9. Suppose a rock is dropped from a lunar cliff. After $t$ seconds, its speed in feet per second is $v(t) = \frac{53}{10}t$, at least until it lands. If the rock lands after 9 seconds, how high (in feet) is the cliff?

   Possibilities:
   (a) $\frac{9}{2}$ feet
   (b) $\frac{53}{90}$ feet
   (c) 9 feet
   (d) $\frac{4293}{20}$ feet
   (e) $\frac{477}{10}$ feet

10. Compute \( \lim_{t \to 2} \frac{t^2 + 6t - 16}{t^2 + 2t - 8} \)

   Possibilities:
   (a) $\frac{4}{3}$
   (b) $\frac{5}{3}$
   (c) 2
   (d) $\frac{7}{3}$
   (e) The limit does not exist.
11. Find the average rate of change of $f(x) = \sqrt{x}$ from $x = 49$ to $x = 81$.

**Possibilities:**
(a) $\frac{\log(49) + \log(81)}{2}$
(b) $\frac{1}{2} (81)^{-1/2} - \frac{1}{2} (49)^{-1/2}$
(c) $\frac{\sqrt{81} - \sqrt{49}}{81 - 49}$
(d) $\frac{\sqrt{81} - \sqrt{49}}{\sqrt{49} - \sqrt{81}}$
(e) $\frac{1}{49} - \frac{1}{81}$

12. If an amount of $x$ dollars is invested at 5% interest compounded continuously, and at the end of 2 years the value of the investment is $6000, find $x$.

**Possibilities:**
(a) $2853.69$
(b) $600$
(c) $5000$
(d) $5429.02$
(e) $6631.02$
13. The tangent line to the graph of $f$ at $x = 7$ has equation $y = 9(x - 7) + 3$. Find $f(7)$ and $f'(7)$.

**Possibilities:**

(a) $f(3) = 7$, $f'(3) = 9$
(b) $f(7) = 9$, $f'(7) = 3$
(c) $f(7) = 3$, $f'(7) = 9$
(d) $f(3) = 9$, $f'(3) = 7$
(e) $f(9) = 3$, $f'(9) = 7$

14. The graph of $y = f(x)$ is shown below. The function is differentiable, except at $x =$

**Possibilities:**

(a) $x=1$, $x=3$, and $x=4$
(b) $x=1$ only
(c) $x=1$, $x=3$, $x=4$, and $x=6$
(d) $x=4$ only
(e) $x=1$ and $x=4$
15. If \( f(x) = 8x^5 + 4x \) then find the second derivative \( f''(x) \):

**Possibilities:**

(a) \( 160x^3 \)
(b) \( 40x^4 + 4 \)
(c) \( 40x^4 + 80x^3 + 80x^2 + 40x + 12 \)
(d) \( 200x^5 \)
(e) \( 160x^3 + 80x \)

16. Suppose \( F(x) = g(x) \cdot h(x + 2) \). If \( g(0) = 8, g'(0) = 4, h(0) = 9, h'(0) = 7, h(2) = 5, \) and \( h'(2) = 3 \), find \( F'(0) \).

**Possibilities:**

(a) 95
(b) 68
(c) 44
(d) 158
(e) 36
17. Find the derivative, \( f'(x) \), if \( f(x) = e^{x^3+3x^2+4x} \).

**Possibilities:**
(a) \( e^{3x^2+6x+4} \)
(b) \( (3x^2 + 6x + 4)e^{x^3+3x^2+4x} \)
(c) \( \ln(x^3 + 3x^2 + 4x) \)
(d) \( (3x^2 + 6x + 4)e^x \)
(e) \( \frac{3x^2 + 6x + 4}{x^3 + 3x^2 + 4x} \)

18. Suppose the derivative of \( g(t) \) is \( g'(t) = 9(t-7)(t-3)(t-8) \). For \( t \) in which interval(s) is \( g \) increasing?

**Possibilities:**
(a) \( (-\infty, 6 - \frac{1}{3}\sqrt{21}) \cup (6 + \frac{1}{3}\sqrt{21}, \infty) \)
(b) \( (9, 3) \cup (7, 8) \)
(c) \( (6 - \frac{1}{3}\sqrt{21}, 6 + \frac{1}{3}\sqrt{21}) \)
(d) \( (-\infty, 3) \cup (7, 8) \)
(e) \( (3, 7) \cup (8, \infty) \)
19. Find the area of the largest rectangle whose sides are parallel to the coordinate axes, whose bottom-left corner is at \((0, 0)\) and whose top-right corner is on the graph of \(y = 6x - x^2\).

**Possibilities:**
(a) 0
(b) 32
(c) 30
(d) 27
(e) 3

20. A farmer currently has harvested 290 bushels of kale that are currently worth $10.51 per bushel. The way things are going, he expects to be harvesting 3.00 bushels per day, and expects the price to be increasing at $0.25 per bushel per day. What is the instantaneous rate of change (measured in dollars per day) of the total value of his kale?

**Possibilities:**
(a) $104.03 per day
(b) $104.04 per day
(c) $104.05 per day
(d) $104.06 per day
(e) $104.07 per day
1. Summation formulas:
\[
\sum_{k=1}^{n} k = \frac{n(n + 1)}{2}
\]
\[
\sum_{k=1}^{n} k^2 = \frac{n(n + 1)(2n + 1)}{6}
\]

2. Areas:
   (a) Triangle \( A = \frac{bh}{2} \)
   (b) Circle \( A = \pi r^2 \)
   (c) Rectangle \( A = lw \)
   (d) Trapezoid \( A = \frac{h_1 + h_2}{2} b \)

3. Volumes:
   (a) Rectangular Solid \( V = lwh \)
   (b) Sphere \( V = \frac{4}{3} \pi r^3 \)
   (c) Cylinder \( V = \pi r^2 h \)
   (d) Cone \( V = \frac{1}{3} \pi r^2 h \)

4. Distance:
   (a) Distance between \((x_1, y_1)\) and \((x_2, y_2)\)
   \[
   D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
   \]
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