1. Let \( f(x) = \ln(x^3 + x - 1) \) Find \( f'(1) \).

(a) 0  
(b) 1  
(c) \( \frac{3}{2} \)  
(d) 2  
(e) \( \frac{5}{2} \)  
(f) 3  
(g) \( \frac{7}{2} \)  
(h) 4  
(i) \( \frac{9}{2} \)  
(j) None of the above
2. Compute the integral
\[ \int_1^5 e^{2x} \left( \ln x \right)^5 \frac{1}{x} \, dx \]

(a) \(-\frac{1}{6}\)
(b) 0
(c) \frac{1}{6}
(d) \frac{1}{5}
(e) \frac{1}{e}
(f) \frac{1}{e}
(g) \frac{e}{6}
(h) e
(i) \frac{21}{2}
(j) None of the above

3. Compute the integral
\[ \int_0^3 x \sqrt{x + 1} \, dx \]

(a) 0
(b) \frac{4}{15}
(c) 3
(d) \frac{44\sqrt{2}}{15}
(e) \frac{14}{3}
(f) \frac{18\sqrt{3}}{5}
(g) \frac{116}{15}
(h) 9
(i) \frac{1192}{15}
(j) None of the above
4. Let
\[ f(x) = \begin{cases} 
  x & \text{if } x < 2 \\
  -3x & \text{if } x \geq 2 
\end{cases} \]

Compute the integral \( \int_{0}^{6} f(x) \, dx \)

(a) \(-54\)  
(b) \(-48\)  
(c) \(-46\)  
(d) \(-36\)  
(e) 0  
(f) 2  
(g) 18  
(h) 36  
(i) 54  
(j) None of the above

5. Find the area between the curves \( y = x^2 - 3 \) and \( y = 1 - 3x \).

(a) 0  
(b) \( \frac{2}{3} \)  
(c) \( \frac{13}{6} \)  
(d) \( \frac{20}{3} \)  
(e) \( \frac{34}{3} \)  
(f) \( \frac{56}{3} \)  
(g) \( \frac{125}{6} \)  
(h) \( \frac{55}{2} \)  
(i) \( \frac{167}{3} \)  
(j) None of the above
6. Let \( f(x) = xe^{x^2} \) Find \( f'(1) \).

(a) 0  
(b) 1  
(c) \( e \)  
(d) \( \pi \)  
(e) 2\( e \)  
(f) 3\( e \)  
(g) 4\( e \)  
(h) 5\( e \)  
(i) 6\( e \)  
(j) None of the above

7. Match the function for the graph and graph of level curves given below (they both come from the same function).

(a) \( f(x, y) = x^2 - y^2 \)  
(b) \( f(x, y) = x^2 + y^2 \)  
(c) \( f(x, y) = x^2 - y^2 + 2 \)  
(d) \( f(x, y) = x^2 + y^2 + 2 \)  
(e) \( f(x, y) = x^2 - 5y^2 + 2 \)  
(f) \( f(x, y) = x^2 + 5y^2 \)  
(g) \( f(x, y) = 5x^2 + y^2 \)  
(h) \( f(x, y) = 5x^2 + y^2 + 2 \)  
(i) \( f(x, y) = x^2 + 5y^2 + 2 \)  
(j) None of the above
8. For the function \( f(x, y) = x^2 - x^4 - y^2 \), with the graph given below, find the correct graph of level curves.

Answers:

A

B

C

D

E

F

G

H

I

(j) None of the above
9. An investment pays 10% interest compounded continuously. Money is invested steadily at the rate of $2000 per year.

What is the future value of this investment in 5 years? (Round to nearest dollar.)

(a) $2,000
(b) $3,297
(c) $10,000
(d) $12,337
(e) $12,974
(f) $13,634
(g) $16,487
(h) $16,442
(i) $32,677
(j) None of the above

10. An investment pays 15% interest compounded continuously. Money is invested steadily for 5 years and the investment is worth $5,000 at the end of 5 years.

At what rate is the money invested? (Rounded to nearest dollar per year.)

(a) 485
(b) 512
(c) 623
(d) 671
(e) 724
(f) 771
(g) 816
(h) 1,000
(i) 5,000
(j) None of the above
For Problems 11 and 12 use the supply and demand curves are given below:

\[ D(x) = 80 - \frac{x}{50} \quad S(x) = 5 + \frac{x}{25} \]

11. Find the equilibrium price.

(a) 5  
(b) 55  
(c) 80  
(d) 82.5  
(e) 165  
(f) 1250  
(g) 4000  
(h) 15,625  
(i) 31,250  
(j) None of the above

12. Find the consumers surplus for the price of $70

(a) 0  
(b) 5  
(c) 500  
(d) 2500  
(e) 3125  
(f) 27,500  
(g) 31,250  
(h) 50,000  
(i) 52,812.5  
(j) None of the above
13. Suppose that the temperature during the year 2008 in St. Louis is predicted to be modeled by the function

\[ T(t) = -2t^2 + 27t + 17 \]

where \( T \) is in degrees Fahrenheit and \( t \) is in months (so \( t = 0 \) is January 1 and \( t = 12 \) is December 31).

Find the average temperature, rounded to nearest degree Fahrenheit, predicted for the year 2007.

(a) 17
(b) 35
(c) 53
(d) 59
(e) 79
(f) 81
(g) 83
(h) 84
(i) 86
(j) None of the above

14. A company spends \( x \) hundred dollars per week on newspaper advertising and \( y \) hundred dollars per week on telemarketing. The company’s weekly sales, in hundreds of dollars, is given by

\[ S(x, y) = 15x^2y \]

Find the amount of weekly sales for the company (rounded to nearest dollar), if they invest $175 in newspaper and $315 in telemarketing.

(a) $1
(b) $14
(c) $145
(d) $1,447
(e) $14,470
(f) $144,703
(g) $1,447,031
(h) $14,470,313
(i) $144,703,125
(j) None of the above
15. Let
\[ f(x, y, z) = \frac{x^3 + xy^3 + z}{z + 1} \]
Find \( \frac{\partial f}{\partial x}(2, 1, 0) - \frac{\partial^2 f}{\partial x \partial y}(4, 6, 2) \).

(a) -23
(b) -9
(c) 2
(d) 4
(e) 6
(f) 15
(g) 17
(h) 28
(i) 30
(j) None of the above

16. Let
\[ f(x, y) = \frac{x - y}{x + y} \]
Find \( f_{xy}(1, 2) + f_{yx}(1, 2) \)

(a) \(-\frac{1}{3}\)
(b) \(-\frac{8}{27}\)
(c) \(\frac{2}{9}\)
(d) \(-\frac{4}{27}\)
(e) \(-\frac{2}{27}\)
(f) 0
(g) \(\frac{4}{27}\)
(h) \(\frac{5}{27}\)
(i) \(\frac{4}{9}\)
(j) None of the above
17. This problem deals with continuous income streams.

(a) Write out the formula (with an integral) for future value of an income stream. Tell what each term in the formula stands for.

(b) How much income is actually earned over the next 50 years if your income stream generates income at the following rate

\[ K(t) = 10e^{0.1t} \]

(c) If your money earns interest at a continuous rate of 10% interest per year. What is the future value of your income stream in 50 years? (Assume your income stream generates income at the same rate as Problem 17b: \( K(t) = 10e^{0.1t} \))
18. Compute the following integrals

(a) \[ \int \frac{dx}{x(1 + \ln x)} \]

(b) \[ \int \frac{3x - 1}{(3x^2 - 2x + 2)^6} \, dx \]

(c) \[ \int_1^7 |x - 3| \, dx \]