MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the partial derivative.
1) Let \( z = f(x, y) = 4(x + 4y - 3)^2 \). Find \( \frac{\partial z}{\partial x} \).

A) 16x + 64y  
B) 8x + 32y + 24  
C) 8x + 32y - 24  
D) 4x + 16y - 12

Find \( f_x \).
2) \( f(x, y) = x \ln (3x + 8y) \)

A) \( f_x(x, y) = \ln (3x + 8y) + \frac{3}{3x + 8y} \)  
B) \( f_x(x, y) = \frac{3x}{3x + 8y} \)  
C) \( f_x(x, y) = \ln (3x + 8y) \)  
D) \( f_x(x, y) = \frac{3x}{3x + 8y} + \ln (3x + 8y) \)

Find the second-order partial derivative.
3) Find \( f_{xx} \) when \( f(x, y) = 8x^3y - 7y^2 + 2x \).

A) -14  
B) 48xy  
C) 24x^2  
D) -28

4) Find \( f_{xy} \) when \( f(x, y) = x^5y^6 - \sqrt{2} x^6y^8 + 17x - y \).

A) 20x^3y^6 - 30\sqrt{2} x^4y^8  
B) 30x^3y^4 - 56\sqrt{2} x^5y^6  
C) 30x^4y^5 - 48\sqrt{2} x^5y^7  
D) 30x^4y^4 - 48\sqrt{2} x^5y^6

5) Find \( f_{yx} \) when \( f(x, y) = \ln(2x + 9y) \).

A) \( \frac{-9}{(2x + 9y)^2} \)  
B) \( \frac{18}{(2x + 9y)^2} \)  
C) \( \frac{9}{(2x + 9y)^2} \)  
D) \( \frac{-18}{(2x + 9y)^2} \)

Find any relative extrema.
6) \( f(x, y) = x^3 - 12xy + 8y^3 \)

A) \( f(2, 1) = -8 \), relative maximum  
B) \( f(1, 2) = 9 \), relative minimum  
C) \( f(2, 1) = -8 \), relative minimum  
D) \( f(1, 2) = 9 \), relative maximum

7) \( f(x, y) = x^2 - y^2 \)

A) \( f(0, 0) = 0 \), relative maximum  
B) No local extrema  
C) \( f(1, 1) = 0 \), relative maximum  
D) \( f(0, 0) = 0 \), relative minimum

Find the relative maximum and minimum values and the saddle points if they exist.
8) \( f(x, y) = 2xy + 2x - 2y \)

A) Relative maximum = -6  
B) Saddle point = (1, 1), saddle point = (-1, -1)  
C) Relative minimum = 2  
D) Saddle point = (1, -1)
9) \( f(x, y) = e^{-(x^2 + y^2 - 4y)} \)
   A) No relative extremum or saddle points
   B) Relative maximum = \( e^4 \), relative minimum = \( e^{-4} \)
   C) Relative maximum = \( e^4 \)
   D) Saddle point = (0, 2)

10) \( f(x, y) = e^{xy} \)
    A) No relative extrema or saddle points
    B) Saddle point = (0, 0)
    C) Relative minimum = 1
    D) Relative minimum = 0

Solve the problem.

11) The following data pertain to the residual chlorine in a swimming pool at various times after it has been treated with chemicals.

<table>
<thead>
<tr>
<th>number of hours, ( x )</th>
<th>residual chlorine (parts per million), ( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>4</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>1.4</td>
</tr>
<tr>
<td>8</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Find the regression line \( y = mx + b \).
   A) \( y = 0.22x + 3 \)
   B) \( y = 0.025x + 4 \)
   C) \( y = -0.37x + 8 \)
   D) \( y = -0.11x + 2 \)

Find the indicated relative minimum or maximum of \( f \) subject to the given constraint.

12) Minimum of \( f(x, y) = x^2 + y^2 \), subject to \( x + y = 1 \)
    A) Minimum = \( \frac{1}{2} \) at \( \left( \frac{1}{2}, \frac{1}{2} \right) \)
    B) Minimum = 1 at (0, 1)
    C) Minimum = \( \frac{1}{2} \) at (0, 1)
    D) Minimum = \( \frac{1}{2} \) at \( \left( \frac{1}{2}, \frac{1}{2} \right) \)

13) Minimum of \( f(x, y) = x^2 - 14x + y^2 - 16y \), subject to \( 2x + 3y = 12 \)
    A) Minimum = -24 at (2, 0)
    B) Minimum = -15 at (0, 1)
    C) Minimum = -61 at (3, 2)
    D) Minimum = -68 at (1, 5)

14) Maximum of \( f(x, y) = 4xy \), subject to \( x + y = 8 \)
    A) Maximum = 72 at (0, 8)
    B) Maximum = 64 at (4, 4)
    C) Maximum = 72 at (2, 6)
    D) Maximum = 64 at (3, 5)

Solve the problem.

15) Find two numbers \( x \) and \( y \) such that \( x + y = 36 \) and \( xy^2 \) is maximized.
    A) \( x = 18 \) and \( y = 18 \)
    B) \( x = 12 \) and \( y = 24 \)
    C) \( x = 9 \) and \( y = 27 \)
    D) \( x = 1 \) and \( y = 35 \)
16) What are the dimensions of a rectangular box, open at the top, which has maximum volume when the surface area is 48 in.\(^2\)?

A) \(x = 4\) in., \(y = 4\) in., \(z = 2\) in.
B) \(x = 4\) in., \(y = 2\) in., \(z = 2\) in.
C) \(x = 8\) in., \(y = 2\) in., \(z = 6\) in.
D) \(x = 6\) in., \(y = 6\) in., \(z = 3\) in.

17) A farmer has 500 m of fencing. Find the area of the largest rectangular field that he can enclose with his fencing. Assume that no fencing is needed along one edge of the field.

A) 62,500 m\(^2\)  B) 96,900 m\(^2\)  C) 44,400 m\(^2\)  D) 31,250 m\(^2\)

Find the indicated extreme value of \(f\) subject to the given constraint.

18) Minimum of \(f(x, y) = xy\), subject to \(x^2 + y^2 = 32\)

A) Minimum: 16 at (4, 4)  B) Minimum: 0 at (0, 0)
C) Minimum: 16 at (4, -4) and (-4, 4)  D) Minimum: -16 at (4, -4) and (-4, 4)

19) Maximum of \(f(x, y) = x^2 + 4y^3\), subject to \(x^2 + 2y^2 = 2\)

A) Maximum: 4 at (0, 1)  B) Maximum: -31 at (1, -2)
C) Maximum: -4 at (0, -1)  D) Maximum: 8 at (2, 1)

Evaluate the integral.

20) \(\int_{-8}^{6} \int_{2}^{3} 2x \, dy \, dx\)

A) 70  B) -28  C) -14  D) -196

21) \(\int_{0}^{1} \int_{8x}^{y} y \, dy \, dx\)

A) 256  B) 32  C) \(\frac{64}{3}\)  D) \(\frac{512}{3}\)

22) \(\int_{0}^{6} \int_{0}^{x/2} (x + y) \, dy \, dx\)

A) 36  B) 54  C) 45  D) 63

Find the volume under the surface \(z = f(x, y)\) and above the rectangle with the given boundaries.

23) \(z = 6x^2y; 0 \leq x \leq 4, 0 \leq y \leq 3\)

A) 676  B) 2256  C) 1256  D) 576

24) \(z = e^{2x} + 3y; 0 \leq x \leq 1, 0 \leq y \leq 1\)

A) \(\frac{1}{6}(e^5 - e^3 - e^2 + 1)\)  B) \(\frac{1}{4}(e^5 - e^3 - e^2 + 1)\)
C) \(\frac{1}{4}(e^5 - e^3 - e^2 - 1)\)  D) \(\frac{1}{6}(e^5 - e^3 - e^2 - 1)\)

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Find the volume under the surface of the specified figure.

25) \( z = 1 + x + y; \quad R = \{(x, y): 0 \leq x \leq 2, \ 0 \leq y \leq 4\} \)

A) 18  B) 24  C) 32  D) 11

Find the volume of the indicated region.

26) The region bounded by \( z = 100 - x^2 - y^2 \) and the xy-plane

A) \( \frac{10000}{3} \pi \)  B) \( \frac{5000}{3} \pi \)  C) 5000\pi  D) 2500\pi

27) the region bounded by the paraboloid \( z = x^2 + y^2 \) and the plane \( z = 64 \)

A) \( \frac{2048}{3} \pi \)  B) \( \frac{4096}{3} \pi \)  C) 1024\pi  D) 2048\pi
Answer Key
Testname: CAL-3-3-REVIEW

1) C
2) D
3) B
4) C
5) D
6) C
7) B
8) D
9) C
10) B
11) D
12) A
13) C
14) B
15) B
16) A
17) D
18) D
19) A
20) B
21) C
22) C
23) D
24) A
25) C
26) C
27) D