

**RELATIVE MAXIMA, MINIMA AND SADDLE POINT**

Locate all relative maxima, relative minima, and saddle points, if any.

1.  $f(x, y) = y^2 + xy + 3y + 2x + 3$

2.  $f(x, y) = x^2 + xy - 2y - 2x + 1$

3.  $f(x, y) = x^2 + xy + y^2 - 3x$

4.  $f(x, y) = xy - x^3 - y^2$

5.  $f(x, y) = x^2 + y^2 + \frac{2}{xy}$

6.  $f(x, y) = xe^y$

7.  $f(x, y) = x^2 + y - e^y$

8.  $f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y} \quad (a \neq 0, b \neq 0)$

9.  $f(x, y) = xy + \frac{2}{x} + \frac{4}{y}$

10.  $f(x, y) = e^x \sin y$

11.  $f(x, y) = y \sin x$

12.  $f(x, y) = e^{-(x^2+y^2+2x)}$

**LAGRANGE MULTIPLIERS**

Use Lagrange multipliers to find the maximum and minimum values of  $f$  subject to the given constraint.

Also, find the points at which these extreme values occur.

1.  $f(x, y) = xy; 4x^2 + 8y^2 = 16$

2.  $f(x, y) = x^2 - y^2; x^2 + y^2 = 25$

3.  $f(x, y) = 4x^3 + y^2; 2x^2 + y^2 = 1$

4.  $f(x, y) = x - 3y - 1; x^2 + 3y^2 = 16$

5.  $f(x, y, z) = 2x + y - 2z; x^2 + y^2 + z^2 = 4$

6.  $f(x, y) = 3x + 6y + 2z; 2x^2 + 4y^2 + z^2 = 70$

7.  $f(x, y, z) = xyz; x^2 + y^2 + z^2 = 1$

8.  $f(x, y) = x^4 + y^4 + z^4; x^2 + y^2 + z^2 = 1$