

# Math 233 - Quiz 10

April 20, 2023

Name key

Score \_\_\_\_\_

Show all work to receive full credit. Supply explanations when necessary.

1. (10 points) Find all relative extreme values and saddle points.

$$f(x, y) = x^3 + y^2 + 2xy - 4x - 3y + 5$$

$$f_x(x, y) = 3x^2 + 2y - 4 = 0$$

$$f_y(x, y) = 2y + 2x - 3 = 0$$
$$2y = 3 - 2x$$

$$3x^2 + 3 - 2x - 4 = 0$$

$$3x^2 - 2x - 1 = 0$$

$$(3x+1)(x-1) = 0$$

$$x = -\frac{1}{3}, x = 1$$

$$\downarrow \quad \downarrow$$
$$y = \frac{11}{6} \quad y = \frac{1}{2}$$

$$\left(-\frac{1}{3}, \frac{11}{6}\right), \left(1, \frac{1}{2}\right)$$

$$D = \begin{vmatrix} 6x & 2 \\ 2 & 2 \end{vmatrix} = 12x - 4$$

$$D\left(-\frac{1}{3}, \frac{11}{6}\right) = -8$$

$\Rightarrow \left(-\frac{1}{3}, \frac{11}{6}, \frac{317}{108}\right)$   
IS A SADDLE POINT

$$D\left(1, \frac{1}{2}\right) = 8 > 0$$

$$\text{AND } f_{yy}\left(1, \frac{1}{2}\right) = 2 > 0$$

$\Rightarrow f\left(1, \frac{1}{2}\right) = \frac{7}{4}$   
IS A REL MIN.