

Make Up  
Regional Exam #4

$$\textcircled{a} \quad f_x = 3x^2 + y = 0 \Rightarrow -y = 3x^2$$

$$f_y = 3y^2 + x = 0 \Rightarrow 3(3x^2)^2 + x = 0$$

$\Downarrow$

$$27x^4 + x = 0$$

$\Downarrow$

$$x(27x^3 + 1) = 0$$

$\Downarrow$

$$x = 0 \quad \text{or} \quad x^3 = -\frac{1}{27}$$

$\Downarrow$

$$x = \sqrt[3]{-1/27} = -1/3$$

$$\text{If } x=0, \quad y=0$$

Critical point  $(0,0)$

$$\text{If } x = -1/3, \quad y = -3(x^2) = -3\left(\frac{1}{9}\right) = -1/3$$

Critical point  $(-1/3, -1/3)$

# Makeup Exam #4

$$(b) \quad f_{xx} = 6x \quad f_{yy} = 6y \quad f_{xy} = 1$$

$$D(x,y) = (6x)(6y) - (1)^2 = 36xy - 1$$

$$D(0,0) = -1 < 0 \Rightarrow (0,0) \text{ a saddle point}$$

$$\left. \begin{aligned} D(-1/3, -1/3) &= 36\left(\frac{1}{9}\right) - 1 = 3 > 0 \\ f_{xx}(-1/3, -1/3) &= 6(-1/3) = -2 < 0 \end{aligned} \right\} \Rightarrow (-1/3, -1/3) \\ \text{a relative maximum}$$