4.3) Determine the level curve(s) of $f(x, y) = x^3 - 3\,x\,y^2$ through the stationary point.

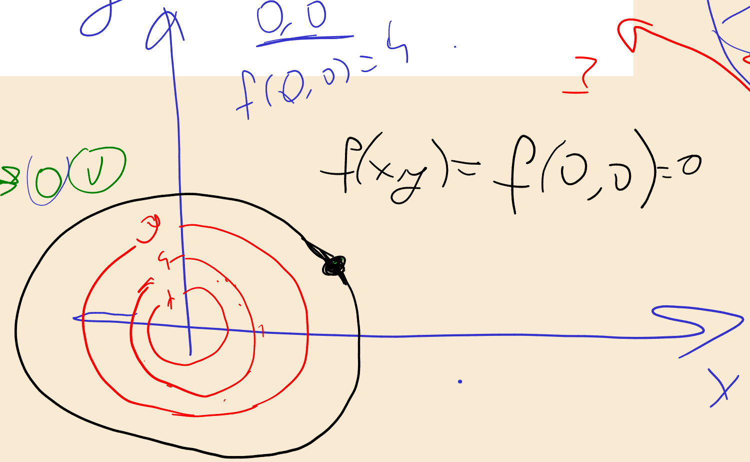
$$\begin{bmatrix} 3x^2 - 3y^2 \\ -6xy \end{bmatrix}$$

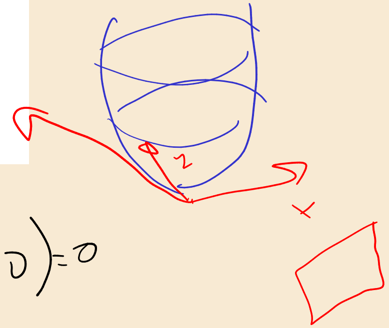
$x = y \to (0, 0)$

$x^3 - 3xy^2 + 4 \qquad x^2 + y^2$

$0, 0$

$f(0,0) = 4$





$f(x,y) = f(0,0) = 0$

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

$x(x^2 - 3y^2) = 0$

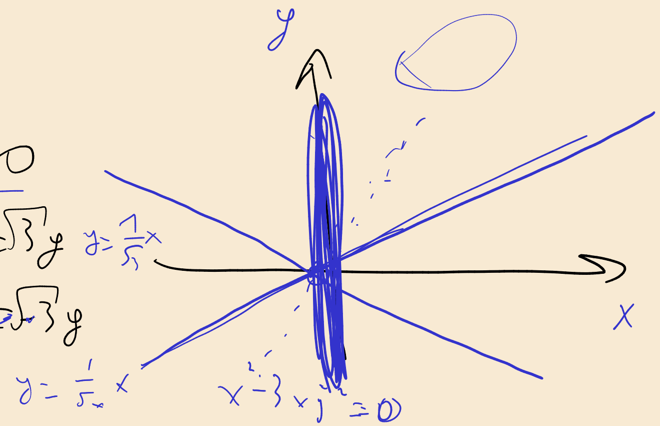
$ab = 0$

$a^2 - b^2 = (a-b)(a+b)$

$f(x,y) = K$

$ab = 0$

$$\left[\begin{array}{l} a = 0 \\ b = 0 \end{array}\right. \qquad \left[\begin{array}{l} x = 0 \\ x^2 - 3y^2 = 0 \end{array}\right. \to \left[\begin{array}{l} x = 0 \\ (x - \sqrt{3}y)(x + \sqrt{3}y) = 0 \end{array}\right. \to \left[\begin{array}{l} x = 0 \\ \left[\begin{array}{l} x = \sqrt{3}y \\ x = -\sqrt{3}y \end{array}\right. \end{array}\right.$$



$$f(x) = F'(x)$$

$\sin$

$\log$ $\quad x^n \quad \frac{x^3}{3}$

$\frac{1}{x}$ $\quad (\lg)' = \frac{1}{x}$ $\quad \sin \to \cos$

$e^x \quad e^x \quad -\cos \to +\sin$

$$\int (fg)' - \int f'g = \int fg'$$

$$\int f\,dg = fg - \int g\,df = xe^x\Big|_1^2 - \int_1^2 e^x \cdot 1\,dx =$$

14.2.2 $\quad \int_1^2 xe^x\,dx$ $\quad = xe^x - e^x\Big|_1^2$

$(e^x x)' = e^x \cdot x + e^x \cdot 1$ $\quad 2e^2 -$

xe^x $\quad \boxed{\begin{matrix} f = x \\ dg = e^x \end{matrix}} \to \begin{matrix} df = 1 \cdot dx \\ g = \int e^x = e^x \end{matrix}$

$$\int x^2 \ln x \, dx$$

$$f = \ln x \quad \Big| \quad df = \frac{1}{x} \cdot dx$$

$$dg = x^2 dx \quad \Big| \quad g = \frac{x^3}{3}$$

$$\ln x \frac{x^3}{3} - \frac{1}{3}\int x^2 dx$$ LIATE

$$\ln x \frac{x^3}{3} - \frac{1}{3}\frac{x^3}{3} + C$$

x^3, sin e^x a^x

$$\int x^2 e^x dx \qquad fg - \int g \, df$$

$$f = x^2 \quad \Big| \quad df = 2x\,dx$$

$$dg = e^x dx \quad \Big| \quad g = e^x$$

$$x^2 e^x - 2\int x e^x dx$$

$$(fg)'$$

$$e^{x^2} = e^{x^2}(x^2)'$$

$$f(g(x))' = f'(g(x)) \cdot g'$$

1 — 2

$$\int_1^2 2x e^{x^2} \boxed{dx}$$

$$u = x^2 \rightarrow \boxed{du = 2x\,dx}$$

$$dx = \boxed{\frac{du}{2x}}$$

1 — 4

$$\int_1^4 \cancel{2x}\, e^u \boxed{\frac{du}{\cancel{2x}}} = \int_1^4 e^u\, du$$

$$e^4 - e^1$$

$$\left(e^{x^2}\right)' = e^{x^2} \cdot 2x$$