$\langle 0, 1 \rangle$

Steepest increase

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

∇f

$\langle -2xy + y^2 + y, \; -x^2 + 2xy + x \rangle$

$\nabla f \cdot \vec{u}$

5. $f(x,y) = 2x^2y - 4xy^2$, $\vec{v} = \langle 1, 3 \rangle$, $P = (2,3)$.

$f_x = 4xy - 4y^2$

$4(2)(3) - 4(3^2) = -12$

$\langle 2, 3, -48 \rangle + t\langle 1, 0, -12 \rangle$

$\langle 2+t, 3, -48 - 12t \rangle$

$f(2,3) = 2(4)(3) - 4(2)(9)$

$24 - 72$

-48

$f_y = 4x^2 - 8xy$

-40

$\langle 2+0t, 3+t, -48 - 40t \rangle$

$D_{\langle 1,3 \rangle} f \quad \left\langle \frac{1}{\sqrt{10}}, \frac{3}{\sqrt{10}} \right\rangle \qquad \left\langle \frac{1}{\sqrt{10}}, \frac{3}{\sqrt{10}}, \frac{1}{\sqrt{10}}(-12) + \frac{3}{\sqrt{10}}(-40) \right\rangle$

7. $f(x,y) = 3x - 5y, \vec{v} = \langle 1,1 \rangle, P = (4,2).$

$f_x = 3$

$f(4,2) = 2$

$(4,2,2)$ $\langle 4+t, 2, 2+3t \rangle$

$\langle 1, 0, 3 \rangle$

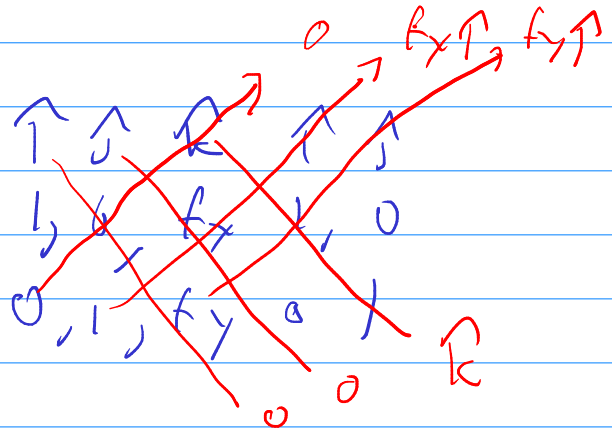
$f_y = -5$ $\langle 4, 2+t, 2-5t \rangle$

$D_{\langle 1,1 \rangle} f = \frac{-2}{\sqrt{2}}$

$\langle \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \rangle$

$\langle \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, \frac{-2}{\sqrt{2}} \rangle$

$\langle 4 + \frac{1}{\sqrt{2}}t, 2 + \frac{1}{\sqrt{2}}t, 2 - \frac{2}{\sqrt{2}}t \rangle$



$\langle -f_x, -f_y, 1 \rangle$

$\langle f_x, f_y, -1 \rangle$

$\langle x, y, f(x,y) \rangle + \langle f_x(x), f_y(y), -1 \rangle t$

$z = -x^2 - y^2 + 2$ at $(0,1)$.

$f_x = -2x$ $\langle 0, 1, 1 \rangle$

$f_y = -2y$ $\langle 0, 1, 1 \rangle + \langle 0, -2, -1 \rangle t$

$\langle f_x, f_y, -1 \rangle$ $\langle 0, 1-2t, 1-t \rangle$

$\langle 0, -2, -1 \rangle$

$0 = f_x(x_0,y_0)(x-x_0) + f_y(x_0,y_0)(y-y_0) + -1(z-f(x_0,y_0))$

$\langle 0, -2, -1 \rangle$

$\langle 0, 1, 1 \rangle$

$0(x-0) + -2(y-1) + -1(z-1) = 0$

$-2y+2-z+1=0$

$3 = 2y+z$

$$\int_1^{2y} 2xy\,dx.$$

$\int_1^{2y} 2xy\,dx$ $\quad x^2y+C\Big|_1^{2y}$

$4y^3+C-y+C$

$4y^3-y$

$\int_3^5 4x\,dx$

$2x^2+C\Big|_3^5 = 2.25+C-3.9+C$

23

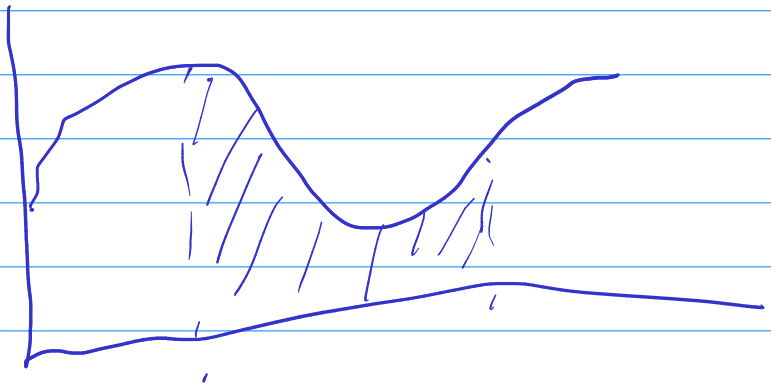
$$\int_1^x \left(5x^3y^{-3} + 6y^2\right) dy.$$

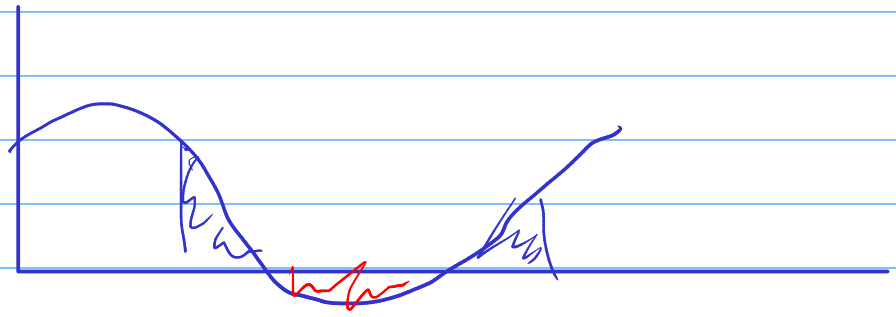
$$\frac{-5}{-2}x^3y^{-2} + 2y^3 + C \Big|_1^x$$

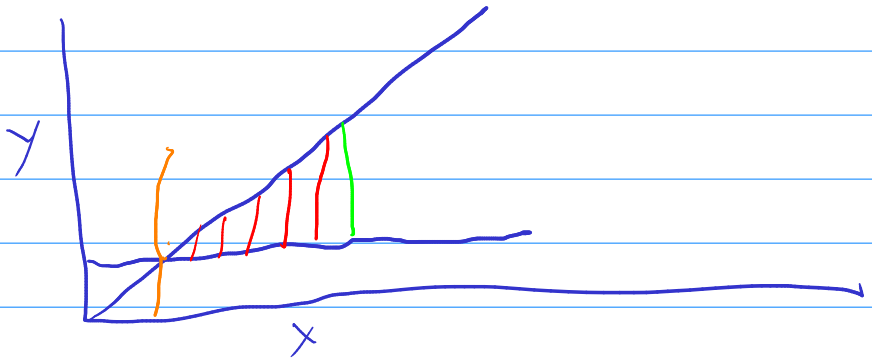
$$\frac{5}{2}x^3 \cdot x^{-2} + 2x^3 + C - \left(\frac{5}{2}x^3 + 2 + C\right)$$

$$\frac{5}{2}x + 2x^3 - \frac{5}{2}x^3 - 2$$

$$-\frac{1}{2}x^3 + \frac{5}{2}x - 2$$







$$\int_1^2 -\frac{1}{2}x^3 + \frac{5}{2}x - 2 \, dx$$

$$-\frac{1}{8}x^4 + \frac{5}{4}x^2 - 2x + C \Big|_1^2$$

$$\left[-2 + 5 - 4 + C\right) - \left(-\frac{1}{8} + \frac{5}{4} - 2 + C\right)$$

$$(-1 + C) - \left(-\frac{7}{8} + C\right)$$

$$-\frac{1}{8}$$