1. ~~E~~ $F(x,y,z) = y^2z^3 i + 2xyz^3 j + 3xy^2z^2 k$

$$\frac{d}{dx} = \frac{d}{dx}(y^2z^3) = 0$$

$$\frac{d}{dy} = \frac{d}{dy}(2xyz^3) = 2xz^3$$

$$\frac{d}{dz} = \frac{d}{dz}(3xy^2z^2) = 6xy^2z$$

Since they are ~~not~~ not the same

the vector is not conserative

2. $\int_C 2xy^2dx + 2x^2y\,dy$, C is the path from $(1,0)$ to $(0,1)$.

$P = f_x = 2xy^2 \quad Q = f_y = 2x^2y$

$$\frac{dP}{dy} = 4xy \ , \ \frac{dQ}{dx} = 4xy$$

the vector field is conserative, the integral is path independent.

$$f(x,y) = \int (2xy^2)\,dx = x^2y^2 + g(y)$$

$$f_y(x,y) = x^2y^2 + g'(y)$$

$$g(y) = \frac{1}{2}y$$

$$g(y) = \frac{1}{4}y^2 + \cancel{k}\,K$$

$$f(x,y) = x^2y^2 + \frac{1}{4}y^2 + K$$

$$\int_C \vec{F}\,d\vec{r} = \cancel{f(1,0)}\ f(0,1) - f(1,0)$$

$$= (\tfrac{1}{4} + K) - (0 + K)$$

$$= \frac{1}{4}$$