2. $f(x,y) = x^3 + 4y^2$

$f_x = 3x^2$

$f_y = 8y$

$\vec{F}(x,y) = 3x^2\vec{i} + 8y\vec{j}$

3. $f(x,y,z) = e^{3x} - e^{y^2z^3}$

$f_x = e^{3x} \cdot 3 = 3e^{3x}$

$f_y = -e^{y^2z^3} \cdot 2yz^3$

$= -2yz^3e^{y^2z^3}$

$f_z = -e^{y^2z^3} \cdot 3y^2z^2$

$= -3y^2z^2e^{y^2z^3}$

$\vec{F}(x,y,z) = 3e^{3x}\vec{i} - 2yz^3e^{y^2z^3}\vec{j} - 3y^2z^2e^{y^2z^3}\vec{k}$

4. $F(x,y) = \underbrace{x^2y}_{M}\vec{i} + \underbrace{\frac{1}{3}x^3}_{N}\vec{j}$

$\frac{\partial M}{\partial y} \stackrel{?}{=} \frac{\partial N}{\partial x}$

$x^2 \stackrel{?}{=} \frac{1}{3} \cdot 3x^2$

$x^2 = x^2$ ✓

5. $F(x,y) = \underbrace{7xy}_{M}\vec{i} + \underbrace{\frac{7}{2}x^2}_{N}\vec{j}$

$\frac{\partial M}{\partial y} \stackrel{?}{=} \frac{\partial N}{\partial x}$

$7x \stackrel{?}{=} \frac{7}{2} \cdot 2x$

$7x = 7x$ ✓

YES

6. $\vec{F}(x,y) = \underbrace{2x^2y}_{M}\vec{i} + \underbrace{x^2y^3}_{N}\vec{j}$

$\frac{\partial M}{\partial y} \stackrel{?}{=} \frac{\partial N}{\partial x}$

$2x^2 \stackrel{?}{=} 2xy^3$

NO