Test #1 solutions

$\underbrace{3x^2 + 7 - 2xy}_{M} + \underbrace{(-x^2 + 27y^2 - 3)}_{N} y' = 0$

$\frac{d}{dy}(M) = \frac{d}{dx}(N)$ means it is exact

$\frac{d}{dy}(M) = \frac{d}{dy}(3x^2 + 7 - 2xy) = -2x$

$\frac{d}{dx}(N) = \frac{d}{dx}(-x^2 + 27y^2 - 3) = -2x$] exact

$N = Fy \quad \frac{d}{dy} \quad F = \int M \, dx$

$\int 3x^2 + 7 - 2xy \, dx$

$x^3 + 7x - 2y\frac{x^2}{2} + Q(x)$

$F = x^3 + 7x - x^2 y + Q(x)$

$Fy = \frac{d}{dy}(x^3 + 7x - x^2 y)$

$= -x^2 + Q(x)$

$N = Fy \quad : -x^2 + 27y^2 - 3 = -x^2 + Q'(x)$

$Q'(x) = 27y^2 - 3$

$\int 27y^2 - 3 \, dy$

$= \frac{27y^3}{3} - 3y$

$= Q(x) = 9y^3 - 3y + C$

$F = x^3 + 7x - x^2 y + Q(y)$

$= x^3 + 7x - x^2 y + 9y^3 - 3y = C$