Math 274 Quiz 3 **Name:** _____

Sections: 2.5-2.6 Point values in boxes.

14 September 2018

1. [2] Show the equation

$$(y - xy^2)dx - xdy = 0.$$

is not exact.

$\frac{\partial}{\partial y}(y - xy^2) = 1 - 2xy \neq \frac{\partial}{\partial x}(-x) = -1$

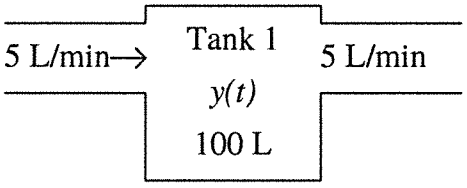
2. [3] The equation

$$(3 + 2xy^3)dx + (3x^2y^2 + \sin y)dy = 0$$

is exact. Find a general solution.

$3x + x^2y^3 - \cos y = C$

3. [5] Consider a 100 L tank of pure water (imported from the Alps) into which a saline solution begins to flow at a constant rate of 5 L/min. The solution in the tank is well-mixed and flows out of the tank at 5 L/min. The concentration of the saline solution entering the tank is 0.5 kg/L.



Letting $y(t)$ denote the mass of salt in the tank after t minutes, determine $y(t)$.

$\frac{dy}{dt} = \frac{5}{2} - \frac{5y}{100}$, $y(0) = 0$

$\frac{dy}{dt} - \left(-\frac{1}{20}\right)y = \frac{5}{2}$

$u(t) = e^{\int \frac{dt}{20}} = e^{t/20}$

$e^{t/20}y' + \frac{1}{20}e^{t/20}y = \frac{5}{2}e^{t/20}$

$e^{t/20}y = \int \frac{5}{2}e^{t/20}dt$

$e^{t/20}y = 50e^{t/20} + C$

$y = 50 + Ce^{-t/20}$

$y(0) = 0$, so

$y = 50\left(1 - e^{-t/20}\right)$