Name: Date: 04/12/2018

M20580 L.A. and D.E. Tutorial
Worksheet 10
Sections 2.1, 2.2, 2.3

1. Which of the following are the first-order linear differential equations? Check **all** that apply:

   ☐ $y' = \dfrac{M(x)}{N(y)}$

   ☐ $y'' + P(x)y = Q(x)$

   ☐ $y' + P(x)y = Q(x)$

   ☐ $P(x)y' + y = Q(x)y^2$

   ☐ $P(x)y' + Q(x)y = R(x)$

   ☐ $y' = P(x) + Q(x)y$

   Write the formula for the integrating factor for each linear equation you found above.

2. Determine whether the following differential equation is first-order linear or separable equation?

$$\frac{dy}{dx} = \frac{\ln x + y\cos x}{\csc x}$$

   If it's a linear equation, find the integrating factor (you don't need to solve it). But, if it's a separable equation, find general solutions to the differential equation

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3. Let $\phi(x)$ be a solution to $\dfrac{dy}{dx} = \dfrac{1+y^2}{x^2}$ that satisfies $\phi(1) = 0$. Find $\phi(2)$.

4. Solve the differential equation $y' = xy + (\sin x)e^{x^2/2}$ with $y(0) = 2$.

5. A tank initially contains 120 L of pure water. A mixture containing a concentration of 10 g/L of salt enters the tank at the rate of 2 L/min, and the well-stirred mixture leaves the tank *at the same rate*.

   Find an expression for the amount of salt in the tank at any time t. Also find the limit of the amount of salt in the tank as $t \to \infty$.