MATH 1B: CALCULUS DISCUSSION SECTION 2 WORKSHEET 10

1. (a) What is $\frac{d}{dx}\left(ye^{f(x)}\right)$?

   (b) Suppose you have a magic box that can integrate ANYTHING but is pretty bad at math otherwise. Use your answer to part (a) to rewrite the differential equation

   $$R(x)y' + P(x)y = Q(x)$$

   in a form which the magic box can integrate (assuming that $R(x)$ is nonzero).

   (c) Use part (b) to write an expression for the solution for the *linearized ice cream equation*

   $$y' = 10 - ky\cos(2\pi t/7) - M$$

2. Solve the differential equation $y' + x^2y = 0$ by separating variables. Then use integrating factor. Do your answers agree?

3. Determine if the following differential equations are seperable, linear, both, or neither. If they are linear, solve them using the integrating factor method.

(a) $yy' = x\sqrt{1+x^2}\sqrt{1+y^2}$

(b) $xy' - 2y = x^3$

(c) [1] $(y')^2 = \left(1 - \dfrac{2M}{y}\right)^2 \left(\dfrac{2M}{y}\right)$

(d) $y' = \cos(x)(1-y)$

(e) $1 + y^2 - y'\sqrt{1+x^2} = 0$

(f) $y' = x + y$

(g) $xy' - \dfrac{y}{x+1} = x; \;\; y(1) = 0$

(h) $1 + 2xy^2 + 2x^2yy' = 0$

4. Suppose you are in charge of a bank. Suppose that people come in at a rate of 100 people per hour and leave at a rate of 50 people per hour. Suppose that on average people have 100 dollars apeice in their wallets when they come in, and that they leave with 10% of the money in the bank as they go out. Write a differential equation to describe amount of money of your bank as a function of time, and solve it, presuming you start the day with no cash.

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[1] This is the equation of motion for a radial null geodesic outside of a Schwarzchild black hole