## MATH 2340 WARM-UP PROBLEMS

1. Is the function  $\mu(x) = e^x$  an integrating function for the differential equation

 $xy' + y = x^4, \quad x > 0?$ 

2. Find the general solution to the differential equation

$$xy' - y = x^3 e^{-x}.$$

Hint: make sure that the differential equation is linear and in standard linear form.

3. Last time, we discussed how to solve linear, first-order, differential equations using an *linear integrating function*. But there is another way that we can solve this problem: *variation of parameters*. As an example, consider the following ODE:

$$\frac{dr}{dt} + 2t r = g(t) \tag{1}$$

- (a) Under what conditions is r(t) = 0 a solution to the ODE?
- (b) If g(t) = 0, solve the differential equation given by (1). Let's call this solution  $r_h(t)$ .

(c) Now, let's solve (1) with g(t) = 2. To do this, assume that the constant of integration in the previous part is now an unknown function of t. In other words, let you  $c \to v(t)$ , where v(t) is unknown. Can you use this information to solve for r(t) when g(t) = 2?

Hint: you are guessing a form for the solution that should look like  $r(t) = v(t)e^{-t^2}$  where v(t) is unknown. If r(t) is a solution, what should you do?