You are encouraged to share ideas and work together to understand the problems and their solutions. Each student, however, should write up their answers in their own words.

1. A separable equation can always be written in the form \( \frac{dy}{dx} = f(x)g(y) \). Show that separating the variables, and then collecting both terms on the same side of the equation, always turns a separable equation into an exact equation. In fact, the paradigm we learned for separable equations is basically the same as for exact equations, just with a couple of shortcuts that work specifically for separable equations.

2. In solving a differential equation, you sometimes encounter an integral that you can’t evaluate. In this case, you just leave the integral in the solution. Since it is usually easier (quicker, more accurate) to numerically approximate an integral than carry out a numerical solution of a differential equation, having a solution in integral form is better than no solution at all. Solve the initial value problem

\[
\frac{dy}{dx} = 2xy + 1, \quad y(0) = 0
\]

and approximate \( y(1) \). You may use a numerical integration routine on your calculator if you have one (the TI-82, 83, and 89 have an excellent numerical integration routine built in), or you may use Simpson’s rule with 2 (or more) panels. As always, you must show your work, but if you use your calculator you just need to note that fact when writing up your results.

Note that this problem is similar to the example on pages 19-20 of the text. There is a typo in the formulas at the end of that example. The formulas in the section labeled SECOND at the top of p. 20 should read

\[
y(1) = e^{-(t^2)} \int_1^1 e^{t^2} \, ds + Ce^{-(t^2)} = 2
\]

\[
C = 2e
\]

The red terms were left out of the printed formula in the text.