1. (10 points) Solve the following differential equation.

$$(2x + \sin y)\ dx + (x\ \cos y + e^y)\ dy = 0$$

2. (10 points) Solve the following differential equation. Express your solution in *explicit form.*

$$y' = -\sin^2(x + y - 5)$$

3. (10 points) Solve the following initial-value problem. Express your solution in *explicit form.*

$$x\ y' + (x+1)\ y = e^{-x}\ \ln x, \qquad y(1) = 0$$

4. (10 points) Solve the following differential equation. Express your solution in *explicit form.*

$$x\ y' + x^2\ y^3 = y$$

5. (6 points) Determine the region of the xy-plane for which the following differential equations possesses a unique solution. Explain your work and sketch the region.

a. $y' = \dfrac{y}{x}$

b. $y' = \sqrt{y-1}\ \sqrt{x}$

6. (10 points) Solve the following differential equation.

$$x^2\, y' = y^2\, e^{x/y} + xy$$

7. (9 points) The rate of change of a population of monkeys is proportional to the square root of the monkey population. Initially there are 100 monkeys and 2 years later there are 400 monkeys. How many monkeys will there be in 5 years?