

Answer the problems on **separate** paper. You do not need to rewrite the problem statements on your answer sheets. Do your own work. Show **all relevant steps** which lead to your solutions. Retain this question sheet so that you can answer the “Outside of class” problems. The “Outside of class” problems are due Friday, November 9, at the beginning of class.

Part A. In class: Do four of the five problems. Outside of class: Do the other problem.

1. Show that $y = x + x \ln x - 1$ is a solution of the differential equation

$$x^2 \frac{dy}{dx} - xy = x^2 + x$$

2. Find the general solution of the differential equation $(x - 2)^2 dy + 3y^4 dx = 0$.

3. Find the general solution of the differential equation $(8x + y \cos(xy))dx + (5y + x \cos(xy))dy = 0$

4. Find the general solution of the differential equation $xy' + 2y = \frac{1}{x^2 + 1}$

5. Solve the initial value problem $x^2(y + 4)dy + dx = 0$, $y(1) = 2$.

Part B. In class: Do two of the three problems. Outside of class: Do the other problem. Observe significant digits.

6. Radioactive carbon-14 has a half-life of 5730.0 years. At a containment site for decaying radioactive materials, regulations stipulate that a sample can be disposed of only if it is 1.0000 gram or smaller. If 3.0000 grams of carbon-14 were delivered to the containment site, how long would they have to keep the decaying sample before it could be disposed of?
7. The temperature at Tech’s computer center is maintained at a constant 20.0°C . On a hot summer day, an iron bar is brought into the room from outside where lying in the sun it had reached a temperature of 32.0°C . After 5.00 minutes the temperature of the bar had dropped to 28.0° . How many minutes later will the temperature of the bar reach 22.0° ?
8. A 70.0 gallon tank is filled with a saline solution containing 15.0 lbs of dissolved salt. Saltwater containing 0.400 lbs of salt per gallon is flowing into the tank at a rate of 2.00 gallons per minute. The solution is well stirred. There is an outflow from the tank at a rate of 2.00 gallons per minute so that the volume saline solution in the tank remains constant.

Determine the amount of salt in the tank after 15.0 minutes.