Math 242,   Exam 1,   Spring, 2024

You should KEEP this piece of paper. Write everything on the **blank paper provided**. Return the problems **in order** (use as much paper as necessary), use **only one side** of each piece of paper. Number your pages and write your name on each page. Take a picture of your exam (for your records) just before you turn the exam in. I will e-mail your grade and my comments to you. **Fold your exam in half** before you turn it in.

The exam is worth 50 points. Each problem is worth 10 points. **Make your work coherent, complete, and correct.** Please $\boxed{CIRCLE}$ your answer. Please **CHECK** your answer whenever possible.

The solutions will be posted later today.

No Calculators, Cell phones, computers, notes, etc.

(1) Find all functions of the form $y = e^{rx}$ which are solutions of the Differential Equation $y'' + 4y' - 5y = 0$.

(2) (a) Verify that $y = \frac{1}{4}x^5 + Cx^{-3}$ is a solution of the Differential Equation $x\frac{dy}{dx} + 3y = 2x^5$.

   (b) Solve the Initial Vakue Problem

$$x\frac{dy}{dx} + 3y = 2x^5 \quad \text{and} \quad y(2) = 1.$$

(3) Solve the Differential Equation

$$\frac{dy}{dx} = x\sqrt{x^2 + 9}.$$

(4) Use Euler's Method to approximate $y(1/2)$, where y is a solution of the Initial Value Problem $y' = 2y$, $y(0) = \frac{1}{2}$. Use two steps, each of size $h = \frac{1}{4}$.

(5) Suppose a car starts from rest, its engine providing an acceleration of 10 ft/sec^2, while air resistance provides $.1$ ft/sec^2 of deceleration for each foot per second squared of the car's velocity.

   (a) Find the velocity of the car at time t.

   (b) Find the limit as time goes to infinity of the velocity of the car.