

YOUR NAME: \_\_\_\_\_

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Read each problem **very carefully** before starting to solve it. Each problem is worth 10 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. Find the particular solution of the initial value problem

$$\frac{dy}{dx} = \frac{e^{-x} - e^x}{3 + 4y}, \quad y(0) = 1.$$

2. Find the general solution of

$$ty' - y = t^2e^{-t}, \quad t > 0.$$

3. A 500 gallon tank originally contains 200 gallons of water with 100 lb of salt in solution. A mixture containing 1 lb of salt per gallon is entering at a rate of 3 gallons per minute and the mixture is allowed to flow out of the tank at a rate of 2 gallons/minute. Find the amount  $y$  of salt in the tank at any time prior to the instant when the solution begins to overflow.
- (Hint: Before writing down the differential equation, find the volume of water in the tank at time  $t$  to help you write an expression for the out-flowing rate.)

4. Check whether the given differential equation is exact and follow the appropriate steps to solve it.

$$(3x^2 - 2xy + 2) + (6y^2 - x^2 + 3)y' = 0.$$

5. Check whether the given differential equation is exact and follow the appropriate steps to solve it.

$$(1 - e^{2x} - y) + y' = 0.$$