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Student ID: _____

EXAM 1

- The exam is closed book, notes and neighbor. No calculators.
- SHOW ALL WORK!!!
- Good luck!



Problem	1	2	3	4	5	6	Bonus	Total
Score								
Possible	16	18	18	14	20	14	10	100

1. (16 points) For the autonomous differential equation, find and classify the critical point(s) as unstable, semi-stable, or asymptotically stable. Draw the phase portrait.

$$\frac{dy}{dx} = y^2(4 - y^2)$$

2. (18 points) Solve the exact differential equation. Find a solution satisfying the initial condition y(0) = 0.

$$(\cos(x) + x + 3y^2)dx + (6xy + e^y)dy = 0$$

3. (18 points) Solve the given Initial Value Problem:

$$(2x+3)y' = y + (2x+3)^{1/2}$$
 $y(-1) = 4$

4. (14 points) Solve the homogeneous differential equation

$$y' = \frac{2 - x - y}{x + y}$$

- 5. (20 points) A full 400 gallon water tank contains 150 lbs of salt. Water containing 1 lb/gal of salt flows into the tank at a rate of 4 gal/min. The well mixed solution flows out at the same rate.
 - a. What is the differential equation and initial value for the system?
 - b. Solve the initial value problem.
 - c. How much salt is in the tank after a long, long time? Provide justification.

6. (14 points) Solve the differential equation with the appropriate substitution:

$$\frac{dy}{dx} = (x - y)^2 - 2(x - y) - 2$$

BONUS: Graph the solution curves for problem 1. Be sure to show concavity! Tip: $\sqrt{2} \approx 1.41$