NOTE: Calculators can be used to check the evaluation of definite integrals, but if the problem asks you to find an antiderivative or use a particular integration technique, then you should show your work. To reiterate: You must SHOW your work to receive credit for the problems.

1. **(5 points)** Use the table on the screen to find the indefinite integral: 
   \[ \int \frac{3}{x\sqrt{9 + 25x^2}} \, dx \]

2. **(10 points)** Solve the following using integration by parts. 
   \[ \int x \ln(x) \, dx \]

3. **(10 points)** Solve the following using partial fractions. 
   \[ \int_{2}^{4} \frac{x}{x^2 + x - 2} \, dx \]

4. **(10 points)** Find the following (show your work): 
   \[ \int_{-1}^{1} \frac{2}{\sqrt{2z+1}} \, dz = \]

5. **(10 points)** Solve the following differential equation: 
   \[ 2x \frac{dy}{dx} = y + x^3 \]

6. **(5 points)** Solve the following by whatever non-technology means you wish. 
   \[ \int \frac{x}{x^2 - 9} \, dx \]

7. **(10 points)** Find the orthogonal trajectories for the family of ellipses \( \{2x^2 + y^2 = C: \ C > 0\} \).

8. **(10 points)** Bartholomew has a 20 gallon salt-water fish tank containing 15 gallons of salt-water with a concentration of .5 lbs of salt per gallon. For the particular fish he needs to introduce into the tank, he needs the concentration of salt to be .7 lbs/gal. He has a 10 gallon bucket of special saltwater solution with a concentration of 1 lb/gal which he plans to pour slowly into the tank while he thoroughly mixes the solution in the tank. Because he is a math nerd, he realizes that he might not be able to add enough to bring the concentration to the desired level, so he plans to drain some of the solution in the tank while he’s adding the higher concentrated solution. He will add 2 gal/min while draining 1 gal/min.

   a) Will he be able to reach the desired concentration level before the tank overflows? If so, when?
   b) If not, what should his drain rate be in order to reach the desired concentration just as the tank becomes full?