Part I Problems

For each of the following ODE’s, draw a direction field by using about five isoclines; the picture should be square, using the intervals between -2 and 2 on both axes. Then sketch in some integral curves, using the information provided by the direction field. Finally, do whatever else is asked.

**Problem 1:** \( y' = -\frac{y}{x} \). Solve the equation exactly and compare your integral curves with the correct ones.

**Problem 2:** \( y' = 2x + y \). Find a solution whose graph is also an isocline, and verify this fact analytically (i.e., by calculation, and not from a picture).

**Problem 3:** \( y' = \frac{1}{x+y} \). Use the interval -3 to 3 on both axes; draw in the integral curves that pass respectively through \((0, 0), (-1, 1), (0, -2)\). Will these curves cross the line \( y = -x - 1 \)? Explain by using the Intersection Principle.