

**Instructions:** Complete each of the following on separate, stapled sheets of paper.

1. Is the IVP  $y' = \sqrt{y^2 - 9}$  guaranteed to have a unique solution with IC  $y(2) = 3$ ? What about with IC  $y(-1) = 1$ ?

2. Solve each of the ODEs below.

(a)  $\frac{dy}{dx} = e^x \cos(y)$

(b)  $\left(1 + \ln(x) + \frac{y}{x}\right) dx = (1 - \ln(x)) dy$

(c)  $(10 - 6y + e^{-3x}) dx - 2 dy = 0$

(d)  $\frac{dr}{d\theta} + r \sec(\theta) = \cos(\theta)$

(e)  $x \frac{dy}{dx} + y = \frac{1}{y^2}$

(f)  $(y^2 + xy) dx - x^2 dy = 0$

3. Solve each of the IVPs below.

(a)  $y \frac{dy}{dx} + \sin(x) = 0, \quad y(0) = 1$

(b)  $(x + y)^2 dx + (2xy + x^2 - 1) dy = 0, \quad y(1) = 1$

(c)  $(x^2 + y^2 - 5) dx = (y + xy) dy, \quad y(4) = 0$

(d)  $x(x + 1) \frac{dy}{dx} + xy = 1, \quad y(e) = 1$

(e)  $x^2 \frac{dy}{dx} - 2xy = 3y^4, \quad y(1) = \frac{1}{2}$

(f)  $(x + y \exp(\frac{y}{x})) dx - x \exp(\frac{y}{x}) dy = 0, \quad y(1) = 2$