

Instructions: Work the problems below as directed. Show all work. Clearly mark your final answers. Use exact values unless the problem specifically directs you to round. Simplify as much as possible. Partial credit is possible, but solutions without work will not receive full credit.

1. Find a general solution to the differential equation $y \ln x - xy' = 0$. Then find the particular solution for the initial condition $y(2) = 5$. You may estimate your constant to two decimal places in the final step.

$$y \ln x = xy'$$

$$\int \frac{\ln x}{x} = \int \frac{y'}{y}$$

$$\frac{(\ln x)^2}{2} + C = \ln y$$

$$\frac{(\ln 2)^2}{2} + C = \ln 5$$

$$C = \ln 5 - \frac{(\ln 2)^2}{2}$$

$$\ln y = \frac{(\ln x)^2}{2} + \left[\ln 5 - \frac{(\ln 2)^2}{2} \right]$$

2. Given the differential equation $\frac{dy}{dx} = y(4-y)(y-2)$. Sketch the phase plane for the equation and use that information to graph the key features of the direction field such as the equilibria (steady state solutions) and the sign of the slope in each region. Label each equilibrium as stable, unstable or semi-stable.

