2. [11 points] Kazilla sends you on a very important trip to the store. Rather than give you directions, she provides you with the differential equation

$$\frac{dy}{dx} = x + xy + 1$$

which gives $x-$ and $y-$coordinates on your map. Your current position on the map is the point $(0, -1)$.

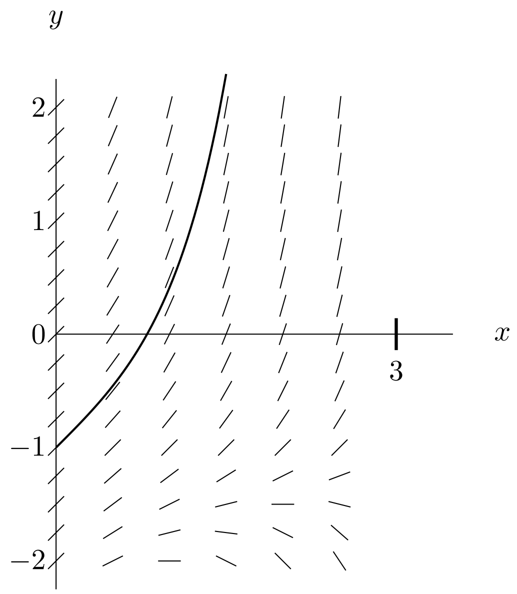
a. [1 point] Is this differential equation separable? Circle one. **Yes** $\boxed{\textbf{No}}$

b. [5 points] Kazilla tells you to follow the solution curve to the differential equation from your current position to $x = 1.5$ to find the location of the store on the map. Use Euler's method with step size $\Delta x = 0.5$ to approximate the $y-$coordinate of the store.

Solution:

x	y	$\Delta y = \Delta x(x + xy + 1)$
0	-1	$0.5(0 + 0(-1) + 1) = 0.5$
0.5	-0.5	$0.5(0.5 + 0.5(-0.5) + 1) = 0.625$
1	0.125	$0.5(1 + (1(0.125) + 1) = 1.0625$
1.5	1.1875	-

c. [2 points] The slope field of the differential equation is given below. Sketch the solution passing through $(0, -1)$. The point (3,0) is labeled for scale.



d. [3 points] Is the estimate for the position of the store you found in part **(b)** above or below the actual position of the store on your map? Justify your answer.

Solution: Euler's method uses tangent line approximations. In part **(c.)** we saw that the actual solution curve is concave up over the region $0 \leq x \leq 1.5$, so Euler's method will give an underestimate for the actual value. Therefore our estimate in part **(b).** is be low the actual position of the store.