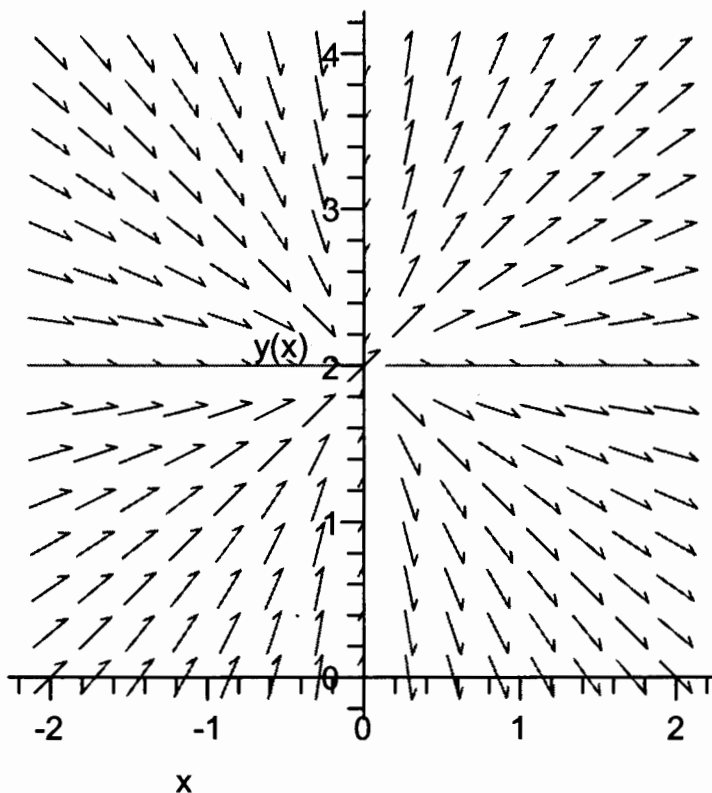


Show all work, including mental steps, in a clearly organized way that speaks for itself. Use proper mathematical notation, identifying expressions by their proper symbols (introducing them if necessary), and use arrows and equal signs when appropriate. Always simplify expressions. **BOX** final short answers. **LABEL** parts of problem. Keep answers **EXACT** (but give decimal approximations for interpretation). Indicate where technology is used and what type (Maple, GC).

1.  $x \frac{dy}{dx} + 2 - y = 0$

- a) Find the general solution using the separable technique.
- b) Find the general solution using the linear technique.
- c) Check that your general solution actually satisfies the DE by backsubstituting everywhere and simplifying.
- d) Find the particular solution which satisfies the initial condition  $y(1) = 3$ .
- e) Hand draw the solution curve with this initial condition (circle the initial point) on the following directionfield:



2. a) An arrow is shot straight upward from the ground with an initial velocity  $v_0 = 160$  ft/s. It experiences both the deceleration of gravity ( $g = 32$  ft/s<sup>2</sup>) and the deceleration  $v^2/800$  ft/s<sup>2</sup> due to the air, so while it is going up, it satisfies the DE:  $\frac{dv}{dt} = -32 - \frac{v^2}{800}$ ,  $v \geq 0$ .

After how many seconds does the arrow reach its highest point (when  $v = 0$ )? Give your final answer with units and accurate to 2 decimal places.

[You will need technology to obtain the antiderivative needed to solve this problem.]

**b) Optional Bonus:**

If you finish early and are sure of all of your work, and have checked it with Maple, answer the question: how long does it take without the air drag? [This should be a slightly bigger number since the air drag slows it to a

stop a bit sooner and hence it is a qualitative check on your answer.]

**c) After Test Bonus:**

Answer the question: how far up does the arrow go, with air drag and without? [solution on-line]

► **solution**

▼ **pledge**

When you have completed the exam, please read and sign the dr bob integrity pledge and hand this test sheet in on top of your answer sheets as a cover page, with the first test page facing up:

"During this examination, all work has been my own. I give my word that I have not resorted to any ethically questionable means of improving my grade or anyone else's on this examination and that I have not discussed this exam with anyone other than my instructor, nor will I until after the exam period is terminated for all participants."

Signature:

Date: