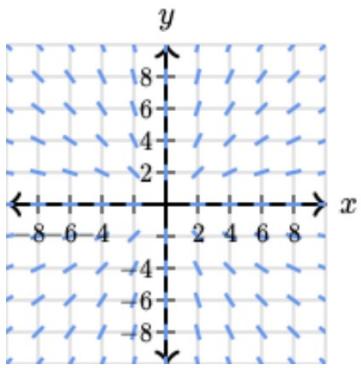
Rules:

- Before we start, choose a team name, an alert ringtone on your phone.
- Choose a group member who will be the "buzzer."
- The first team with the right answer ***after all the answers have been read*** gets points.
- If you buzz in with the wrong answer, you lose a point.
- Except for DOUBLE and FINAL jeopardy, every question is worth one point.
- The last question is "FINAL JEOPARDY," where you'll be able to wager your points (or get two points if you have less than two).

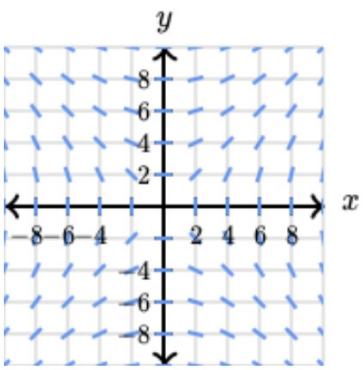
Don't flip until we start the next question together!
(this handout is double sided)

Example 31.0.1. Which of the following is the slope field for $\frac{dy}{dx} = \frac{x-2}{y}$?

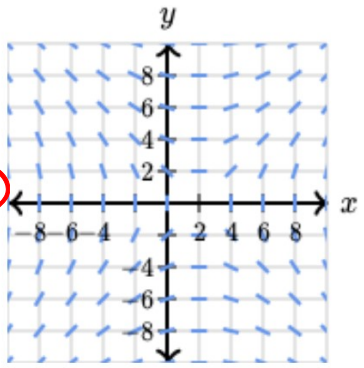
A



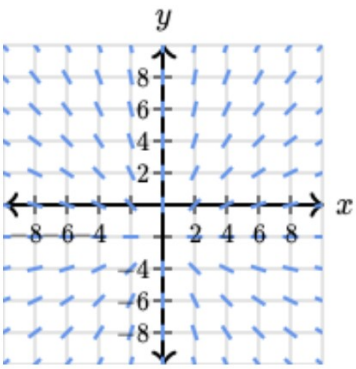
B



C



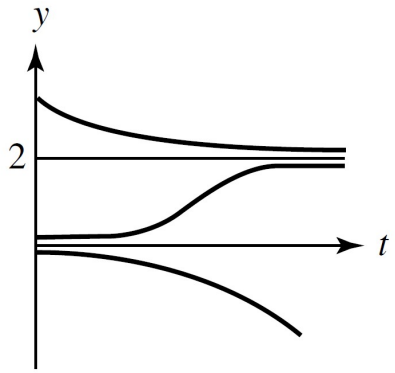
D



Don't flip until we start the next question together!

(this handout is double sided)

Example 31.0.2. Which differential equation could have the following family of solution curves?



(a) $\frac{dy}{dt} = -t(t-2)$

(b) $\frac{dy}{dt} = t(t-2)$

(c) $\frac{dy}{dt} = -y(y-2)$

(d) $\frac{dy}{dt} = y(y-2)$

$\frac{dy}{dt} = 0 \iff y = 0, 2$

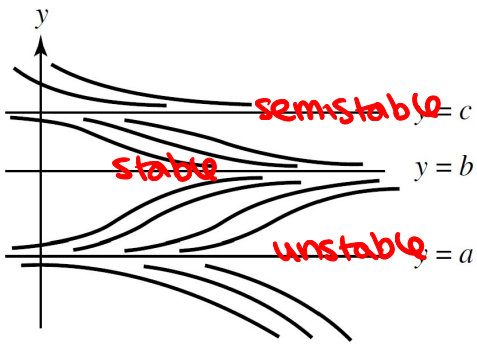
and $\frac{dy}{dt} > 0$ when $0 < y < 2$

$\frac{dy}{dt} < 0$ when $y > 2$ or $y < 0$

Don't flip until we start the next question together!

(this handout is double sided)

Example 31.0.3. The following is a family of solutions to an autonomous differential equation.



The differential equation has

(a) stable equilibrium at $y = a$

(b) semi-stable equilibrium at $y = b$

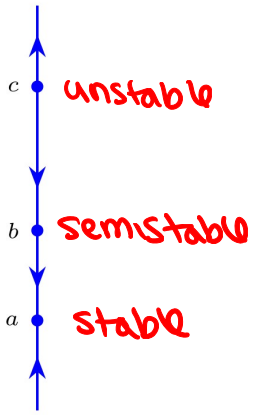
(c) unstable equilibrium at $y = c$

(d) semi-stable equilibrium at $y = c$

Don't flip until we start the next question together!

(this handout is double sided)

Example 31.0.4. The differential equation $\frac{dy}{dx} = f(y)$ has the following phase line.



$\frac{dy}{dx} = f(y)$ has

(a) stable equilibrium at $y = a$

(b) semi-stable equilibrium at $y = b$

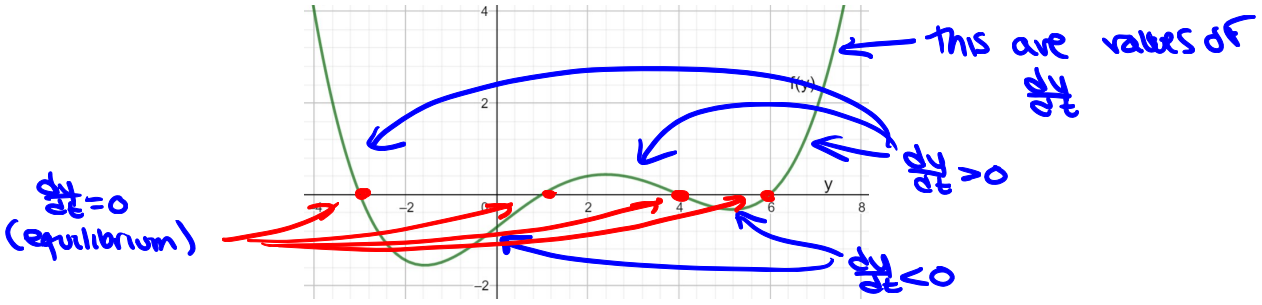
(c) unstable equilibrium at $y = c$

(d) all of the above

Don't flip until we start the next question together!

(this handout is double sided)

Example 31.0.5. Consider $\frac{dy}{dt} = f(y)$ where the graph of $f(y)$ is given below.



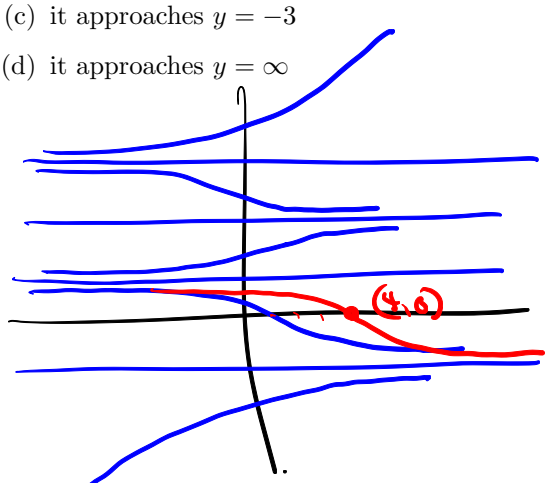
Estimate what happens overall (as $t \to \infty$) to a solution passing through $(4, 0)$.

(a) it approaches $t = 6$

(b) it approaches $y = 6$

(c) it approaches $y = -3$

(d) it approaches $y = \infty$

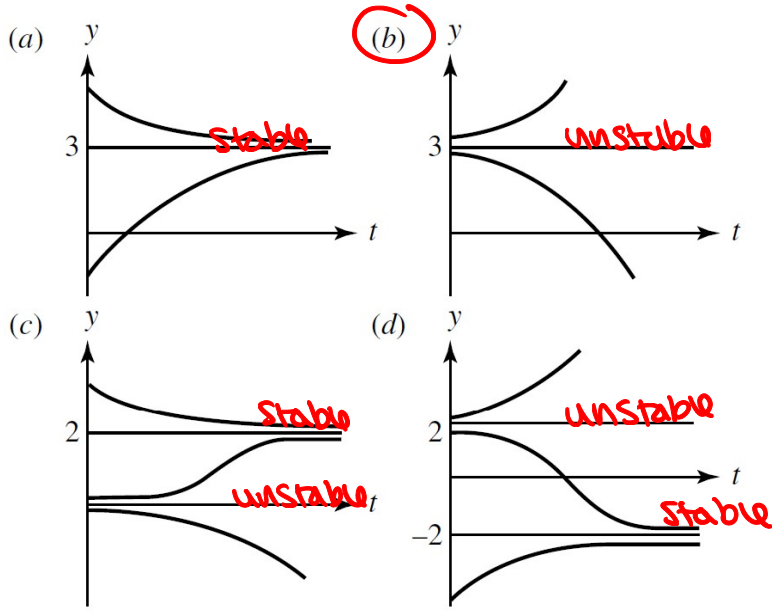


this soln will go toward $y=-3$ as $t \to \infty$

Don't flip until we start the next question together!

(this handout is double sided)

Example 31.0.6. Which of the following has no stable equilibrium?



Don't flip until we start the next question together!

(this handout is double sided)

DOUBLE JEOPARDY

This question is worth 2 points!

Example 31.0.7.

Which of the following equations has $y = Cx^{-1}$ as a family of solutions?

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

(b) $\frac{dy}{dx} = -\frac{x}{y}$

(c) $\frac{dy}{dx} = \frac{y}{x}$

(d) $\frac{dy}{dx} = -\frac{y}{x}$

$y = Cx^{-1} \Rightarrow \frac{dy}{dx} = -Cx^{-2} = \frac{-Cx^{-1}}{x} = -\frac{y}{x}$

Don't flip until we start the next question together!

(this handout is double sided)

DOUBLE JEOPARDY

This question is worth 2 points!

Example 31.0.8.

The equation

$$x^2 + y^2 = r^2$$

is a family solutions to which of the following differential equations?

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

(b) $\frac{dy}{dx} = -\frac{x}{y}$

(c) $\frac{dy}{dx} = \frac{y}{x}$

(d) $\frac{dy}{dx} = -\frac{y}{x}$

find $\frac{dy}{dx}$

$\frac{d}{dx}(x^2+y^2) = \frac{d}{dx} r^2$

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

$\Rightarrow \frac{dy}{dx} = -\frac{x}{y}$

Don't flip until we start the next question together!

(this handout is double sided)

Example 31.0.9.
All of the following are solutions to the differential equation

$$\frac{dy}{dx} = -\frac{x}{y}.$$

Which one passes through the point passing through the point $(3, 4)$?

(a) $x^2 + y^2 = 5$

(b) $x^2 + y^2 = 25$

(c) $x^2 + y^2 = 6$

(d) $x^2 + y^2 = 36$

$3^2+4^2=5^2$

Don't flip until we start the next question together!

The next question is FINAL JEOPARDY.

Bet points before you flip. If you have less than two, the question is worth 2 points.

(this handout is double sided)

FINAL JEOPARDY

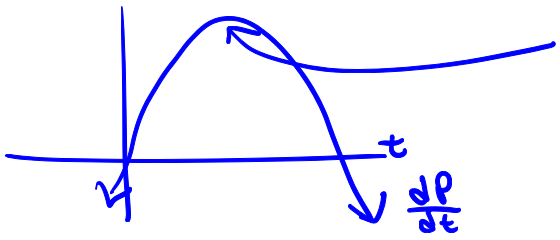
Example 31.0.10. Let $P(t)$ be the number of crocodiles in a mud hole at time t. Suppose

$$\frac{dP}{dt} = 0.01P - 0.0025P^2.$$

How many crocodiles are in the mud hole when the population is growing the fastest?

(you don't have to buzz in for this question)

can do this with second deriv (like in notes)
or using fact that it's a quadratic!



maximized $\frac{1}{2}$ btw roots

$0.01P - 0.0025P^2 = 0$

$\Leftrightarrow P = 0, 4$

so max is

$\frac{4-0}{2} = 2$