SLOPE FIELDS Practice Name ______________________________

________ 1.) $\frac{dy}{dx} = -3$

________ 2.) $\frac{dy}{dx} = x - 1$

________ 3.) $\frac{dy}{dx} = 3 - x^2$

________ 4.) $\frac{dy}{dx} = \cos x$

________ 5.) $\frac{dy}{dx} = \sqrt{y+2}$

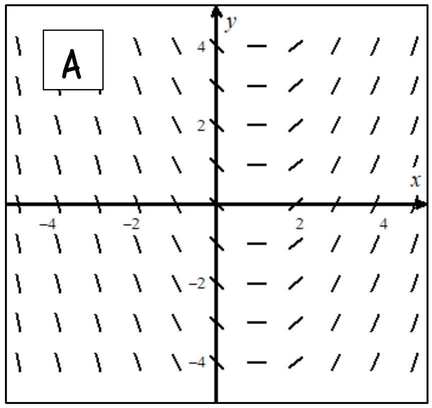
________ 6.) $\frac{dy}{dx} = y$

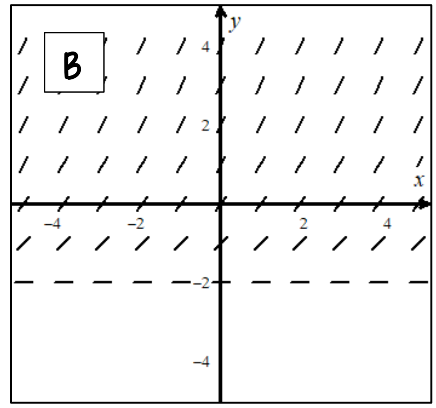
________ 7.) $\frac{dy}{dx} = e^y$

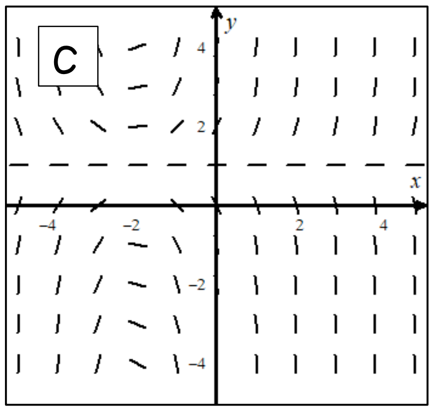
________ 8.) $\frac{dy}{dx} = (x+2)(y-1)$

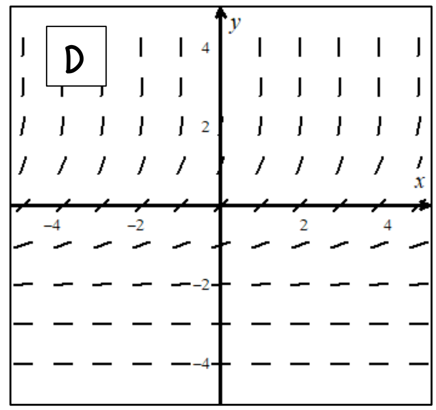
________ 9.) $\frac{dy}{dx} = \sin(x) + y$

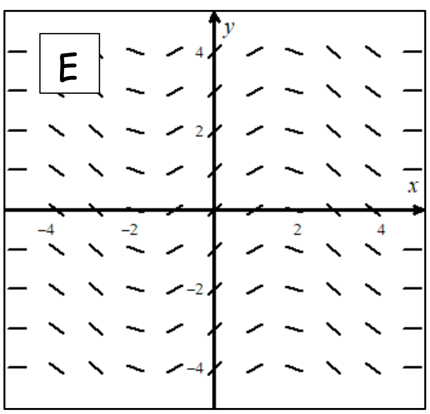
________ 10.) $\frac{dy}{dx} = (x+y)^{50}$

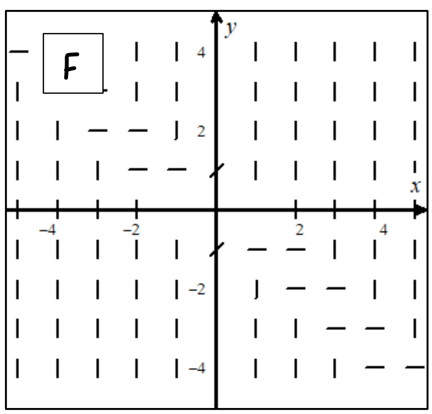


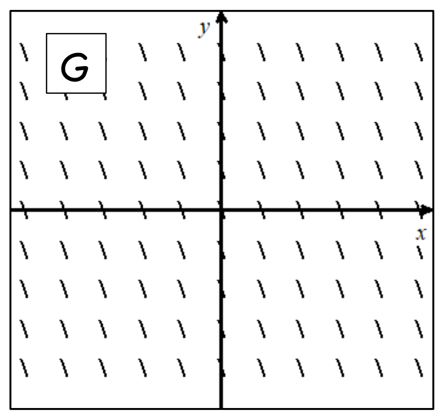


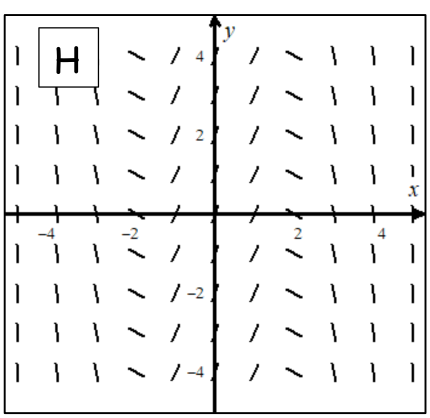


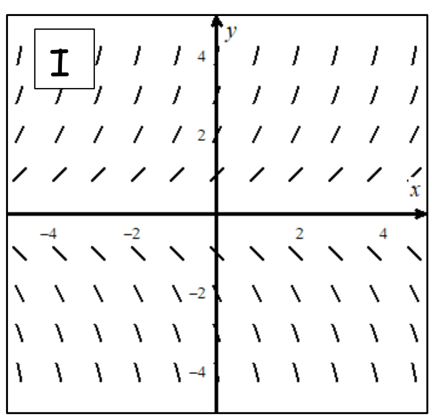


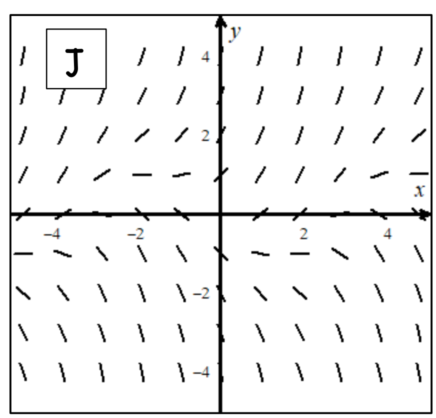












SLOPE FIELDS Practice Name ______________________________

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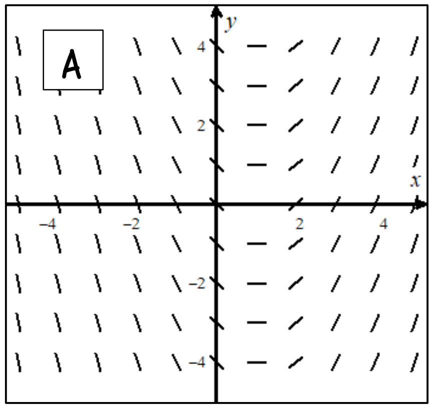
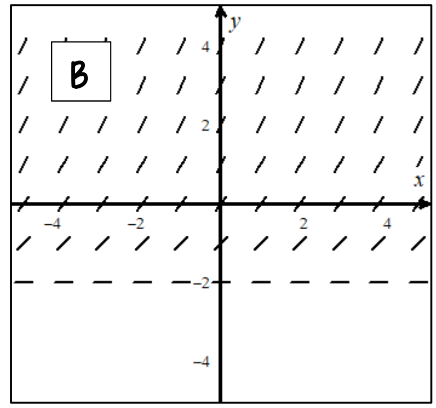
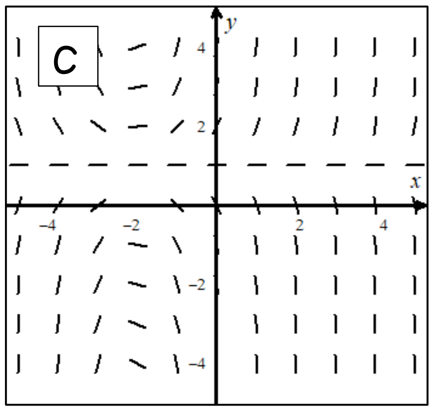
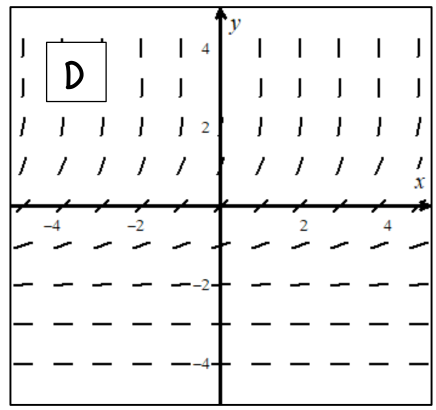
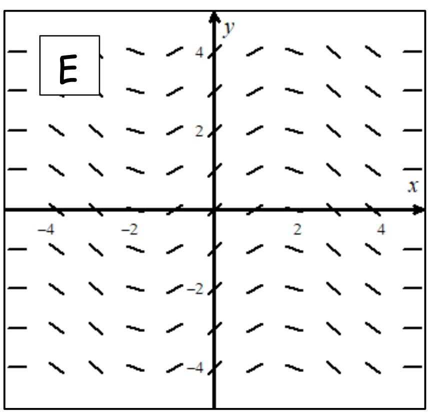
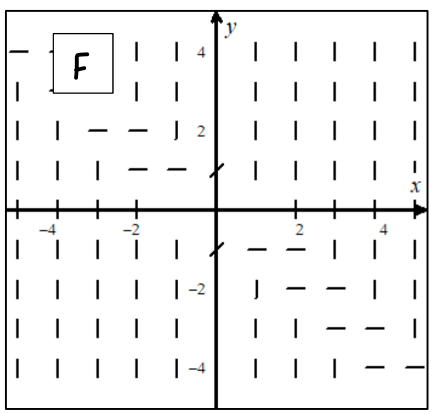


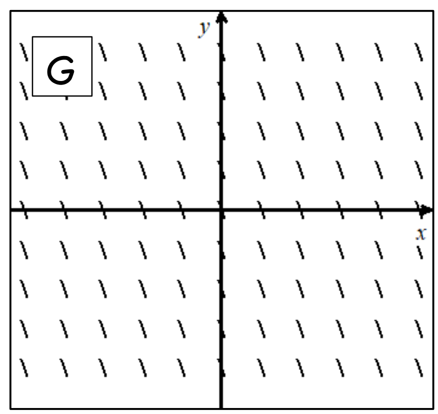


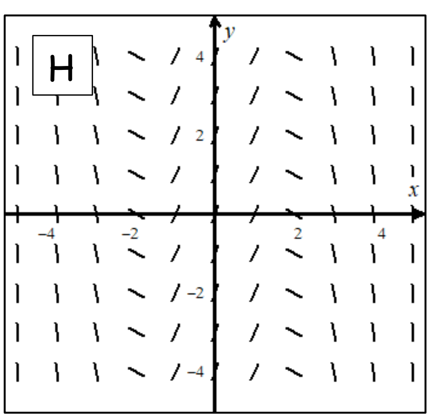


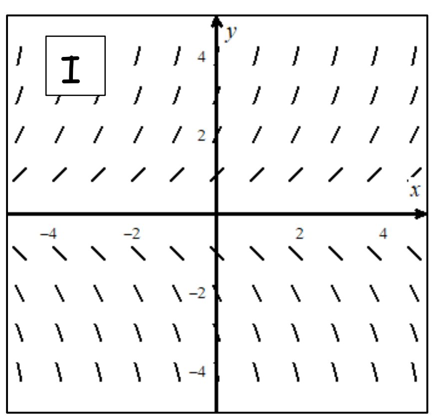


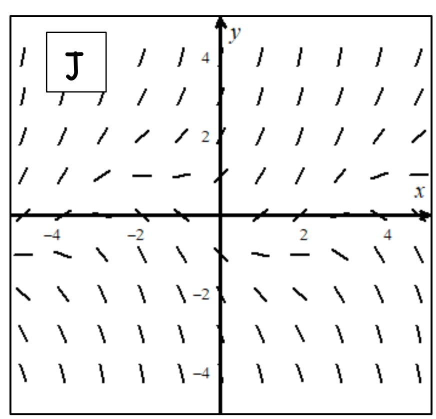












Slope Field Task Cards

Name ________________________________

Directions: For each differential equation task card, match the appropriate slope field and state a reason to justify your choice.

DE	SF	Evidence
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

Slope Fields Task Cards
ANSWER KEY

NOTE: Evidence is subject to student understanding and is not included with this key.

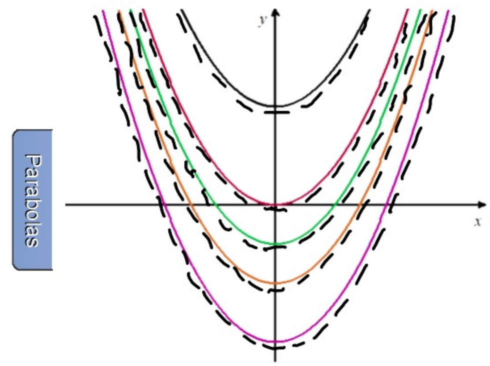
DE	SF
1.	F
2.	K
3.	H
4.	C
5.	J
6.	A
7.	G
8.	B
9.	E
10.	M
11.	D
12.	L

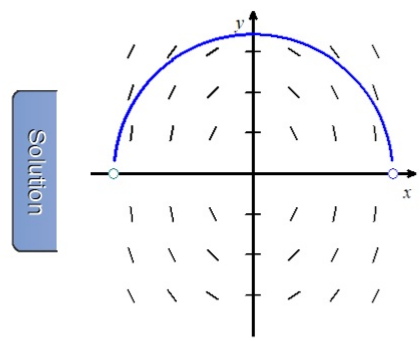
TEACHER NOTES:

If you do not have access to an interactive whiteboard, you can teach this lesson using transparencies of the slides that follow.

1. Use a transparency of slide 1.
2. Place another blank transparency on top of slide 1. Then, have students draw short segments, tangent to the curves, on top of the slide, to create a slope field, as shown.
3. Remove slide 1, this leaves only the slope field of parabolas in the form y= x^2 + C.
4. Use slide 2 to discuss the infinite number of solutions to this slope field.
5. Use slide 3 with any derivative.

   I prefer to use $\frac{dy}{dx} = -\frac{x}{y}$ because it leads to a circle. If you think of a slope field as a set of "signposts" pointing in the direction we should go at each "marker," it becomes easy. Give each student an ordered pair to evaluate the "slope" in the window from [-3, 3] by [-3, 3].
6. Have them sketch their slopes on the slide 3 transparency.
7. Slide 4 is the completed slope field for a particular solution, with the initial condition of (0, 3), the solution is $x^2 + y^2 = 9$ for $-3 < x < 3$.





This is a rich opportunity to open the discussion about possible constraints that *College Board* might require during the *AP Exam*. Some thoughtful questioning might include:

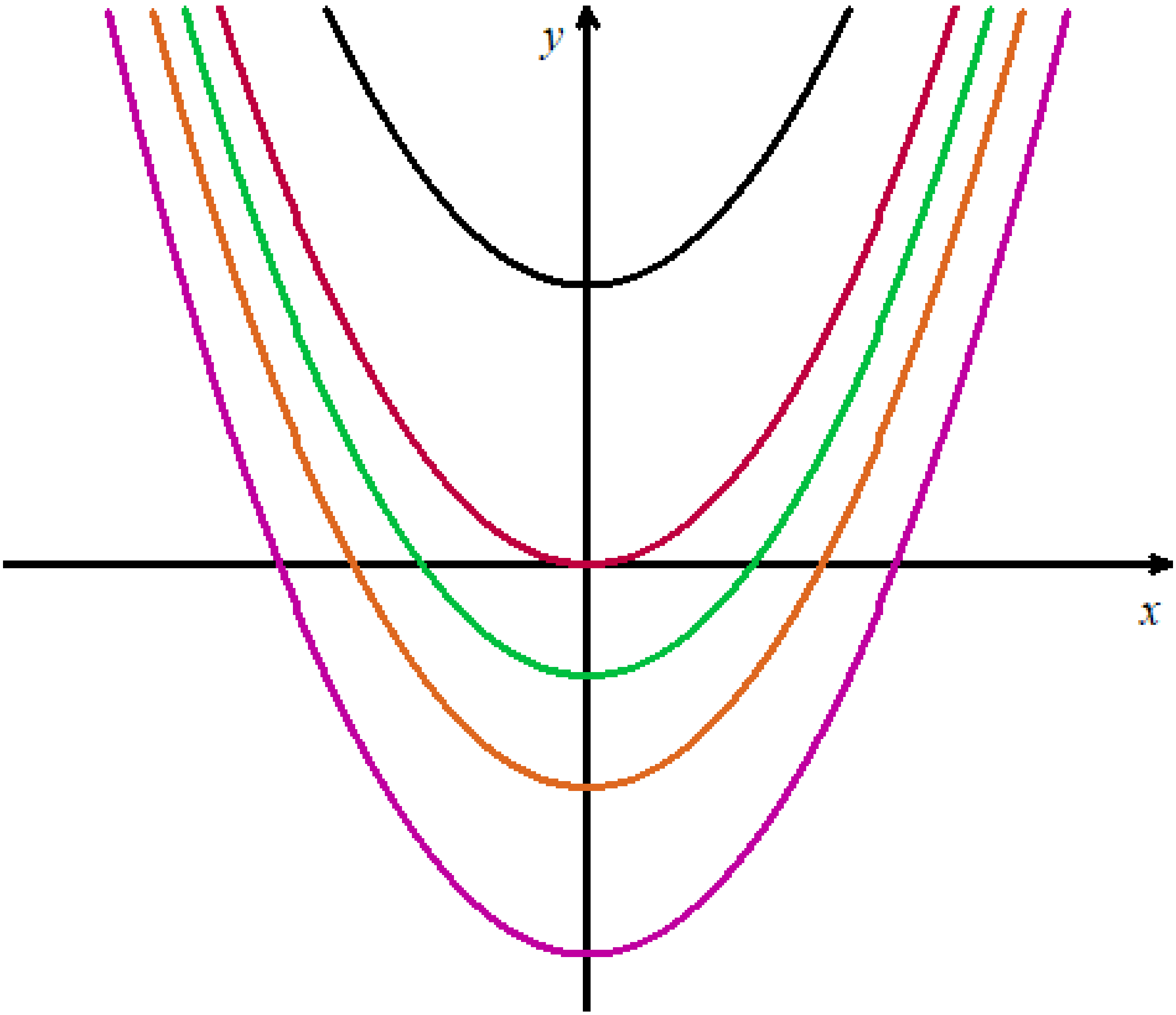
1. What solutions would constrain the slope to be horizontal? If y-values aren't zero then x = 0 would be a possible solution.
2. How can the slopes approach vertical? As long as x-values aren't zero, then as y approaches zero, the slopes are approaching vertical. Be sure to remind students that 0/0 isn't 1, and, that solutions cannot pass through any undefined slopes, including vertical slopes.
3. Are there any absolutes in this slope field? For example, the slope will ALWAYS BE NEGATIVE in Quadrants I and III, and ALWAYS POSITIVE in Quadrants II and IV.
4. How would you sketch the particular solution, y = f(x), that passes through the point (0, 3)? Will they recognize the fact that their answer must be a function? When reading the prompt that asks for y = f(x), do they know that their answer must pass the vertical line test, and will not include points where the slope (derivative) is undefined?
5. For our particular solution, with the initial condition of (0, 3), the solution is $x^2 + y^2 = 9$ for $-3 < x < 3$.

TECHNIQUES FOR HOW TO DISTINGUISH BETWEEN SLOPE FIELDS:

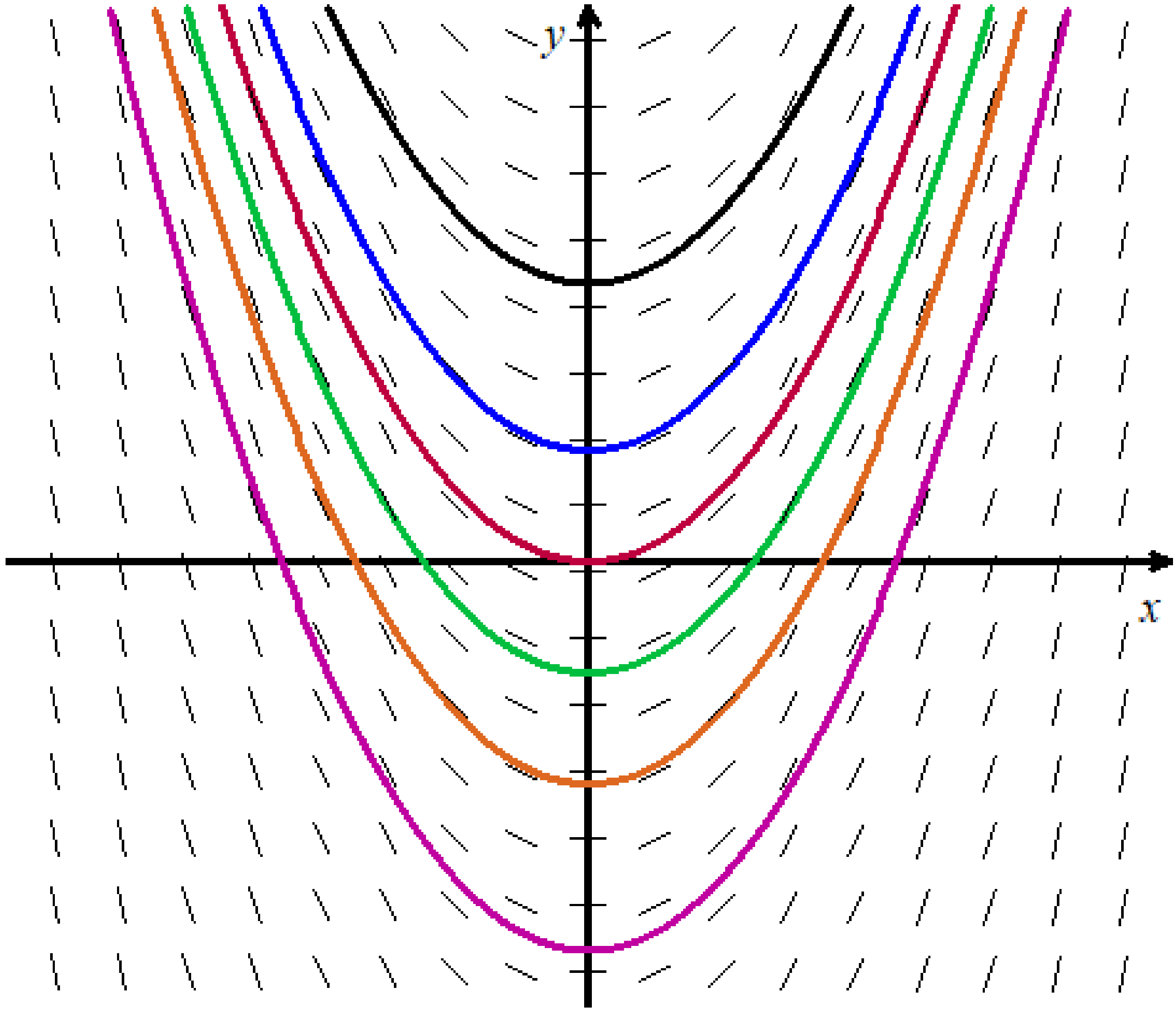
While graphing calculators, DESMOS, GEOGEBRA, and my favorite WINPLOT will draw slope fields, students are not permitted to use technology on the *AP* Exam. Students should know how to sketch slope fields by hand; and, know how to identify a slope field for given conditions or particular solutions. How do you explain, guide, and direct your students to develop a technique for such situations?

<u>What strategies and trends do you look for when matching slope fields?</u>

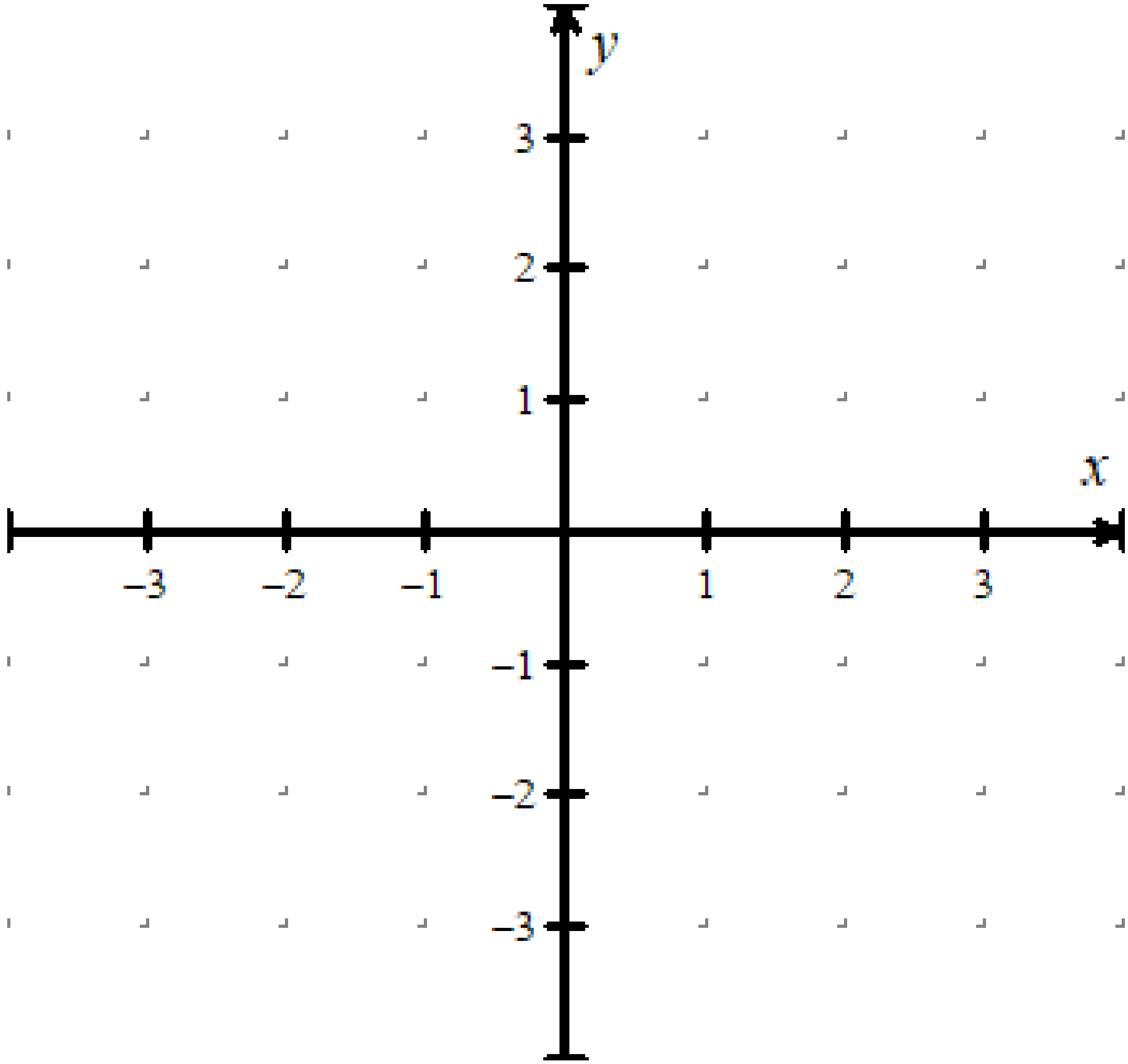
- Look for places where the slopes are 0; that is, dy/dx=0
- Look for places where the slopes are undefined
- Look at the slopes along the y-axis
- Look to see if the slopes only depend on x; vertical translations
- Look to see if the slopes only depend on y; horizontal translations
- Is the derivative changing on intervals of x, y, or both? If it's only changing on one variable then the rate (dy/dx) will only contain that variable.
- Look to see where the slopes are positive and where they are negative
- As a last resort, plug in random points. Such as, (1, 1) (1, −1) (−1, −1) and (−1, 1) for example. You want to eliminate possible answers.



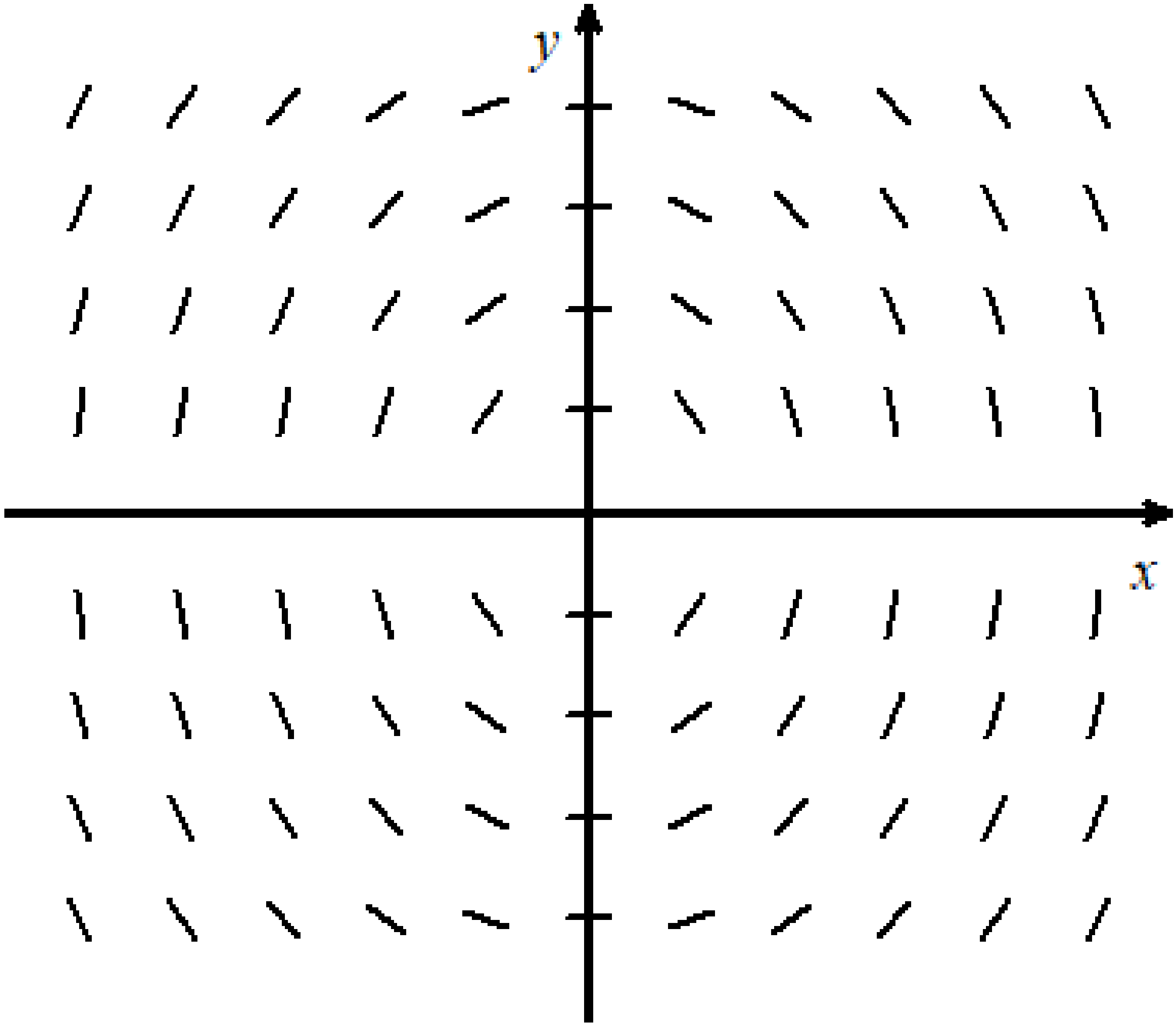
Slide 1



Slide 2



Slide 3



Slide 4

FLAMINGO MATH

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