Name: Lesson 4 Solutions, Part 1 Class #:

Math 48A, Lesson 4: Read Graphs to Solve Equations

1. EVALUATE LINEAR FUNCTIONS

Recall our discussion of function notation:

$$f(\underbrace{x}_{\text{input}}) = \underbrace{-2x-3}_{\text{output}}$$

1. Let $f(x) = -2x - 3$. Evaluate each of the following:

$f(-4)$, $f\left(-\frac{1}{2}\right)$, $f\left(\frac{1}{2}\right)$, and $f(4)$

input: $x = -\frac{1}{2} \Rightarrow$ $\boxed{f\left(-\frac{1}{2}\right) = -2}$

output: $f(-\frac{1}{2}) = (-2x - 3)\Big|_{x=-\frac{1}{2}}$ (evaluation bar)

$= -2\left(-\frac{1}{2}\right) - 3$

$= \boxed{-2} \cdot \boxed{\frac{-1}{2}} - 3$ (multiplication; fraction)

$$= \boxed{\frac{-2}{1}} \cdot \boxed{\frac{-1}{2}} - 3$$

fraction fraction

multiplication

$$= \frac{-2 \cdot -1}{1 \cdot 2} - 3$$

$$= \frac{2}{2} - 3$$

$$= 1 - 3$$

$$= \boxed{-2}$$

$$\frac{2}{1} \cdot \frac{1}{2} = \frac{2 \cdot 1}{1 \cdot 2} = \frac{2}{2} = 1$$

fraction fraction

multiplication

Famous Algebra Tricks

- $\frac{A}{B} \cdot \frac{C}{D} = \frac{A \cdot C}{B \cdot D} = \frac{AC}{BD}$

fraction · fraction

multiplication

they make a bond (multiplication bond on top and on bottom)

when multiplying two fraction, they come togetner

and divide

- $\frac{A}{B} \div \frac{C}{D} = \frac{A}{B} \cdot \frac{D}{C} = \frac{A \cdot D}{B \cdot C}$

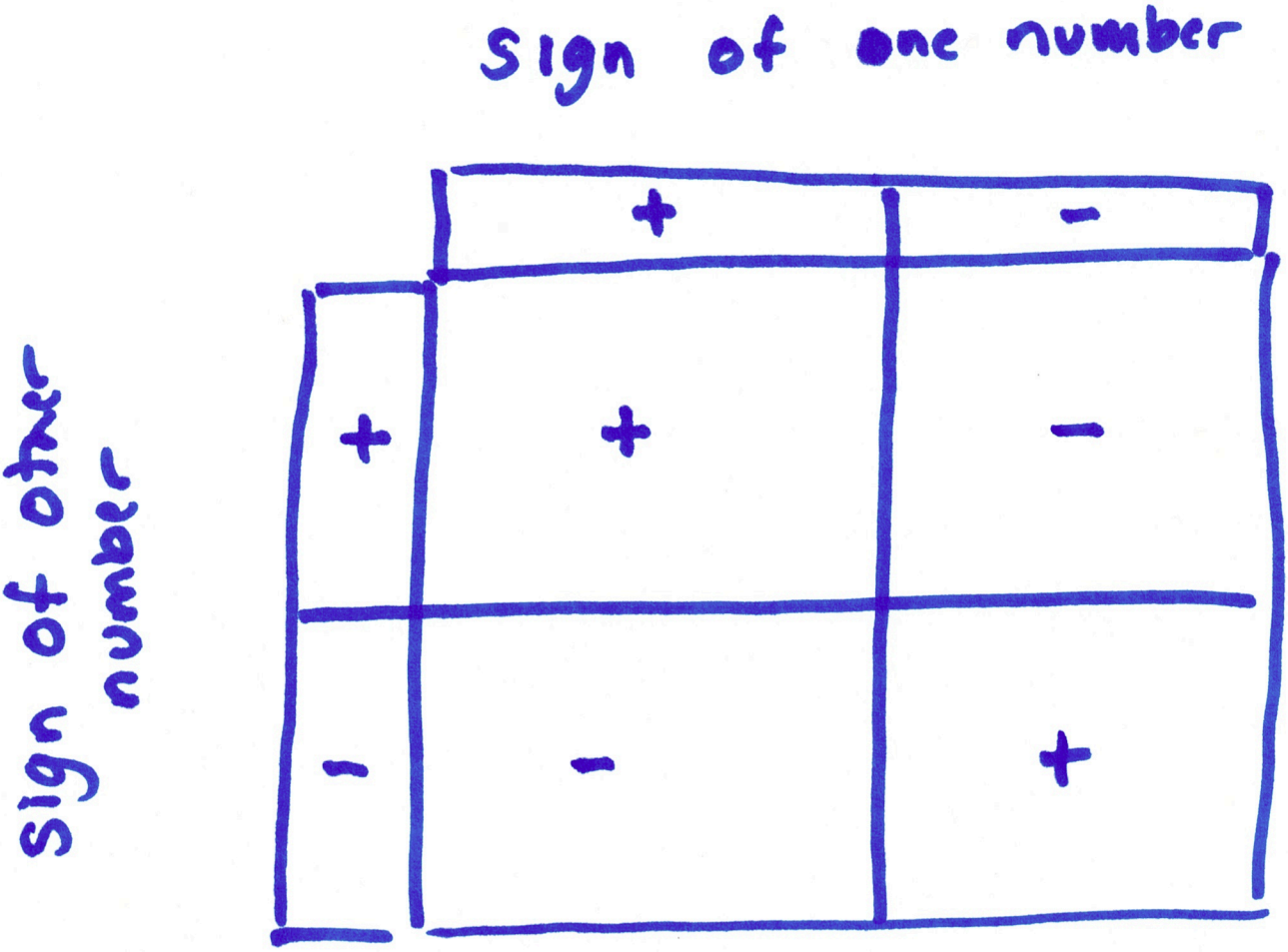
fraction ÷ fraction

divide

- **Division by 1:** $A = \frac{A}{1}$

(division by 1 doesn't change anything)

- When multiplying two numbers together, remember sign matters



- $\frac{A}{A} = 1$ if $A \neq 0$

↑ any nonzero number divided by itself is zero

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Algebraic Technique to solve algebraic equations

To find the solution of an algebraic equation using an algebraic method, isolate the unknown variable by using inverse operations.

2. Solve the equation $-2x - 3 = \frac{1}{2}x + 2$ using an algebraic technique. Show your steps. If possible, please solve this equation in more than one way.

Linear equation: $-2x - 3 = \frac{1}{2}x + 2$

ouch ... let's annihilate this first

anything I do to RHS, I gotta do to LHS

$\Rightarrow \quad -2x - 3 \neq \frac{2}{1} \cdot \left(\frac{1}{2}x + 2\right)$

multiply to every value (distributivity)

$\Rightarrow \quad -2x - 3 \neq 1 \cdot x + \frac{2}{1} \cdot 2$

$\Rightarrow \quad -2x - 3 \neq x + 2 \cdot 2$

$\Rightarrow \quad -2x - 3 \neq x + 4$

$+2x \qquad\qquad +2x$

Cancel

$\Rightarrow \quad -3 \neq 3x$

CORRECT MY MISTAKE:

$2(-2x - 3) = \frac{2}{1}\left(\frac{1}{2}x + 2\right)$

distribute

$-4x - 6 = x + 4$

$+4x \qquad\qquad +4x$

cancel

$-6 = 5x + 4$

$-4 \qquad\quad -4$

cancel

$-10 = 5x$

$$\frac{-10}{5} = \frac{5 \cdot x}{5}$$

$$-2 = 1 \cdot x$$

$$\boxed{-2 = x}$$

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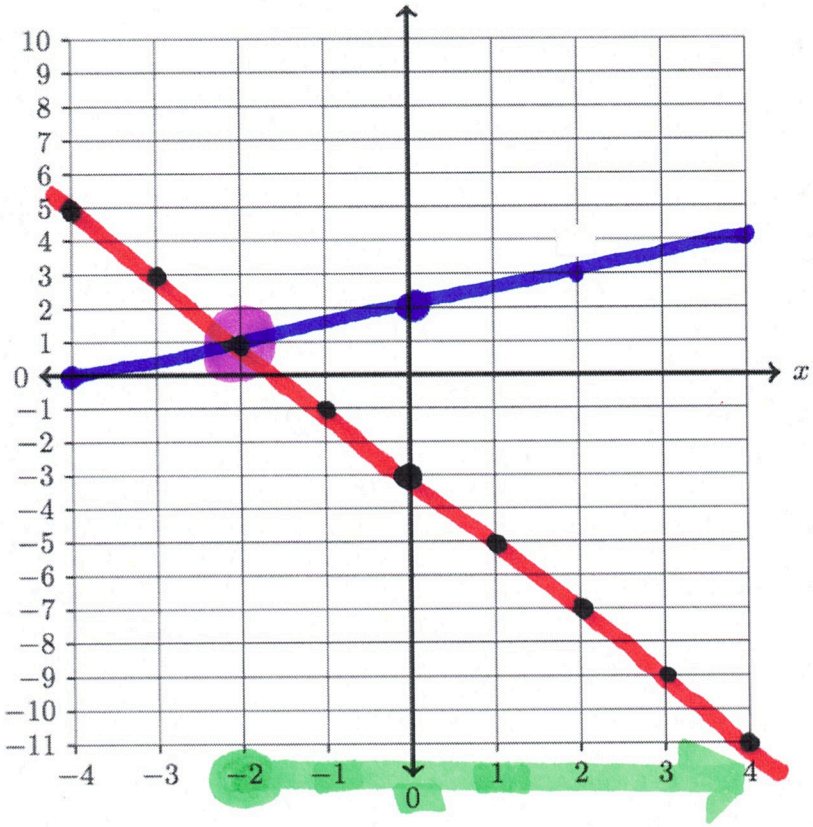
Graphical Technique to solve algebraic equations

To find the solution(s) to an algebraic equation using a graphical technique, complete the five steps:

Step 1: Identify and graph the function on the left-hand side of the equals sign.
Step 2: Identify the function on the right-hand side of the equals sign and graph this function on the same axis you used in step 1.
Step 3: Find the point(s) of intersection between the graphs of the two functions.
Step 4: Write each point of intersection as an ordered pair in the form (x, y). Then, identify the 1st coordinate (the "x" value) of the points of intersection.
Step 5: Set the variable from the equation equal to the 1st coordinate of each point of intersection. This represents the solution(s) to the algebraic equation.

3A. Complete the 5 steps outlined above to solve the equation $-2x - 3 = \frac{1}{2}x + 2$ using a graphical technique.

x	Left-hand side: $y_1 = -2x - 3$	Right-hand side: $y_2 = \frac{1}{2}x + 2$
−4	5	0
−3	3	0.5
−2	1	1
−1	-1	1.5
0	-3	2
1	-5	2.5
2	-7	3
3	-9	3.5
4	-11	4



Point of Intersection: (-2, 1)

x = -2
x-coordinate

y = 1
y-coordinate

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3B. At what point do the two graphs in Problem 3A above intersect? Specifically identify this point on the graph and write it as an ordered pair below.

(-2, 1)

3C. What is the x-coordinate of the point of intersection you found in Problem 3B? In other words, what does x equal when the two lines cross in the graph you found in Problem 3A.

$x = -2$

3D. What is the solution to the equation $-2x - 3 = \frac{1}{2}x + 2$ that you found in Problem 2? How does that answer compare to your answer to problem 3C?

It is identical!

Finding points of intersection solves equations

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3E. Use the graph you drew in Problem 5A to solve the inequality: $-2x - 3 \leq \frac{1}{2}x + 2$

$-2x - 3 \leq \frac{1}{2}x + 2$

This is true where

$-2 \leq x < \infty$

In interval notation

$[-2, \infty)$

Closed bracket (it's allowed to be equal)

Open parentesis (Never touches this value)