
Four Ways to Get There

ID: 13460

Time required
45 minutes

Activity Overview

In this activity, students will use a variety of features of the TI-73 Explorer to represent problem situations. Students will look at problems algebraically, graphically, verbally, and numerically.

Topic: Numbers

- *Translating verbal sentences into mathematical equations*
 - *Unit analysis*
 - *Function zeros*
 - *Solutions to systems of equations*
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Teacher Preparation and Notes

- *Students will work with graphing equations, changing window settings, setting up a table, and using the equation solver.*
- *TI-Navigator is not required for this activity, but an extension is given for those teachers that would like to use it.*
- ***To download the student worksheet and TI-Navigator files, go to education.ti.com/exchange and enter “13460” in the quick search box.***

Associated Materials

- *MGAct13_FourWays_worksheet_TI73.doc*
- *MGAct13_FourWays_Nav_TI73.act*

Suggested Related Activities

To download the activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Linear Equations: Using Graphs and Tables (TI-73 Explorer) — 4415*
- *Table that Equation (TI-73 Explorer) — 8461*
- *Getting Started with TI-Navigator: Linear Equations (TI-73 Explorer & TI-Navigator) — 5611*
- *River of Life (TI-73 Explorer & TI-Navigator) — 5601*

Problem 1 – Draining a Water Tank

The Rule of Four emphasizes that problem situations can be represented in four different ways. These multiple representations are: 1) verbal, 2) numerical, 3) analytic (algebraically), and 4) geometric (graphically).

Questions 1–3

In this problem, a water tank is being drained by two pipes. Use the following information to set up one way to solve this particular problem.

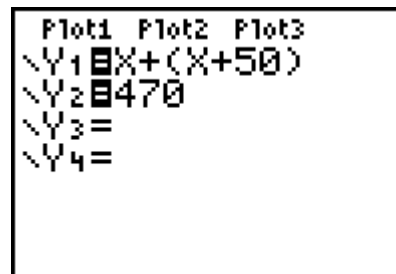
One pipe drains at a rate of 50 l/min faster than the other pipe. If they release 4,700 liters in 10 minutes, what is the drainage rate?

Students are first asked to translate the problem into a verbal sentence using variables.

- If the first pipe drains at x l/min, then the second drains at $x + 50$ l/min.
- Together the pipes drain 4700 l/10 min = 470 l/min.
- So, $x + (x + 50) = 470$.

Students are to enter the expression for the drainage rate of both pipes working together in **Y1** and the unit rate in **Y2**.

Note: To enter X, press \boxed{x} .



Questions 4–6

Students are to put together the expressions to form an equation and solve for x , algebraically.

$$x + (x + 50) = 470$$

$$2x + 50 = 470$$

$$2x = 420$$

$$x = 210$$

Next, students will set up the table to find the value where both equations are equal. To access the table setup, press $\boxed{2nd}$ \boxed{WINDOW} . Change the settings as shown at the right and then press $\boxed{2nd}$ \boxed{GRAPH} to view the actual table.



As students scroll down, they will notice that they “skip” 470 when x goes from 200 to 250. Engage them in a discussion about how you could include the numbers between 200 and 250 in the table.

Direct students to return to the table setup and adjust Δ Tbl to be 10 instead of 50 and have them look at the table again. They should now find an exact match between Y_1 and Y_2 for 470 is at $X = 210$.

X	Y1	Y2
200	450	470
210	470	470
220	490	470
230	510	470
240	530	470
250	550	470
260	570	470

X=210

Problem 2 – Solving by Different Methods

Next, students will explore the same problem graphically and numerically.

Questions 9–10

Have students check that their two equations are still in the $Y=$ editor.

Students may need to adjust the window in order to actually see the graphs and the intersection of the graphs. Have them discuss what values might be appropriate for the window.

To adjust the window, press $\boxed{\text{WINDOW}}$. A suggested window is shown at the right.

Note: ΔX will automatically update when X_{\min} and X_{\max} are changed. Students should not change the ΔX value.

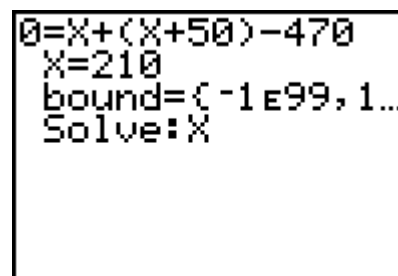
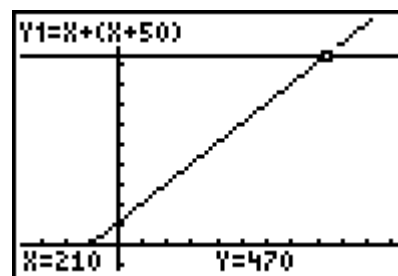
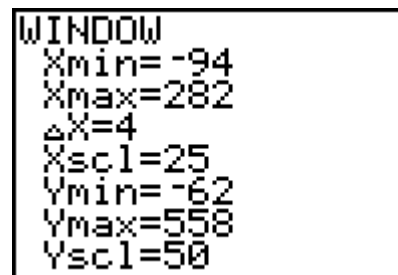
Questions 11–12

Finally, students will find the solution to the equation using the **Solver**. To access the solver, press $\boxed{\text{MATH}}$ $\boxed{6}$. The equation should come up empty but if it does not, simply press $\boxed{\text{CLEAR}}$ to remove any previous information.

Students will need to enter the equation set equal to 0. This can be accomplished by subtracting 470 from both sides.

Once the equation is entered, use the \downarrow to move to the line that says **Solve: X** and press $\boxed{\text{ENTER}}$. The solution will appear next to the **X=** line above.

Students should quickly see that the same solution is obtained using this method as well.



Extension – TI-Navigator™

1. For Questions 9 and 10, load the activity settings file *MGAct13_FourWays_Nav_T173.act* into Activity center. Start the activity and have students enter the two equations on their calculators. Once students have submitted the equations, they will be able to see the intersection point.

After looking at the graph and discussing the intersection point, click on the **Equation** tab. Select **Y1** in the second column. Select **Y2** in the third column. This replicates the table solution method shown earlier in the activity. Scroll through the table until you find where the second and third columns are equal (470) and look at the x-value. Students will see that again, the x-value is 210.

2. Use **Screen Capture** or **Quick Poll** to monitor student activity throughout the lesson.

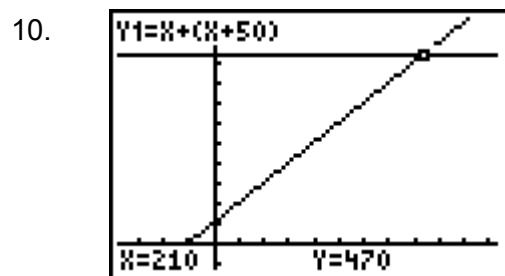
Solutions – student worksheet

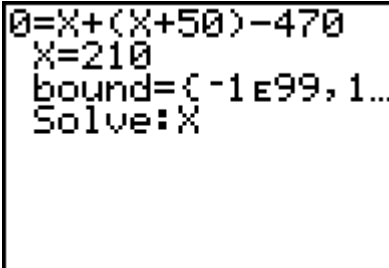
Problem 1

1. If the first pipe drains at x l/min, then the second drains at $x + 50$ l/min. Together the pipes drain 4700 l/10 min = 470 l/min. So, $x + (x + 50) = 470$.
2. 470 l/min
3. $Y_1 = x + (x + 50)$; $Y_2 = 470$
4. $x + (x + 50) = 470$
5. 210
6. Students should observe that with the initial window settings, they “skip” past the point where 470 would appear in both lists. They need to make the changes in the table step smaller to find where 470 appears in both lists.
7. 210
8. $210, 260$

Problem 2

9. $(210, 470)$; Yes, the exact intersection can be found.



11. 

12. 210
13. It is the same.
14. It is the same.
15. Answers will vary. Students should see that there could be limitations with finding an “exact” intersection on a graph. This is not the “best” method of solving an equation but it can give you a visual idea of where the intersection is. Students may also conclude that the table could have the same limitation.



Problem 1 – Draining a Water Tank

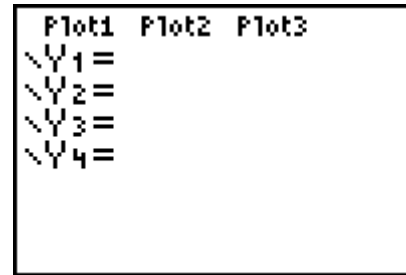
In this problem, a water tank is being drained by two pipes. Use the following information to set up one way to solve this particular problem.

One pipe drains at a rate of 50 liters per minute faster than the other pipe. If the pipes release 4,700 liters in 10 minutes, what is the drainage rate?

1. Translate the word problem above to a verbal sentence using variables.

2. Together, what is the unit rate that water drains from the tank? _____ l/min

3. Enter the combined expression for the rate the water drains in Y_1 . Enter the unit rate in Y_2 . To access Y_1 , press $\boxed{Y=}$.



What are these expressions?

$Y_1 =$ _____

$Y_2 =$ _____

4. Write an equation where the left side is Y_1 and the right side is Y_2 .

5. What value of x will make the left side of this equation equal to 470? _____

One way to answer this question is to use tables to determine the correct value for x .

Set up the table by pressing $\boxed{2nd} \boxed{WINDOW}$. Starting at zero and incrementing by 50 is a good start.



6. Use $\boxed{\downarrow}$ and $\boxed{\uparrow}$ to scroll through the table looking for when Y_1 is equal to Y_2 . What do you find? _____

7. Adjust the table values as needed to find an exact answer. What value makes the two sides equal?

8. At what rate does each pipe drain? Pipe 1: _____ Pipe 2: _____

Problem 2 – Solving by Different Methods

9. Another way to solve this equation is by looking at a graph. You have already entered the left and right side in Y1 and Y2. The point on the graph you are interested in is where the two lines intersect. Press **WINDOW** to adjust the viewing window to an appropriate setting. Then press **GRAPH**.

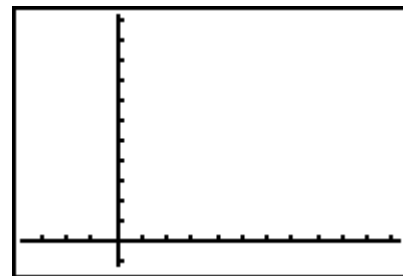
Use the **Trace** feature (**TRACE**) to find the intersection point. _____

Are you able to find the exact intersection for the lines? _____

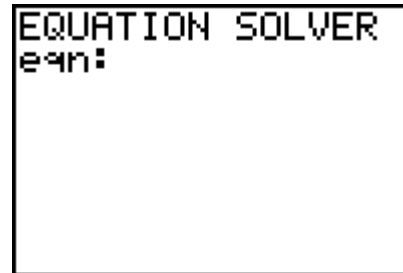
If not, adjust the Window settings to allow you to find the exact intersection point.

Press **WINDOW** and adjust the various values, including Xscl, until you can.

10. Draw your graphs on the screen at the right and indicate the intersection point.



11. Finally, use the SOLVER to find a numerical solution to the equation. To access the solver, press **MATH** **6**.
- Enter the equation set equal to 0. (subtract 470 from both sides)



12. Press **ENTER**. What value is returned for x ? _____

13. How does this value compare to the value you found as the intersection of the graphs?

14. How does this value compare to the value you found using the table?

15. What are the advantages or disadvantages to the different ways of solving equations?

