Boats In Motion

ID: 11298

Time Required
45 minutes

Activity Overview

In this activity, students will make observations about the motion of a boat going up and down the river. They will be instructed to solve the system of equations algebraically and graphically. Minimized slider bars allow students to explore the slope of a distance-time graph.

Topic: Linear Equations

- *Motion, distance = rate × time*
- *Slope and graphically solving equation*

Teacher Preparation and Notes

- *The student worksheet provides instructions and question to guide the inquiry and focus the observations.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student TI-Nspire™ document (.tns file) and student worksheet, go to education.ti.com/exchange and enter "11298" in the keyword search box.***

Associated Materials

- *BoatsInMotion_Student.doc*
- *BoatsInMotion.tns*

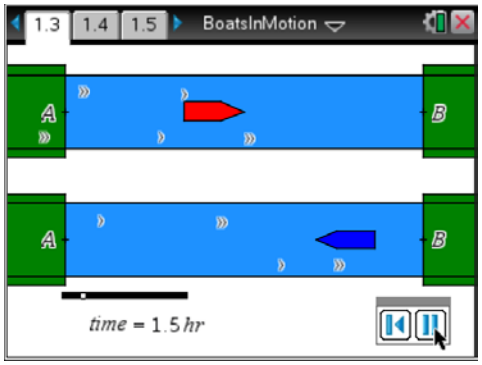
Suggested Related Activities

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

- *Solving Systems of Linear Equations with Linear Combinations (TI-Nspire™ CAS technology) — 8818*
- *How Many Solutions? (TI-Nspire™ technology) — 9284*
- *Tables and Linear Relationships (TI-Nspire™ technology) — 10884*

Problem 1 – Observe Motion & Graphically Solve

On page 1.3, students press play and make observations about the motion of the boats. Ask students why the boat goes faster downstream than upstream. They should know that the boat goes with the current downstream making it travel more distance in less time. When the boat goes upstream it has to fight the current.



1. 3 hours downstream

2. 5 hours upstream

3. Downstream rate = $r + 2$; Upstream rate= $r - 2$

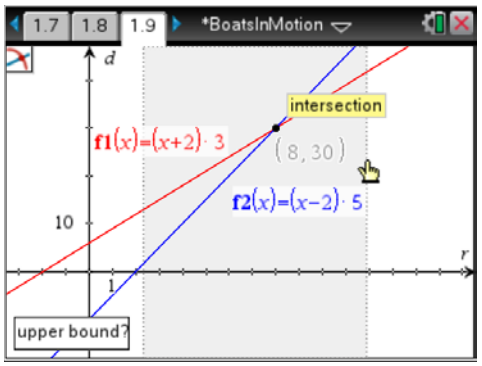
4. **down** $d = (r + 2)3$

up $d = (r - 2)5$

5. $3r + 6 = 5r - 10$

$2r = 16$

$r = 8$ mph



Substituting this into either equation gives a distance of 30 miles. Alton and Barnhart are about 30 miles apart along the Mississippi in the St. Louis area.

TI-Nspire™ Navigator™ Opportunity: *Class Capture* and/or *Live Presenter*
See Note 1 at the end of this lesson.

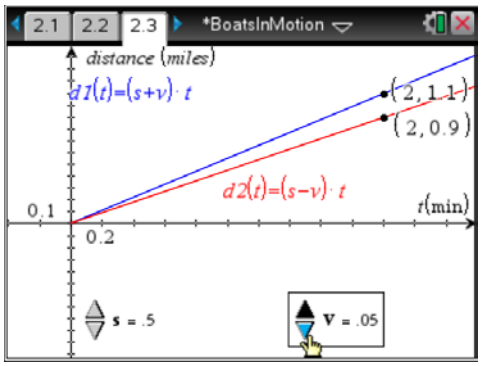
Problem 2 – Distance-Time Graph, Explore Slopes

Using $d = r \cdot t$ for this situation gives the following equations:

$1.1 = (s + v)\ 2$ $\quad$ $0.9 = (s - v)\ 2$

where s is the rate (speed) of the steam engine and v is the rate (velocity) of Velma's walking.

Using the graph on page 2.3, students are to use the arrows to change the rates of the train and Velma's walking so that the lines go through the points (2, 1.1) and (2, 0.9). The slopes of the lines represent the rates of s and v.

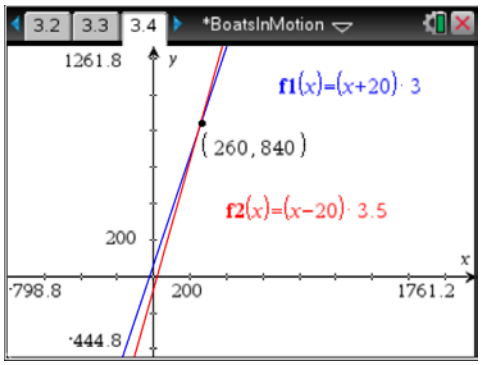


To solve this system of equations, students are to distribute and then add the first equation to the second.

The solution is the train is moving at 0.5 miles/min and Velma is walking at 0.05 miles/min.

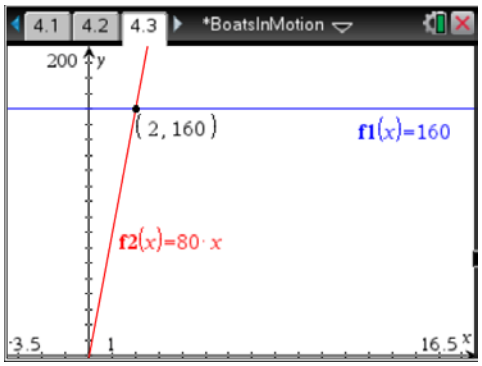
Problem 3 – Planes

11. 3 hours
12. 3.5 hours
13. $d = (r + 20)3$ and $d = (r – 20)3.5$
14. $3r + 60 = 3.5r – 70$
    $130 = 0.5\ r$
    $260 = r$
    260 km/h is the speed of the airplane in still air.
15. The intersection of the two equations is the ordered pair (260, 840), which represents the same information that was found algebraically.



Problem 4 – Cars

16. $d_{slow}=30t$ and $d_{fast}=50t$
17. $30t + 50t = 160$
    $80t = 160$
    $t = 2$ hours
18. The x-coordinate represents the number of hours for the cars to reach a distance of 160 miles, the y-coordinate, apart.



TI-Nspire™ Navigator™ Opportunity: *Class Capture* and/or *Live Presenter*
See Note 2 at the end of this lesson.

TI-Nspire™ Navigator™ Opportunities

Note 1
Problem 1: *Class Capture* and/or *Live Presenter*
Class Capture can be used here and throughout the lesson to ensure students are able to follow directions on finding the intersection point. You may choose to pick a student (or group of students) as a live presenter to demonstrate the activity to the class.

Note 2
Problem 4: *Class Capture* and/or *Live Presenter*
This is another good place to use screen capture to make sure students are able to enter the functions to graph. A live presenter can be used to demonstrate how the formulas are entered.