Solving Inequalities Graphically – ID: 9989

By Holly Thompson

Time required
45 minutes

Activity Overview

Students will solve inequalities graphically by setting bounds on the graph that represent the portions of the graph that satisfy the inequality. Each of the inequalities presented in this activity represent real-world situations, which should aid in students understanding the concept of inequalities.

Concepts

- *Solving inequalities graphically and using tables*
- *Using inequalities to represent situations*

Teacher Preparation

This investigation offers an approach to solving inequalities by using a graph of the function and using points on the function to find the x-values where the inequality is satisfied. This activity also helps students understand what types of situations can be represented using inequalities.

- *This activity could be used in Algebra 2 as an extension after students have learned how to solve different types of equations. This activity can also be used in Precalculus before students learn to solve inequalities with sign patterns.*
- *The screenshots on pages 2–4 (top) demonstrate expected student results. Refer to the screenshots on pages 4 (bottom) and 5 for a preview of the student TI-Nspire document.*
- ***To download the student .tns file and student worksheet, go to education.ti.com/exchange and enter "9989" in the quick search box.***

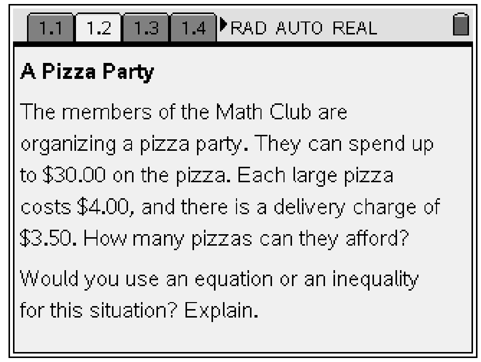
Classroom Management

- *This activity is intended to be initially **teacher-led,** after which students may be able to work individually or with a partner. You may use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds. Be sure to cover all the material necessary for students' total comprehension.*
- *The student worksheet PreCalcAct06_SolvInequGraph_worksheet_EN is intended to guide students through the main ideas of the activity, and it also serves as a place for students to record their answers. Alternatively, you may wish to have the class record their answers on separate sheets of paper, or just use the questions posed to engage a class discussion.*

TI-Nspire™ Applications

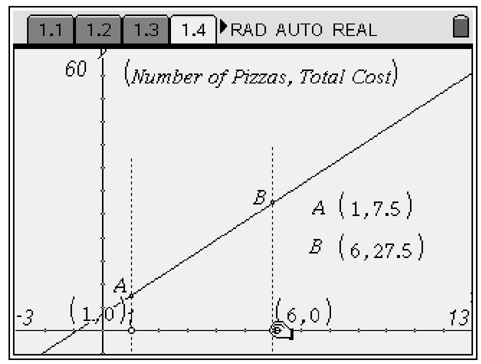
Graphs & Geometry, Lists & Spreadsheet, Notes

Problem 1 – A Pizza Party

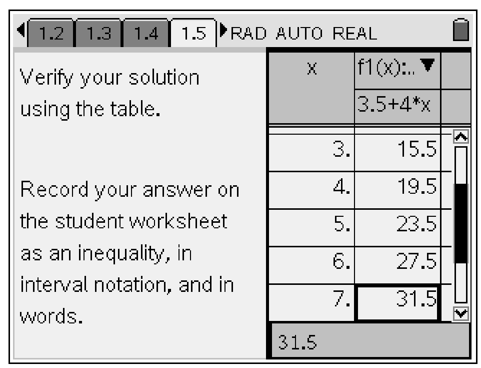


In Problem 1, students will explore the first of four real-world examples of inequalities that they will solve using graphs and tables. You may wish to walk students through the steps in this problem, allowing them to complete the others on their own or with a partner.

After reading through page 1.2, students should conclude that the inequality $3.5 + 4x \le 30$ appropriately represents the situation, for whole-number values of x (the number of pizzas).

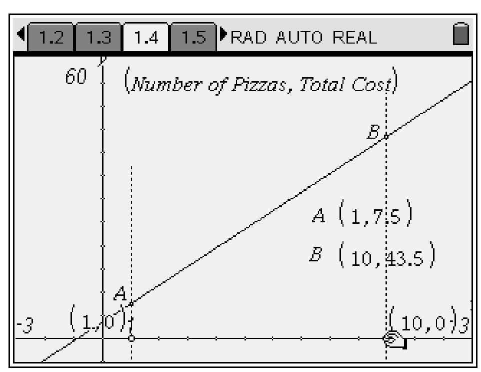


On page 1.4, students will consider the graph of the function **f1**(x) = 3.5 + 4x. Dragging the two open circles on the x-axis (which are locked to the tick marks on the axis to reflect that you cannot order fractional values of a pizza), students should set the minimum and maximum values for the number of pizzas that can be ordered based on the inequality restrictions. They should find the minimum number to be 1 (at least one pizza will be ordered) and the maximum number to be 6 (with a total cost of $27.50).



Students should also use the table on 1.5 to check their solutions. Have them begin by looking at the total cost for 1 pizza. Moving down the table, it should be obvious that there is not enough money allotted for the Math Club to purchase 7 pizzas.

On their worksheets, students should record their answers as an inequality, in interval notation, and in words. ($1 \le x \le 6$; [1, 6]; between 1 to 6 pizzas, inclusive)

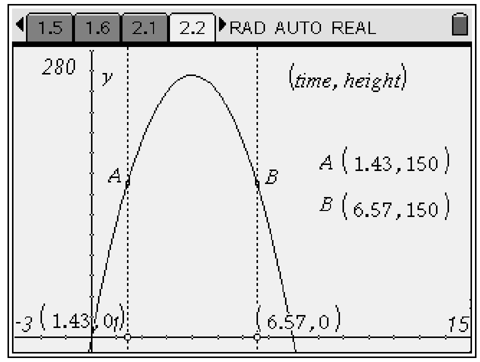


Page 1.6 asks students to now consider that the Math Club has an additional $15 to spend on pizza and to adjust their answers accordingly. Using the graph or table, they should find that the greatest number of pizzas that are able to be purchased is now 10, with a total cost of $43.50. ($1 \le x \le 10$; [1, 10]; between 1 to 10 pizzas, inclusive)

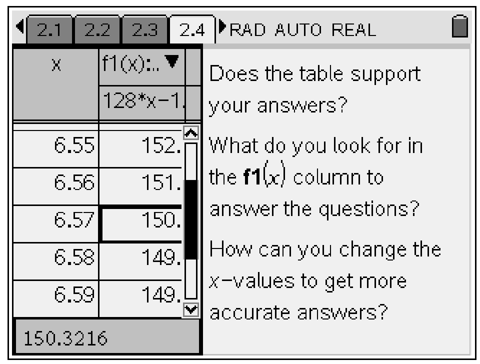
Problem 2 – The Path of a Rocket

Problem 2 poses two questions for students to solve regarding the height of a rocket over time. Again dragging the open points along the *x*-axis, they should find that:

- **f1**(x) > 150 when 1.42 < x < 6.57;
  or on the interval (1.42, 6.57)
  (shown to the right)
- **f1**(x) < 75 when 0 ≤ x < 0.637 or 7.36 < x ≤ 8;
  or [0, 0.637) ∪ (7.36, 8]



On page 2.4, there is a function table that students may use to confirm their answers; however, since the domain of this real-world function includes more than just positive integers, the table can be more difficult to use. Discuss with students how use the table to identify the integers that the answer is in between, and then how to adjust the table settings (**MENU > Function Table > Edit Function Table Settings**) to narrow in on a more accurate answer.

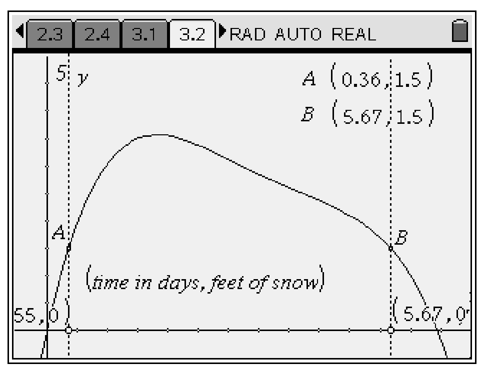


Problem 3 – A Snowstorm

Students should be familiar enough with the process now to complete this problem, concerning the depth of accumulated snow over one week during a snowstorm, individually or in pairs.

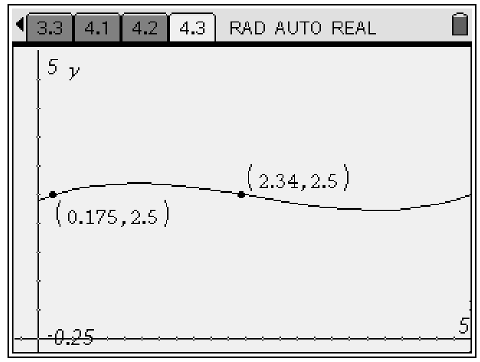
Using the graph, students should find that:

- **f1**(x) ≥ 1.50 when 0.355 ≤ x ≤ 5.67;
  or on the interval (0.355, 5.67)
  (shown to the right)
- **f1**(x) ≤ 0.75 when 0 ≤ x < 0.154 or 6.13 < x ≤ 7;
  or [0, 0.154] ∪ [6.13, 7]
  [Be sure students consider this question carefully—when 6.44 < x ≤ 7, there was no snow on the ground, which means that it was safe to drive.]



Students wishing to verify their answers using a table may press ctrl + T on the *Graphs & Geometry* screen to insert a function table.

Problem 4 – Lung Capacity



The graph in this problem has not been constructed as the other three, so that students can look for other ways to also solve, such as finding an intersection or simply placing points on the graph and adjusting their coordinates, as shown to the right.

Be sure students understand what is being asked of them in the question. First they must determine the interval over which **f1**(*x*) ≥ 2.5 as they have done previously, but then they must take it one step further by using the endpoints of the interval to determine the number of seconds that **f1**(*x*) ≥ 2.5.

The interval is (0.175, 2.34), for a total of 2.34 – 0.175 = 2.17 seconds.

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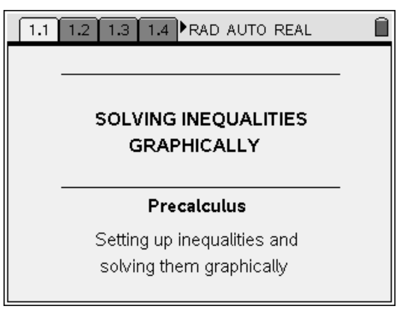
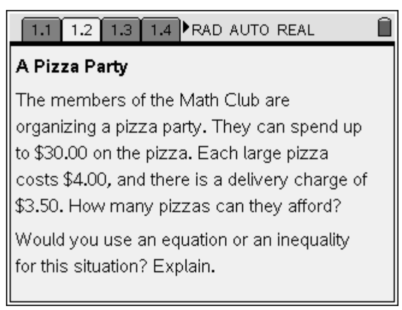
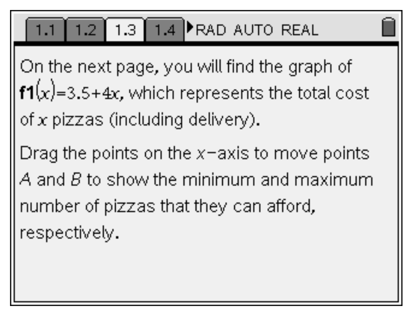
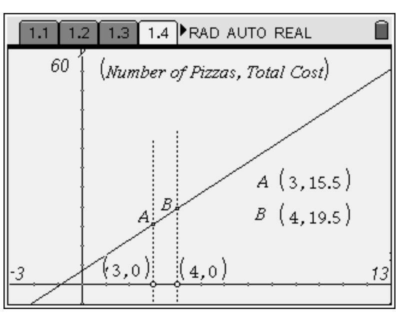
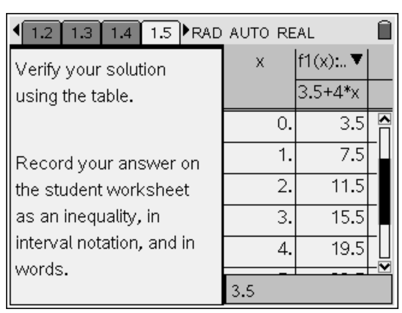
(Student)TI-Nspire File: *PreCalcAct06_SolvInequGraph_EN.tns*

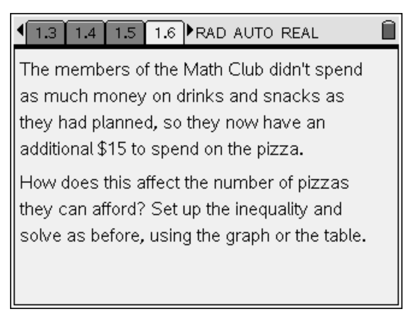


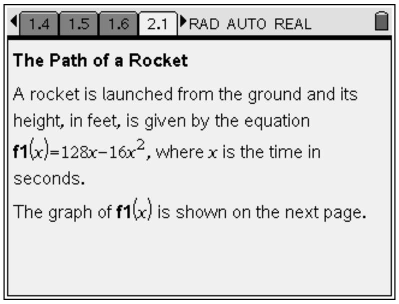








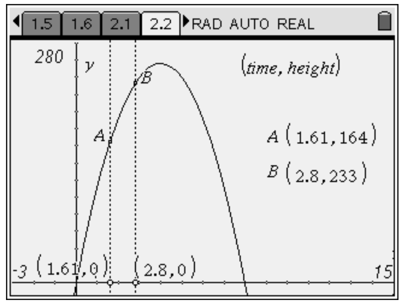


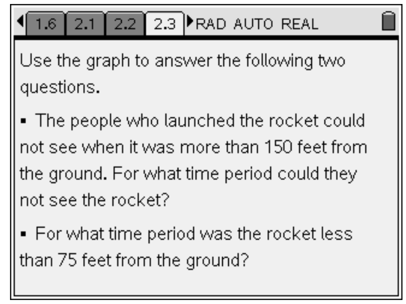

1.4 1.5 1.6 2.1 RAD AUTO REAL

The Path of a Rocket

A rocket is launched from the ground and its height, in feet, is given by the equation $f1(x)=128x-16x^2$, where x is the time in seconds.

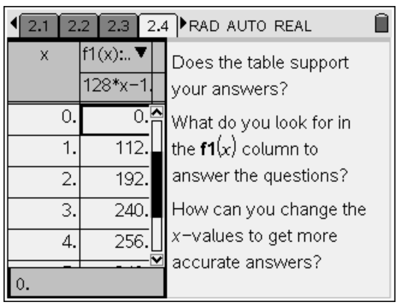
The graph of $f1(x)$ is shown on the next page.




1.6 2.1 2.2 2.3 RAD AUTO REAL

Use the graph to answer the following two questions.

- The people who launched the rocket could not see when it was more than 150 feet from the ground. For what time period could they not see the rocket?
- For what time period was the rocket less than 75 feet from the ground?


2.1 2.2 2.3 2.4 RAD AUTO REAL

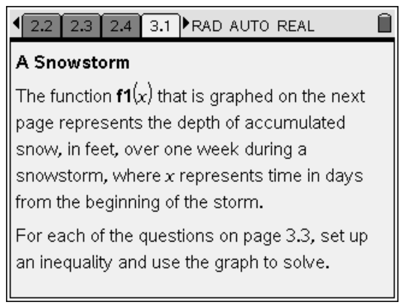
x	f1(x):..
	128*x−1.
0.	0.
1.	112.
2.	192.
3.	240.
4.	256.

0.

Does the table support your answers?

What do you look for in the $f1(x)$ column to answer the questions?

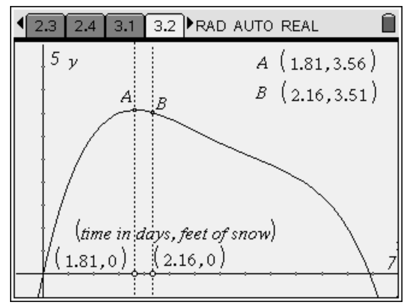
How can you change the x–values to get more accurate answers?

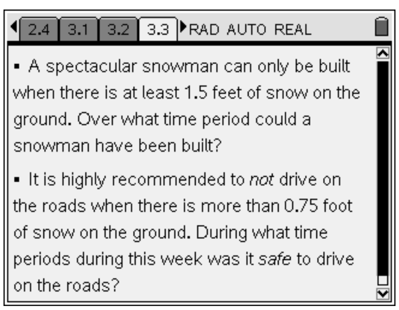

2.2 2.3 2.4 3.1 RAD AUTO REAL

A Snowstorm

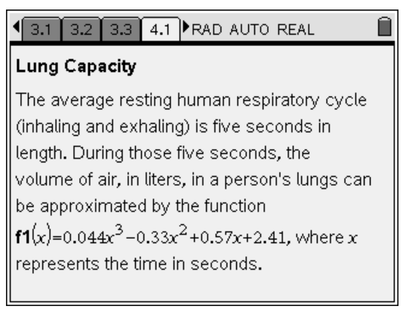
The function $f1(x)$ that is graphed on the next page represents the depth of accumulated snow, in feet, over one week during a snowstorm, where x represents time in days from the beginning of the storm.

For each of the questions on page 3.3, set up an inequality and use the graph to solve.



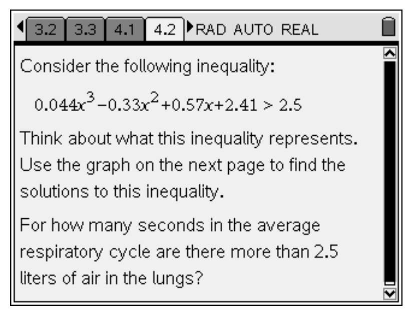

2.4 3.1 3.2 3.3 RAD AUTO REAL

- A spectacular snowman can only be built when there is at least 1.5 feet of snow on the ground. Over what time period could a snowman have been built?
- It is highly recommended to *not* drive on the roads when there is more than 0.75 foot of snow on the ground. During what time periods during this week was it *safe* to drive on the roads?


3.1 3.2 3.3 4.1 RAD AUTO REAL

Lung Capacity

The average resting human respiratory cycle (inhaling and exhaling) is five seconds in length. During those five seconds, the volume of air, in liters, in a person's lungs can be approximated by the function $f1(x)=0.044x^3-0.33x^2+0.57x+2.41$, where x represents the time in seconds.


3.2 3.3 4.1 4.2 RAD AUTO REAL

Consider the following inequality:

$0.044x^3-0.33x^2+0.57x+2.41>2.5$

Think about what this inequality represents. Use the graph on the next page to find the solutions to this inequality.

For how many seconds in the average respiratory cycle are there more than 2.5 liters of air in the lungs?