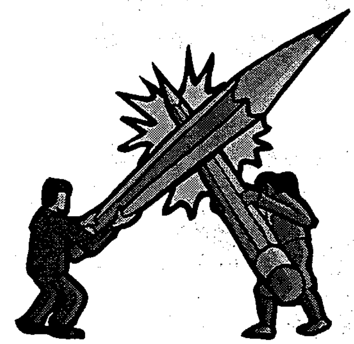
Inequalities

Section 8.1
Solving Simple Inequalities



Inequalities compare two quantities that are not equal. The comparisons most commonly used are ***greater than***, represented by the (>) symbol, and ***less than*** shown by the (<) symbol.

Both these comparisons are inequalities. Notice that in a *greater than* comparison, the large end of the symbol is on the side with the greater value. In a *less than* comparison the small end points to the smaller number.

$6 > 2$ $\quad$ $7 + 1 < 9$ $\quad$ $2a < 8$

In addition to *greater than* or *less than*, you can also have additional conditions to either comparison.

$\geq$ The symbol $\geq$ means the left quantity is either *greater than* or *equal to* the quantity on the right.

$\leq$ The symbol $\leq$ means the left quantity is either *less than* or *equal to* the quantity on the right.

When you have multiple conditions in an "or" comparison, only one of the conditions has to be true for the statement to be true.

When you do the math on both sides, you can see that five is not greater than five — they are equal. **$7 - 2 \geq 4 + 1$**

As long as one of the conditions is true, the inequality is also true. **$5 \geq 5$**

Solving Inequalities and Comparisons

Inequalities and comparisons can be "solved" in much the same way as equations. You find replacement values that make the statements true. Most of the same rules apply as with equations. There is one exception – you'll see it in a minute.

Addition Principle

As with equations, you can add (or subtract) the same value to both sides of the statement, and the inequality will still be true.

$$3 < 7$$
$$3 + 3 < 7 + 3$$
$$6 < 10$$

Take a simple inequality to start, like 3 < 7. If you add three to both sides and combine like terms, the resulting comparison is still true — six is less than 10.

Subtracting the same number from both sides works the same way.

Now let's see how this works when solving an inequality with a variable.

Example 1: **Solve the inequality $a + 2 > 7$.**

Isolate the variable by adding the opposite of +2 to both sides of the inequality. The opposite is –2.

Now you have a set of replacement values for *a* that includes every number that is greater than five. You could try a few to see if it really works, but you can be sure it does.

$$a + 2 > 7$$
$$a + 2 - 2 > 7 - 2$$
$$a > 5$$

Multiplication Principle

Multiplying both sides of an inequality by the same number, however, is a different matter. If you multiply or divide both sides by a ***positive*** number, the comparison remains the same. But if you multiply or divide both sides by a negative number, the comparison changes — the sign is reversed! That's your exception — let's look.

With $2 < 6$ as the original comparison, multiply both sides by a positive number, +2, and see what happens. As you can see, 4 is less than 12, so the inequality sign does not change.

$$2 < 6$$
$$2 \cdot 2 < 6 \cdot 2$$
$$4 < 12$$

Likewise if you divided both sides by +2, the inequality is still true.

$$2 < 6 \qquad \frac{2}{2} < \frac{6}{2} \qquad 1 < 3$$

But when you multiply or divide by a negative number, look what happens:

$$2 < 6$$
$$2 \cdot (-3) < 6 \cdot (-3)$$
$$-6 \overset{?}{<} -18 \longleftarrow \text{No/Incorrect}$$
$$-6 \overset{?}{>} -18 \longleftarrow \text{Yes/Correct}$$

Using the same inequality, multiply both sides by a negative number, –3.

The problem is immediately obvious; –6 is not less than –18. In fact, the opposite is true. Remember, the negative number that is closest to zero is the larger one.

So in order for the statement to remain true, the sign must be reversed.

Division works the same way. If you divide by an negative number, the sign also reverses.

Rule for Multiplying and Dividing with Negative Numbers

Whenever you multiply or divide both sides of an inequality by a negative number, the sign must be reversed to keep the inequality true.

Example 2: **Solve the inequality $3a < 12$.**

Isolate the variable; multiply by the reciprocal of 3, which is $\frac{1}{3}$.

The replacement values for a are all numbers less than 4.

$$3a < 12$$
$$\frac{1}{3} \cdot 3a < 12 \cdot \frac{1}{3}$$
$$a < 4$$

Example 3: **Solve the inequality $-3a < 12$.**

Isolate the variable; multiply by the reciprocal of –3, which is $-\frac{1}{3}$.

Since you are multiplying by a negative number, you must reverse the sign.

The replacement values for a are all numbers *greater* than –4.

$$-3a < 12$$
$$-\frac{1}{3} \cdot -3a > 12 \cdot -\frac{1}{3}$$
$$a > -4$$

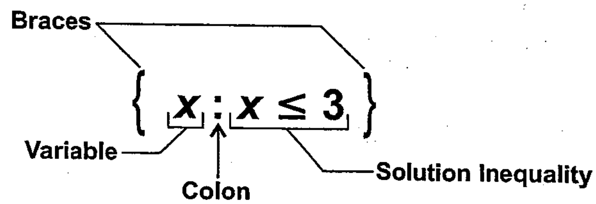
Solution Sets for Inequalities

You can also write solutions for inequalities in set notation. Set notation may look complicated, but it's really easy once you understand the symbols. Let's look.

You have simplified an inequality, and the solution is $x \leq 3$. The solution in set notation looks like this:

$$\{x : x \leq 3\}$$

It's read, "the set of real numbers for x where (or such that) x is less than or equal to 3."



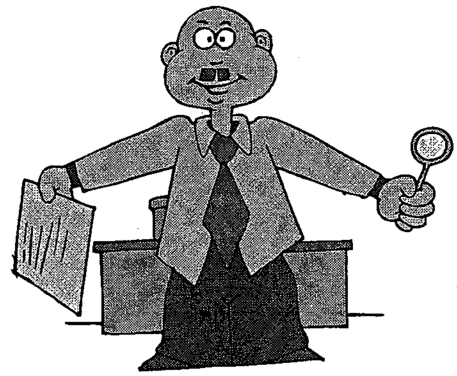
Practice

Solve the following simple inequalities. Remember the rule for multiplying and dividing with negative numbers.

1. $m + 2 > 6$ ________	2. $a - 2 < 10$ ________
3. $6x + 4 > 12$ ________	4. $8n - 4 > 20$ ________
5. $\frac{1}{2}r + 4 > 7$ ________	6. $-5d + 3 > 13$ ________
7. $4 - 2a < 12$ ________	8. $3m - 2 < 13$ ________

Inequalities

Section 8.2
Solving Multi-Step Inequalities



As you saw in Section 6, solving equations can require several steps. The same is true for inequalities. They can require several steps. The only difference in solving inequalities is keeping up with the inequality symbol and making sure the symbol is reversed when multiplying or dividing by a negative number. Changing the direction of the sign when needed can make solving inequalities tricky. Let's look at some hints that might help you.

Variable on the Right

When you solve equations, sometimes the variable ends up on the right side of the equals sign. In equations, you can just reverse the left and right sides.

$6 = x$ is the same as $x = 6$

However, when a variable is on the right side of an inequality, you have to keep the inequality symbol pointed towards the same quantity. That means you reverse the direction of the sign if you reverse the sides. Notice that the small part points towards the same quantity (the x), and the large part opens towards the same quantity (the 6).

$6 > x$ is the same as $x < 6$

Reverse the sign.
Both "point" to the x.

Variable on Both Sides

To reduce the number of steps, always eliminate the term with the smaller coefficient so that you end up with a positive coefficient in front of the variable. Then, if necessary, swap the sign to rearrange the inequality.

$3x + 2 > 4x$

$-3x + 3x + 2 > 4x - 3x$

$2 > x$ or $x < 2$

Example 1: **Solve the inequality $3x - 2 > 8x - 20 + x$.**

$3x - 2 > 8x - 20 + x$

Solving this inequality will require several steps, but you have done these steps before with equations. Let's take it step by step to review.

Step 1: Combine like terms. $\quad 3x - 2 > 9x - 20$

Step 2: Isolate the variable on one side of the inequality. Choose to eliminate the term with the smaller coefficient. Add $-3x$ to both sides. $\quad -2 > 6x - 20$

Step 3: Eliminate the -20 by adding $+20$ to both sides. $\quad 18 > 6x$

Step 4: Multiply both sides by the reciprocal of 6. $\quad 3 > x$

Step 5: Rewrite so the variable is on the left side. $\quad x < 3$

In set notation, the solution would be $\{x : x < 3\}$

Solving Multi-Step Inequalities

Example 2: **Solve the inequality** $-(a+4) \geq -7$

$$-(a + 4) \geq -7$$

Step 1: Clear the parentheses first. The minus sign in front of the parentheses means –1 times $(a+4)$. Remember, you have to distribute the multiplication to both terms inside the parentheses.

$$-a - 4 \geq -7$$

Step 2: Eliminate the –4 by adding +4 to both sides.

$$-a \geq -3$$

Step 3: Eliminate the minus sign in front of the variable by multiplying by –1 on both sides. Remember, for an inequality, this means you must also reverse the sign.

$$a \leq 3$$

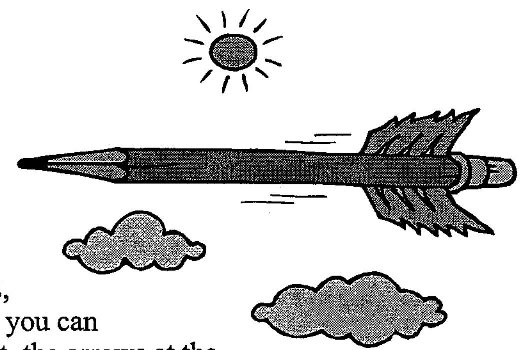
Practice

Solve the following inequalities. Remember the rule for multiplying and dividing with negative numbers.

1. $7m + 4 \leq 3m + 16$ ________	2. $17 - 5a < 8a - 9$ ________
3. $5x + 4 > -13x - 32$ ________	4. $4n - 5 > 5n + 20$ ________
5. $\frac{1}{4}r + 4 > 3r - 7$ ________	6. $-5(d+3) > -3d - 13$ ________
7. $-5(4-2a) \geq 3(2+a) + 23$ ________	8. $6(m+2) < 13(m-2) - 4$ ________

Inequalities

Section 8.3
Graphing Inequalities

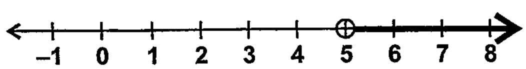


To show the solution set for an inequality, you can also draw a graph. When the solution set has only one variable, the graph is a number line. A number line is a single line that runs infinitely in both directions — positive numbers, negative numbers, and zero included. You don't always see all three because you can draw only the portion of the number line that is needed for your solution. But, the arrows at the ends of the number line indicate it keeps going in both directions to include all numbers.

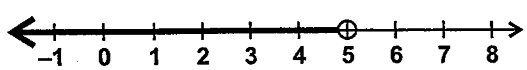
The solution on a number line begins with a circle as the starting point. To indicate "greater than" or "less than," you use an open circle. To show "greater than or equal to" or "less than or equal to," you use a solid circle. To indicate the direction of numbers that satisfy the inequality, a thicker line is drawn on or above the number line. Look at the examples below.

Open Circle

$>, <$



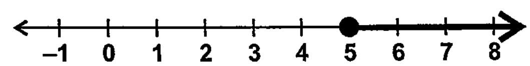
$a > 5$



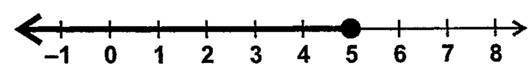
$a < 5$

Solid Circle

$\geq, \leq$



$a \geq 5$



$a \leq 5$

REMEMBER!

If the comparison is "greater than" or "less than," leave the circle open.
If the comparison is "greater than or equal to" or "less than or equal to," color in the circle.

Hint: Do you notice anything about the direction of the solution set in comparison with the inequality sign? As long as the variable is on the left, the inequality sign will point in the direction of the solution set. Caution: This only works if the inequality is completely solved and the variable is on the left.

Example 1: **Graph the solution for the inequality $-2(x + 2) < 6$.**

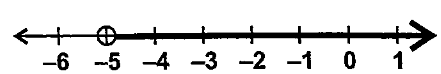
Before you can graph, you must solve the inequality. $-2(x + 2) < 6$

Step 1: Use the distributive property to clear the parentheses. $-2x - 4 < 6$

Step 2: Eliminate the -4 by using the addition principle. $-2x < 10$

Step 3: Eliminate the -2 by using the multiplication principle. Reverse the sign when multiplying by a negative. $x > -5$

Step 4: Now you can graph the solution. Draw an open circle around -5. The thick line points to the right, the same direction as the inequality symbol.



Example 2: **Graph the solution for the inequality $-1 \le -x + 2$.**

$$-1 \le -x + 2$$

Step 1: Use the addition principle to eliminate the +2.

$$-3 \le -x$$

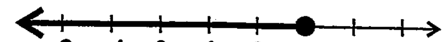
Step 2: Eliminate the minus sign by using the multiplication principle. Reverse the sign when multiplying by a negative.

$$3 \ge x$$

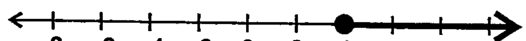
Step 3: Rearrange the inequality so that the variable is on the left.

$$x \le 3$$

Step 4: Now you can graph the solution. Draw a solid circle around 3. The thick line points to the left, the same direction as the inequality symbol.



Example 3: **The solution for an inequality is graphed on the number line below.**



Which solutions of the following inequalities are represented by the graph?

$2x - 2 \ge 6 \qquad 8 \ge 2x \qquad -x - 2 \le 6 \qquad -x + 4 \le 0$

This problem is similar except you have to work backwards.

First, look at the graph. What is the solution represented by the graph? Hopefully you recognize that it would be $x \ge 4$.

$$x \ge 4$$

Now simplify each inequality to see which ones match. The steps for simplifying each are shown below.

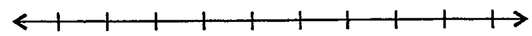
$2x - 2 \ge 6$	$\frac{8}{2} \ge \frac{2x}{2}$	$-x + 2 \le 6$	$-x + 4 \le 0$
$+2 \quad +2$	$4 \ge x$	$-2 \quad -2$	$-4 \quad -4$
$\frac{2x}{2} \ge \frac{8}{2}$		$-x \le 4$	$-x \le -4$
		$\times(-1) \quad \times(-1)$	$\times(-1) \quad \times(-1)$
$x \ge 4$	$x \le 4$	$x \ge -4$	$x \ge 4$
yes	no	no	yes

From this example, you can see how easy it would be to make a small mistake to give you a wrong answer. Be careful when simplifying inequalities. Write down each step.

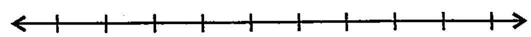
Practice 1

Graph the solution set for the following inequalities. Use the number line given. (Label each number line with an appropriate range of integers.)

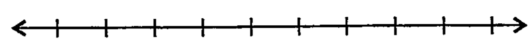
1. $2m + 4 > 16$



2. $7x + 4 < 32$

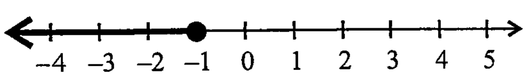


3. $\frac{1}{2}r + 2 \geq r - 1$



Practice 2

For the solution set graphed on each number line below, determine whether the solutions for the inequalities below them are represented by the graph. In each blank beside the inequality, write a *Y* for yes or an *N* for no.



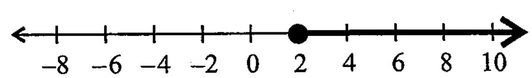
_____ 1. $x + 4 \leq 3$

_____ 2. $2x - 1 \leq -3$

_____ 3. $-x + 7 \geq 6$

_____ 4. $-x - 4 \geq -5$

_____ 5. $2 \geq 3 - x$



_____ 6. $\frac{1}{2}x - 2 \leq -1$

_____ 7. $5 - x \leq 7$

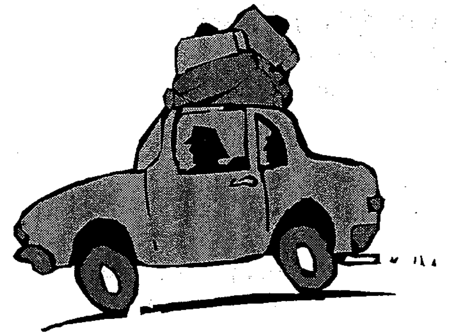
_____ 8. $x + 1 \geq 3$

_____ 9. $2x - 3 \geq -3$

_____ 10. $4 \leq x + 2$

Inequalities

Section 8.4
Solving Word Problems with Inequalities



As with any word problems or real-world situations, the key is in being able to translate English words into algebra symbols. This is especially true with inequalities because subtle differences in the words can mean big differences in setting up the problem. Let's look.

Comparison	Symbol	Words
greater than	$>$	greater than more than greatest
less than	$<$	less than least
greater than or equal to	$\geq$	greater than or equal to at least no less than
less than or equal to	$\leq$	less than or equal to at most no more than

Example 1: **Kesha and two friends are planning a trip. Kesha's mother has said that she can put no more than $100 on her credit card to rent a car. If the rental company charges a flat rate of $25 plus $0.10 per mile, what is the greatest distance the girls can travel?**

Step 1: What is being asked? **The greatest distance that can be traveled**

Step 2: What is given? **Total rental charges can be no more than $100**
Charges are flat rate of $25 plus $0.10 per mile

Step 3: What are the unknowns? **Let d = distance**

Step 4: What mathematical relationships are given?

When setting up an inequality, make sure the limiting quantity goes on the right side of the inequality.

$$25 + 0.10\,d \leq 100$$

25: flat rate; +: plus; 0.10: charge per mile; d: miles; $\leq$: no more than; 100: maximum total charge

Step 5: Solve the inequality for d.

$$25 + 0.10\,d \leq 100$$
$$0.10\,d \leq 75$$
$$d \leq 750$$

Step 6: Answer the question. **$d \leq 750$ miles**

Kesha can travel no more than 750 miles, or the distance must be less than or equal to 750 miles.

Example 2: **A company makes small barrels to store materials. The machine is set to make a barrel that ranges from 2 feet to 6 feet in height in 1 foot increments. A customer wants a barrel with a diameter of 3 feet and a volume of at least 35 cubic feet. What is the smallest height that can be used with this diameter to make the barrel? Use the following for your calculations.**

Volume (V) = $\pi r^2 h$ **Pi (π) = 3.14**

Step 1: What is being asked? **smallest height**

Step 2: What is given? **Diameter equals 3 feet**
Volume is at least 35 cubic feet

Step 3: What are the unknowns? **Let h = height**

Step 4: What knowledge is assumed? **The problem gives diameter, but the formula requires radius. It is assumed that you know radius is equal to half the diameter.**

radius, (r) = 1.5 feet

Step 5: What mathematical relationships are given?

$V \geq 35$

volume at least 35 feet

Substitute in the formula for volume. The limiting quantity (35 feet) is on the right side of the inequality.

$\pi r^2 h \geq 35$

Step 6: Substitute in the values given and solve the inequality for h.

$$(3.14)(1.5)^2(h) \geq 35$$
$$(3.14)(2.25)h \geq 35$$
$$7.065h > 35$$
$$h \geq 4.95$$

Step 7: Answer the question. **$h \geq 5$ feet**

Round to the nearest foot. The barrel height must be 5 feet or higher. To answer the question, 5 feet is the smallest height that can be used.

Discount store cards where you pay a set amount for the card and then get a discount on your purchases are becoming very popular. Many different types of stores now offer them, but do they really save you any money?

Now that you know how to do inequalities, you can find out. Check it out.

Section 8.4, continued
Solving Word Problems with Inequalities

Example 3: **The video game store offers a 10% discount on each game you buy when you purchase a $10 discount card. Without the discount card, the average cost of a game in the store is $18.90. What is the minimum number of games you would have to buy to save money with the card?**

Step 1: What is being asked?

minimum number of games for the discount to be more than what you paid for the card ($10).

Step 2: What is given?

Discount per game = 10%
Average cost per game = $18.90

Step 3: What are the unknowns?

Let g = minimum number of games

Step 4: What knowledge is assumed?

The problem assumes that you know how to calculate the discount. If you take the average price per game and multiply it by the percent as a decimal (0.10), the average discount is $1.89. (Round to 2 places with money.)

Step 5: What mathematical relationships are given?

Total discount on g games is $1.89g$.

To save money, the total discount must be more than (>) the $10 card cost.

Total Discount — $1.89g$ > 10 — Card Cost
(> : greater than)

$$1.89g > 10$$

Step 6: Substitute in the values given and solve the inequality for g.

$$1.89g > 10$$
$$g > 5.29$$

Step 7: Answer the question.

6 games

Since game purchases must be integers (you can't have part of a purchase), you need to round up to the nearest whole number. To save money on the purchase of the card, you would have to purchase more than 5 games. That means you would have to buy at least 6 games to save money. The minimum number of games to save money is 6.

Practice

Set up and solve the following inequality word problems. Write the inequality in the top blank, and write the answer in the bottom blank.

1. Darren wants to make a rectangular vegetable garden in his backyard. He would like the total area to be at least 200 square feet. One of the sides must measure 12 feet. What dimensions can he make the other side?

____

____

2. Martin can spend no more than $5.50 for lunch. He spent $4.60 for a sandwich and chips. How much can he spend for a drink and stay within his budget?

____

____

3. You are planning a party. You cannot spend more than $65.25 for the refreshments. If chips are $17.50, cookies are $19.40, and pretzels are $11.20, what is the most you can spend for sodas?

____

____

4. Carl is planning a banquet for his friend's graduation. He is not sure how many people he can invite with a budget of $1,500. The catering company charges $650 plus $5.50 per person. What's the greatest number of people he can invite and stay within the budget? Let p equal the number of people invited.

____

____

5. A theater can seat 1,050 people. The drama club is doing a play as a fund-raiser. Their expenses totaled $1,162. If they make $4.40 per ticket, what is the minimum number of seats they must sell to make a profit?

____

____

6. A season's pass to a local amusement park costs $161.20 per person. Regular admission to the park is $12.40 per person. How many visits would you have to make to the park to make the season's pass worth the price?

____

____

Inequalities

Section 8.5
Understanding Averages

Working with averages is another real-world situation that may require the use of inequalities. When it comes to averages, the one that students are most aware of is the grades they get for school work. Sounds like a good place to begin.

Average

$$\frac{\text{sum of item}}{\text{number of items}}$$

You can figure out your grade point average by adding all your test scores and then dividing by the total number of tests. You use this same process to find any average. An average is the sum of items divided by the number of items.

Let's start with finding a current average. Suppose you have taken five tests this semester. Your scores are 88, 75, 91, 77, and 80.

$$\{ 88 , 75, 91, 77, 80 \}$$

Calculate your current average by totaling the current grades and dividing by five. Round to the nearest whole number. With these grades, your average is 82.

$$\frac{88 + 75 + 91 + 77 + 80}{5} = 82$$

Example 1: **You have an A average. Your grades are 90, 95, 92, 97, and 93. There is a test scheduled on Friday before spring break. If you miss the test, you cannot make it up. How much damage can one zero do to your average if your family decides to leave early for spring break?**

Step 1: Calculate the current average.

$$\frac{90 + 95 + 92 + 97 + 93}{5} = 93$$

Step 2: Add one zero and recalculate the average.

$$\frac{90 + 95 + 92 + 97 + 93 + 0}{6} = 78$$

Step 3: How much difference did the zero make? Original average minus the new average is fifteen.

$$93 - 78 = 15$$

One zero made a 15 point difference. You have gone from an A to a C! If there had been fewer grades, the difference would have been even more drastic.

Now let's say you have a test coming up and you want to know what grade you need to maintain your average. Since you probably don't mind if your average goes up, your calculation becomes an inequality. You want to know the minimum grade, but any grade higher than that will also work!

Example 2: **Your first five test grades are 88, 75, 91, 77, and 80. What grade do you need to make on the sixth test to maintain your average?**

Step 1: First, calculate your current average by totaling the current grades, and then divide by five. From above, you've already seen that these grades average to 82.

$$\frac{88 + 75 + 91 + 77 + 80}{5} = 82$$

Step 2: To calculate your average after test six, you would add a variable, *T*, to stand for the test you haven't taken yet and divide by six.

$$\frac{88 + 75 + 91 + 77 + 80 + T}{6}$$

Step 3: Here's where the inequality comes in. Maintaining a grade point average means that you want to have at least that grade, but it could be higher. Do you recognize this wording as a greater than or equal to condition?

$$\frac{88 + 75 + 91 + 77 + 80 + T}{6} \geq 82$$

Step 4: To find a value of T that will maintain your current 82 average, make the new average greater than or equal to the current average and solve for T.

According to the calculations, you would have to make at least an 81 on test six to maintain your average.

$$\frac{411 + T}{6} \geq 82$$

$$411 + T \geq 6(82)$$

$$411 + T \geq 492$$

$$T \geq 81$$

Example 3: **Using the same five grades as in Example 2, would it be possible for you to raise your average high enough to have an A average after test 6?**

In this case, instead of maintaining a grade average, you want to pull up a grade average.

Work this problem the same way except you don't need your current average this time. You can skip the first step and set the left side greater than or equal to 90.

Solve the inequality for T. According to the calculations, you would have to make at least 129 on test six to get a 90 or better average. Unless the test has a lot of extra credit, you won't have an "A" after this test. Even if you made a 100 on test six, the best average you could have is an 85.

$$\frac{88 + 75 + 91 + 77 + 80 + T}{6} \geq 90$$

$$\frac{411 + T}{6} \geq 90$$

$$411 + T \geq 6(90)$$

$$411 + T \geq 540$$

$$T \geq 129$$

Free Advice

FREE!

Averages increase in small increments, so don't wait until the last minute to try to pull your average up. It may become statistically impossible to make it happen!

Example 4: **To maintain a certain weight without weight gain, a wrestler calculates that he must average no more than 2000 calories per day. He is weighed each week before a competition, so he tries to maintain that average over each week. For the first six days of the week, he consumed the following calories each day: 1950, 1975, 2010, 2005, 2055, and 2100. How many calories can he consume on day seven to average no more than 2000 calories per day for the week?**

Set this problem up the same way. Add the calories using x for the unknown quantity and divide by 7. But this time, the relationship is less than or equal to.

When you do the math, you can see that he should eat 1905 calories or less for day 7.

$$\frac{1950 + 1975 + 2010 + 2005 + 2055 + 2100 + x}{7} \leq 2000$$

$$\frac{12095 + x}{7} \leq 2000$$

$$12095 + x \leq 14000$$

$$x \leq 1905$$

Practice

For each question below, first write the equation or inequality in the first blank. Then perform the calculations and record your answer in the second blank.

1. Your current grades in Algebra I are 74, 88, 87, and 83. Calculate your current grade point average based on these grades.

 ____

 ____

2. Your current grades in Algebra I are 74, 88, 87, and 83. What grade do you need on the next test to raise your average to at least 85?

 ____

 ____

3. Before basketball season started, Jacki's goal was to average at least 16 points per game. During the season, she scored 18, 15, 10, 22, 16, 12, 6, 20, and 14 for the first nine games and has one more game to play. How many points must she score in the last game to make her pre-season goal?

 ____

 ____

4. The average rainfall per month in one Mississippi county is 4.8 inches per month. The rainfalls for the months of January through November are 5.8, 5.1, 6.8, 5.0, 4.7, 4.4, 4.9, 3.8, 4.1, 3.1, and 4.2. How many inches of rain must fall in December for the county to average at least 4.8 inches for the year?

 ____

 ____

5. Leroy is a car salesman. His goal is to make $3,500 in car sale commissions each month. For the past five months, he has made $3,800, $3,200, $2,800, $3,500, and $3,000. What is the minimum commission he must get in the sixth month to make his average for the first six months?

 ____

 ____

6. Golf is one of the few sports in which the lowest score wins. To make the high school golf team, each player must play 6 rounds of golf and average 80 or less per round on the high school course. Jamie scored the following in his first five rounds: 82, 85, 79, 76, and 80. What score must he have in his sixth round to make the team?

 ____

 ____

Inequalities
Section 8 Review

Answer each question below. Darken the circle that represents the correct answer.

1. Sheryl solved the inequality below by using the steps shown.

Given:	$5(2a+4)-2>8$
Step 1:	$10a+20-2>8$
Step 2:	$10a+18>8$
Step 3:	$10a>-10$
Step 4:	$a<-1$

Which step contains Sheryl's first mistake?

A Step 1

B Step 2

C Step 3

D Step 4

Ⓐ Ⓑ Ⓒ Ⓓ

2. Dora solved the inequality below by using the steps shown.

Given: $-\frac{1}{2}x+4<-\frac{1}{4}x-1$

Step 1: $-\frac{1}{2}x+5<-\frac{1}{4}x$

Step 2: $x-10<2x$

Step 3: $-10<x$

Step 4: $x>-10$

Which step contains Dora's first mistake?

A Step 1

B Step 2

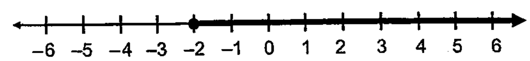
C Step 3

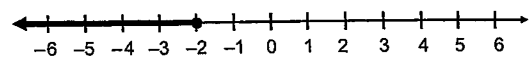
D Step 4

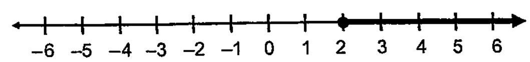
Ⓐ Ⓑ Ⓒ Ⓓ

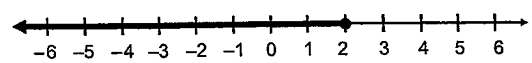
3. Which graph below best represents the solution for the following inequality?

$$x-2\le 2x$$

A


B


C


D


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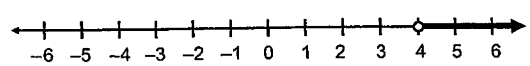
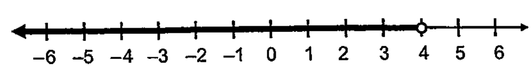
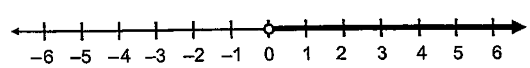
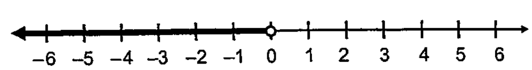
4. Which graph below best represents the solution for the following inequality?

$$2(x+1)<3x+2$$

A


B


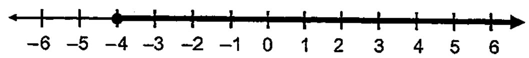
C


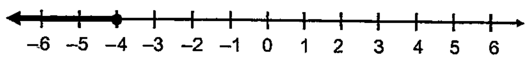
D


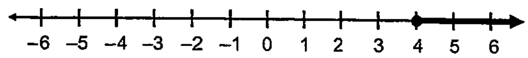
Ⓐ Ⓑ Ⓒ Ⓓ

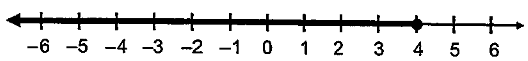
5. Which graph below best represents the solution for the following inequality?

$$-(x+5) \le -1$$

A 

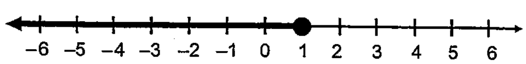
B 

C 

D 

Ⓐ Ⓑ Ⓒ Ⓓ

6. The solution of an inequality is graphed on the number line below.



Which inequality's solution is NOT represented by this graph?

A $-x+5 \ge 4$

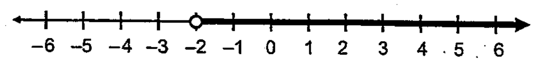
B $0 \ge x-1$

C $2x-1 \le 1$

D $x+7 \le 6$

Ⓐ Ⓑ Ⓒ Ⓓ

7. The solution of an inequality is graphed on the number line below.



Which inequality's solution is NOT represented by this graph?

A $x+4>2$

B $x-1>-3$

C $-x+1<-1$

D $-x-4<-2$

Ⓐ Ⓑ Ⓒ Ⓓ

8. A storage company sells rectangular store boxes in different sizes. Cassie needs a storage box with a volume of at least 20 cubic feet. She wants the length to be 5 feet and the width to be 3 feet. If the heights come in 1 foot increments, what is the smallest height she can buy that has a volume of 20 cubic feet or more? Use the formula for the volume of a rectangular prism, $V = lwh$.

A 1 foot

B 2 feet

C 3 feet

D 4 feet

Ⓐ Ⓑ Ⓒ Ⓓ

9. To meet her budget, Tamera can spend no more than \$55 on her telephone bill each month. Her bill is based on a flat fee of \$35 plus \$0.07 per minute for long distance calls. What is the maximum number of long distance minutes she can talk without going over her budgeted amount?

A 201
B 285
C 286
D 300

Ⓐ Ⓑ Ⓒ Ⓓ

10. Marsha wants to earn an average grade of at least 93 for her six algebra tests. The scores for her first five tests are 95, 84, 91, 93, and 97. Which inequality can be used to determine x, the grade Marsha needs to earn on her sixth test to have an average grade of at least 93?

A $\frac{95+84+91+93+97}{5}+x>93$

B $\frac{95+84+91+93+97}{5}+x\leq 93$

C $\frac{95+84+91+93+97+x}{6}\geq 93$

D $\frac{95+84+91+93+97+x}{6}<93$

Ⓐ Ⓑ Ⓒ Ⓓ

11. Henry has \$25 to spend at an arcade. Game tokens are \$1.25 each. After buying a soft drink and a pretzel for \$5.25, what is the maximum number of tokens he can purchase?

A 15
B 16
C 19
D 20

Ⓐ Ⓑ Ⓒ Ⓓ

12. A grocery store offers its customers a discount card that gives 15% off all purchases, p. The card costs \$12 per year. Which inequalities could be used to show the amount a customer would need to purchase each year to SAVE money?

A $0.15p>12$

B $0.15p<12$

C $\frac{p}{0.15}>12$

D $\frac{p}{0.15}<12$

Ⓐ Ⓑ Ⓒ Ⓓ

13. A baseball pitcher has a pre-season goal to average less than 3 earned runs per game. In his first 5 games, his earned runs were 6, 2, 5, 1, and 3. Which inequality can be used to determine x, the earned runs he must have in the sixth game to keep his pre-season goal?

A $\frac{6+2+5+1+3}{5}+x<3$

B $\frac{6+2+5+1+3}{5}+x>3$

C $\frac{6+2+5+1+3+x}{6}<3$

D $\frac{6+2+5+1+3+x}{6}>3$

Ⓐ Ⓑ Ⓒ Ⓓ

14. Yana wants to rebuild her rectangular patio. She wants the perimeter to be 120 feet at most. The length will be 6 feet longer than the width. What are the largest possible dimensions for the patio?

A 10 ft × 12 ft
B 20 ft × 6 ft
C 27 ft × 33 ft
D 57.5 ft × 62.5 ft

Ⓐ Ⓑ Ⓒ Ⓓ