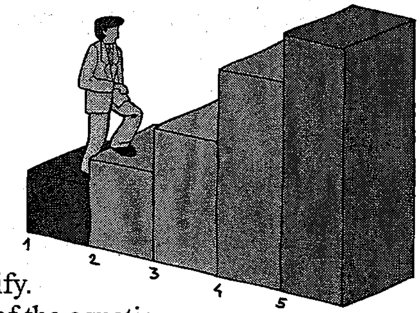
Multi-Step Equations

Section 6.1
Introduction to Multi-Step Equations



Only the most basic equations require the use of one principle (addition or multiplication) at a time. Most require the use of a combination of the two to simplify. That's what we mean by "multi-step." Equations that have constants on both sides of the equation and a coefficient in front of the variable take both the addition and multiplication principles. To solve, just take it one step at the time.

Example 1: **Simplify the equation $3m + 4 = 13$.**

Step 1: First, use the addition principle to eliminate the +4 by adding the opposite.

$$\begin{array}{r} 3m + 4 = 13 \\ -4 = -4 \\ \hline 3m = 9 \end{array}$$

Step 2: Next, use the multiplication principle to eliminate the coefficient of the variable. Remember, multiply by the reciprocal.

$$\frac{1}{3} \cdot 3m = 9 \cdot \frac{1}{3}$$

$$\frac{3}{3}m = \frac{9}{3}$$

$$m = 3$$

Step 3: Use the substitution principle to check the solution.

Check:

$$3(3) + 4 = 13$$

$$9 + 4 = 13$$

$$13 = 13$$

Now look at an example that doesn't work out so neatly.

Example 2: **Simplify the equation $\frac{2}{3}x - 1 = 4$.**

Step 1: In this example, first eliminate the –1 by adding +1 to both sides.

$$\begin{array}{r} \frac{2}{3}x - 1 = 4 \\ +1 = +1 \\ \hline \frac{2}{3}x = 5 \end{array}$$

Step 2: Next eliminate the coefficient of x by multiplying by its reciprocal. The answer is an improper fraction, so convert to a mixed number as the final solution.

$$(\frac{3}{2})(\frac{2}{3})x = (\frac{5}{1})(\frac{3}{2})$$

$$x = \frac{15}{2} \text{ or } 7\frac{1}{2}$$

Step 3: Use the improper fraction form to check the solution.

Check:

$$(\frac{\cancel{2}}{\cancel{3}})(\frac{\overset{5}{\cancel{15}}}{\cancel{2}}) - 1 = 4$$

$$5 - 1 = 4$$

$$4 = 4$$

Section 6.1, continued
Introduction to Multi-Step Equations

Practice

Solve the following multi-step equations by using the addition principle and the multiplication principle. Show your work and write your final answer in the blank provided. Convert improper fractions to mixed numbers. Make sure you check each solution by using substitution.

1. $3m - 2 = 7$ ________	2. $2a + 5 = -2$ ________	3. $\frac{1}{3}x + 2 = 2$ ________
4. $14c + 2 = 4$ ________	5. $-2x - 4 = 6$ ________	6. $-\frac{1}{2}m - 3 = 2$ ________
7. $-2x + 1 = -6$ ________	8. $3y - 7 = 1$ ________	9. $-\frac{2}{3}a + 5 = 1$ ________
10. $-\frac{3}{4}y - 1 = 5$ ________	11. $\frac{2}{5}x + 2 = -1$ ________	12. $\frac{2}{3}c - 9 = -2$ ________

Multi-Step Equations

Section 6.2
Combining Like Terms

Another condition you are likely to encounter when solving multi-step equations is like terms on one or both sides of the equation.

Example 1: **Simplify the equation $4n + 4 - n + 1 = 14$**

If you remember what "terms" are, this will be an easy one. Let's start by identifying the terms in this equation. Keep in mind that a term is a constant, a variable, or a product of the two. Terms are separated by addition or subtraction symbols.

$$4n + 4 - n + 1 = 14$$

- **Term 1** — Product of a constant and a variable ($4n$)
- **Term 2** — Constant (4)
- **Term 3** — Variable (n)
- **Term 4** — Constant (1)
- **Term 5** — Constant (14)

Like terms have the same mathematical structure. That's important because like terms can be combined. Terms with the same variable (to the same power) can be combined, and terms with only constants can be combined.

Step 1: Since addition and subtraction can be regrouped, rearrange the equation so that the like terms are together. Combining the like terms eliminates one of the variable terms and one of the constant terms. Now the equation looks like one you've seen before.

$$4n + 4 - n + 1 = 14$$
$$4n - n + 4 + 1 = 14$$
$$3n + 5 = 14$$

Step 2: Use both the addition and multiplication principles to solve. First, use the addition principle to eliminate the +5.

$$3n + 5 + (-5) = 14 + (-5)$$
$$3n = 9$$

Step 3: Use the multiplication principle to convert the $3n$ to $1n$, or just n.

$$\frac{1}{3} \cdot 3n = 9 \cdot \frac{1}{3}$$
$$n = 3$$

Step 4: Check your solution.

Check:

$$4(3) + 4 - 3 + 1 = 14$$
$$12 + 4 - 3 + 1 = 14$$
$$14 = 14$$

Simplifying Negative Coefficients

CAUTION
One situation that can happen is a negative one (–1) coefficient in front of the variable. You cannot leave a negative coefficient. You must simplify it!

Example 2: **Simplify the equation $n + 2 - 2n = 18$**

$$n + 2 - 2n = 18$$

Step 1: Combine the like terms, n and $-2n$.

$$-n + 2 = 18$$

Step 2: Eliminate the +2 by adding the opposite, –2.

$$-n + 2 + (-2) = 18 + (-2)$$
$$-n = 16$$

Now, you are close to what you want, but you have a negative 1 for the coefficient of the variable on the left side. The only problem is that ***you can't leave it like that.***

Step 3: To clear the negative coefficient, you can use the multiplication principle to multiply both sides of the equation by negative one. We'll write it out so you can see it better.

$$(-1)(-n) = 16(-1)$$

The negative one times the negative one on the left side will make the n positive. The negative one times the positive sixteen will make it –16. The solution is $n = -16$.

$$n = -16$$

Step 4: Check the solution.

Check:

$$-16 + 2 - 2(-16) = 18$$
$$-16 + 2 + 32 = 18$$
$$18 = 18$$

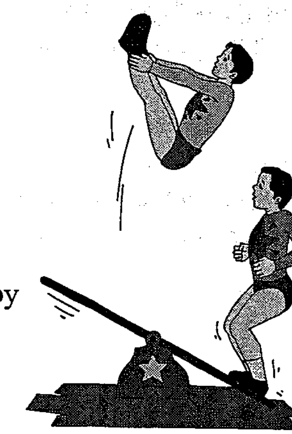
Practice

Solve the following multi-step equations by combining like terms and using the addition and multiplication principles. Show your work and write your final answer in the blank provided. Make sure you check each solution by using substitution.

1. $4m + 2 - 2m = 10$ __________	2. $a - 2 - 2a = 10$ __________
3. $6x + 1 - 3x = 10$ __________	4. $8n + 2 - 9n = -8$ __________
5. $7r - 4 - 8r = 5$ __________	6. $5d - 3 - 3d = 13$ __________

Multi-Step Equations

Section 6.3
Variables on Both Sides



Equations with variables on both sides of the equals sign only look scary. The variables are actually no different from any other term in the equation as long as they are like terms. As you may recall, like terms have the same mathematical structure, so they can be simplified by combining them.

Example 1: **Simplify the equation $6r = 4r + 16$.**

Since variables can be treated like any other term, you can eliminate the variable from one side of the equation by adding the opposite. It will simplify things if you will choose to eliminate the smaller variable.

Step 1: Pick the variable on the right side of the equation because it is smaller. Add the opposite to both sides. In this example, $4r$ is on the right, so add the opposite of $4r$ to both sides.

$$\begin{array}{r} 6r = 4r + 16 \\ -4r = -4r \\ \hline 2r = 16 \end{array}$$

Step 2: Use the multiplication principle to eliminate the coefficient of 2.

$$\frac{1}{2} \cdot 2r = 16 \cdot \frac{1}{2}$$

$$\frac{1}{\cancel{2}} \cdot \cancel{2}r = \overset{8}{\cancel{16}} \cdot \frac{1}{\cancel{2}}$$

$$r = 8$$

Step 3: Now substitute and check.

Check:

$$6r = 4r + 16$$
$$6(8) = 4(8) + 16$$
$$48 = 32 + 16$$
$$48 = 48$$

Example 2: **Simplify the equation $3y + 2 = 4y + 12$.**

Step 1: You can use the addition principle to eliminate the $3y$ on the left side by adding the opposite, $-3y$. That clears the $3y$.

$$\begin{array}{r} 3y + 2 = 4y + 12 \\ -3y \quad\; = -3y \quad\;\; \\ \hline 2 = y + 12 \end{array}$$

Step 2: Next, to eliminate the +12 use the addition principle again. That leaves $-10 = y$, which is the same as $y = -10$.

$$\begin{array}{r} 2 = y + 12 \\ -12 = \quad -12 \\ \hline -10 = y \end{array} \quad \text{or} \quad y = -10$$

Step 3: Check your solution with substitution.

Check:

$$3(-10) + 2 = 4(-10) + 12$$
$$-30 + 2 = -40 + 12$$
$$-28 = -28$$

Section 6.3, continued
Variables on Both Sides

Practice

Solve the following multi-step equations that have variables on both sides. Show your work and write your final answer in the blank provided. Make sure you check each solution by using substitution.

1. $6y + 10 = 18 - 2y$ __________	2. $2x + 5 = 19 - 5x$ __________
3. $3a + 8 = 5a - 6$ __________	4. $m + 7 = -3m - 1$ __________

Mixed Practice 6.1 – 6.5

Solve the following equations. Show your work and write your final answer in the blank provided. Make sure you check each solution by using substitution.

1. $4 - x = 7$ __________	2. $4m - 4 - m = 8 + 2m$ __________
3. $-2b = 20$ __________	4. $3a - 12 - a = 2 - 5a$ __________
5. $\frac{2}{3}c + 2 = -5$ __________	6. $\frac{3}{4}n - 4 = -5$ __________

Multi-Step Equations

Section 6.4
Equations with Parentheses

Equations with parentheses present a unique challenge because the parentheses must be cleared before the equation can be solved. Remember that all operations inside parentheses must be done first. But if there are no like terms inside, you must do something else to clear the parentheses. Check out this one.

Example: **Simplify the equation $4(a + 3) = (8 - 12)$.**

Step 1: The parentheses on the right side contain like terms. Remove the parentheses by combining the terms.

$$4(a + 3) = (8 - 12)$$
$$4(a + 3) = -4$$

Step 2: The parentheses on the left side do not contain like terms. But you can remove these parentheses by using the distributive property to ***distribute*** the multiplication.

$$4(a) + 4(3) = -4$$
$$4a + 12 = -4$$

Step 3: Once the parentheses have been cleared, you can use what you already know to solve the equation. Use the addition principle to eliminate the +12, and then use the multiplication principle to remove the 4 in front of the variable.

$$4a + 12 - 12 = -4 - 12$$
$$4a = -16$$
$$\frac{1}{4} \cdot 4a = -16 \cdot \frac{1}{4}$$
$$a = -4$$

Step 4: Don't forget to check the solution.

Check:

$$4(-4 + 3) = (8 - 12)$$
$$4(-1) = (-4)$$
$$-4 = -4$$

Practice

Solve the following equations that have parentheses. Show your work and write your final answer in the blank provided. Make sure you check each solution by using substitution.

1. $2(3x + 2) = 16$ __________

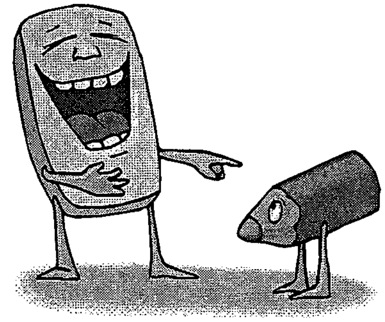
2. $5(b - 3) = 10$ __________

3. $-3(a - 2) = 5(a + 2)$ __________

4. $3(5 - m) = -(2m - 1)$ __________

Multi-Step Equations

Section 6.5
Equations with Decimals or Fractions



Clearing Decimals

When an equation has decimal coefficients or constants, the decimals can be cleared by following these simple steps:

Clearing Decimals

1. Count the greatest number of decimal places found in the equation.
2. Write 10 with an exponent equal to the largest number of places (2 places = 10^2 or 100).
3. Multiply all the terms on both sides of the equation by the power of ten determined in step 2.
4. Solve by combining like terms and using the addition and multiplication principles.

Example 1: **Simplify the equation $0.04t + 3.1 = 0.02t + 3.2$**

Step 1: Count the greatest number of decimal places found in the equation. In this example, that is 2 places.

$$0.04t + 3.1 = 0.02t + 3.2$$

2 places 1 place 2 places 1 place

Step 2: Two places after the decimal means the factor will be 10^2 or 100. Multiply all terms by 100.

$$0.04t(100) + 3.1(100) = 0.02t(100) + 3.2(100)$$
$$4t + 310 = 2t + 320$$

Step 3: Add the opposite of 310 to both sides.

$$4t + 310 - 310 = 2t + 320 - 310$$
$$4t = 2t + 10$$

Step 4: Add the opposite of $2t$ to both sides.

$$4t - 2t = 2t - 2t + 10$$
$$2t = 10$$

Step 5: Multiply both sides by the reciprocal of 2.

$$2t \cdot \frac{1}{2} = 10 \cdot \frac{1}{2}$$
$$t = 5$$

Practice 1

Solve the following equations that have decimals. Show your work and write your final answer in the blank provided.

1. $0.5x + 0.5 = 8$ __________	2. $0.25a - 0.05 = 3.2$ __________

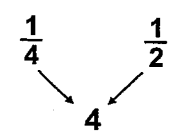
3. $2.05r + 2 = 8.15$ __________	4. $0.5b - 0.15 = 0.35$ __________
5. $-0.02a - 0.2 = -0.6$ __________	6. $0.4m + 1 = 2.14$ __________

Clearing Fractions

You have seen that when a variable has a fractional coefficient, you can use the multiplication principle to solve the problem. However, when an equation has more than one fractional coefficient or constant, it takes a little more work to solve. The easiest way to solve this type of equation is to clear all the fractions, but that takes a few more steps than with clearing decimals.

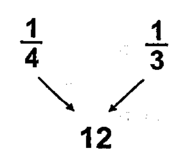
What you must do is look at all the denominators of the terms. Find the smallest number of which each of the denominators is a factor. You then multiply all the terms by that number. In case you have forgotten, that number is called the ***Least Common Denominator***, or LCD for short. Here's a bit more about LCDs.

- The first thing to check is if one of the denominators is a factor of the other. In the case of 4 and 2, 2 will divide evenly into 4, so 2 is a factor of 4. Do the mental math, and you can see that 4 is the LCD for this example.



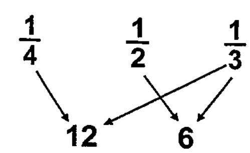
- How would you find an LCD for fractions with the denominators of 4 and 3 since one is not a factor of the other?

  The easiest way to find a common denominator is to multiply the denominators together. The product here is 12. If you do a little "mental math" you will see that 12 is the smallest number that has both 3 and 4 as a factor. That makes 12 the LCD.



- Try fractions with denominators of 2, 3, and 4, and see what happens. The product of $4 \times 2 \times 3$ would be 24. But is 24 the smallest number that each denominator will divide into evenly (same thing as a factor of)? You could do the "mental math" and see if you could find something smaller, or you could do it a different way.

  Pick a pair of denominators and multiply them. Then see of the other denominator will divide evenly into the product. If you pick two and three, the product would be six. Now see if the other denominator, 4, will divide evenly into six. It doesn't, so try the other pair. The product of 4×3 is 12, and the other denominator, 2, will divide evenly into 12. Now you have the LCD.



Clearing Fractions

1. Find the Lowest Common Denominator (LCD) for all the fractions in the equation.
2. Multiply all the terms on both sides of the equation by the LCD.
3. Solve normally by combining like terms and using the addition and multiplication principles.

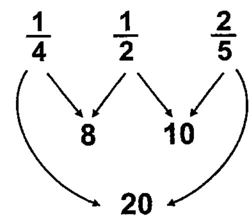
Example 2: Simplify the equation $\frac{1}{4}d + \frac{1}{2} = \frac{1}{2}d + \frac{2}{5}$.

Step 1: Find the LCD of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{2}{5}$.

$$\frac{1}{4}d + \frac{1}{2} = \frac{1}{2}d + \frac{2}{5}$$

Check to see if any of the denominators is a factor of the others. *Two is a factor of four but not of five, so try something else.*

Pick a pair and multiply them. Then check to see if the other will divide evenly. *Two times four is eight, but five won't divide evenly into eight. Two times five is ten, but that doesn't work either. Four times five is 20 and two is a factor of 20.*



Step 2: Multiply each term by the LCD of 20.

$$(20)\frac{1}{4}d + (20)\frac{1}{2} = (20)\frac{1}{2}d + (20)\frac{2}{5}$$

$$\cancel{(20)}^{5}\frac{1}{\cancel{4}}d + \cancel{(20)}^{10}\frac{1}{\cancel{2}} = \cancel{(20)}^{10}\frac{1}{\cancel{2}}d + \cancel{(20)}^{4}\frac{2}{\cancel{5}}$$

$$5d + 10 = 10d + 8$$

Step 3: Solve as a multi-step equation.

$$5d - 10d + 10 = 10d - 10d + 8$$
$$-5d + 10 = 8$$
$$-5d + 10 - 10 = 8 - 10$$
$$-5d = -2$$
$$d = \frac{2}{5}$$

Practice 2

Solve the following equations that have fractions. Show your work and write your final answer in the blank provided.

1. $\frac{1}{2}y + \frac{1}{4} = \frac{3}{4}$ __________	2. $\frac{2}{3}a + \frac{1}{4} = \frac{1}{3}$ __________
3. $\frac{2}{5}m + \frac{1}{4} = \frac{1}{2}$ __________	4. $\frac{2}{3}n - \frac{1}{9} = \frac{1}{7}$ __________

Multi-Step Equations

Section 6.6
Identifying Mistakes

Once you have experience in solving multi-step equations, you will begin to take short cuts and not write down every step. You can add, subtract, multiply, and divide in your head. However, once you stop writing down each step, it is easy to make mathematical mistakes. If you always check your solution by using substitution, you will know if you have made a mistake. Then you can double-check the steps and make corrections. Watch out for the following mistakes:

1. **Adding the opposite to one side, but adding the original to the other side**

   Be careful that you always add the same thing to both sides of an equation.

   Identify which step has a mistake.

   Given: $2x - 10 = 2$

   Step 1: $2x = -8$ ⟵ **Mistake!** To eliminate the −10, we should add +10 to both sides. +10 was added to the left side, but −10 was added to the right side.

   Step 2: $x = -4$

2. **Multiplying by the reciprocal on one side, but multiplying by the original factor on the other**

   Also be careful to multiply both sides by the same factor.

   Identify which step has a mistake.

   Given: $3r - 2 = 7$

   Step 1: $3r = 9$

   Step 2: $r = 27$ ⟵ **Mistake!** To eliminate the coefficient of 3, you must multiply by the reciprocal, $\frac{1}{3}$, but the right side was multiplied incorrectly by 3.

3. **Making arithmetic errors, especially with negative numbers**

   When adding, subtracting, multiplying, or dividing with negative numbers, it is easy to make a mistake. Double-check your math.

   Identify which step has a mistake.

   Given: $-3b + 7 = -14$

   Step 1: $-3b = -21$

   Step 2: $b = -7$ ⟵ **Mistake!** To eliminate the coefficient of −3, we must multiply by the reciprocal, $-\frac{1}{3}$. In this case, the negative was forgotten. Remember, a negative multiplied by a negative is a positive.

4. Simplifying terms that cannot be simplified

Make sure you add only terms that are alike. Terms that are not alike cannot be combined or simplified.

Identify which step has a mistake.

Given: $4a - 2ab = 6 + 4$

Step 1: $2b = 10$ ⟵ **Mistake!** The 6 + 4 can be combined correctly to get 10, but the $4a - 2ab$ cannot be combined. These terms are not alike.

Step 2: $b = 5$

5. Multiplying only the first term inside the parentheses by the factor outside the parentheses

When clearing parentheses to solve equations, you again have more opportunities for arithmetic mistakes. Make sure you multiply all terms inside the parentheses by the factor outside the parentheses.

Identify which step has a mistake.

Given: $4(c - 6) = 2(c + 1)$

Step 1: $4c - 6 = 2c + 2$ ⟵ **Mistake!** The 4 outside the parentheses on the left side of the equation should have been multiplied to both the c and the -6 inside the parentheses. The -6 was not correctly multiplied. The 2 on the right side of the equation was distributed correctly to both terms inside the parentheses.

Step 2: $2c - 6 = 2$

Step 3: $2c = 8$

Step 4: $c = 4$

6. Not multiplying all terms by the same factor when clearing decimals or fractions.

When clearing decimals or fractions, make sure you multiply every term by the same factor.

Identify which step has a mistake.

Given: $0.002y + 0.2 = 0.06$

Step 1: $2y + 2 = 6$ ⟵ **Mistake!** The factor to clear all the decimals should have been 10^3 or 1000. Each term should have been multiplied by 1000; however, each term was multiplied by a different factor. The 0.2 was multiplied by 10, and the 0.06 was multiplied by 100.

Step 2: $2y = 4$

Step 3: $y = 2$

Identify which step has a mistake.

Given: $\frac{1}{2}a + \frac{1}{3} = 6$

Step 1: $3a + 2 = 6$ ⟵ **Mistake!** The LCD of 2 and 3 is 6, so each factor should be multiplied by 6. The terms on the left were correctly multiplied, but the term on the right was not.

Step 2: $3a = 4$

Step 3: $a = \frac{4}{3}$

Section 6.6, continued
Identifying Mistakes

Practice

Identify the mistake in each of the following problems. Follow the example given.

Given: $3y - 9 = 3(3y - 1)$
Step 1: $3y - 9 = 9y - 3$
Step 2: $6y - 9 = -3$
Step 3: $6y = 6$
Step 4: $y = 1$

Mistake in Step **2**.
Should have **added 3y + (–9y) to get –6y**
instead of **making an arithmetic error and getting 6y**

1. **Given:** $3a + 5 = 4a - 2$
   Step 1: $-a + 5 = -2$
   Step 2: $-a = -7$
   Step 3: $a = -7$

   Mistake in Step ____.
   Should have ________________
   instead of ________________

2. **Given:** $2(x - 1) = 10$
   Step 1: $2x - 2 = 10$
   Step 2: $2x = 8$
   Step 3: $x = 4$

   Mistake in Step ____.
   Should have ________________
   instead of ________________

3. **Given:** $3m - 7 = 10$
   Step 1: $3m = 18$
   Step 2: $m = 6$

   Mistake in Step ____.
   Should have ________________
   instead of ________________

4. **Given:** $0.2a + 0.06 = 0.05$
   Step 1: $2a + 6 = 5$
   Step 2: $2a = -1$
   Step 3: $a = -\frac{1}{2}$

   Mistake in Step ____.
   Should have ________________
   instead of ________________

Identifying Mistakes

5. **Given:** $3(r-2)=r+6$
   Step 1: $3r-2=r+6$
   Step 2: $2r-2=6$
   Step 3: $2r=8$
   Step 4: $r=4$

   Mistake in Step ____.
   Should have ________________________________
   instead of ________________________________

6. **Given:** $\frac{1}{2}m-10=12$
   Step 1: $2m-10=24$
   Step 2: $2m=34$
   Step 3: $m=17$

   Mistake in Step ____.
   Should have ________________________________
   instead of ________________________________

7. **Given:** $3a-3ab=9+3$
   Step 1: $-3b=9+3$
   Step 2: $-3b=12$
   Step 3: $b=-4$

   Mistake in Step ____.
   Should have ________________________________
   instead of ________________________________

8. **Given:** $6x+5-x=-25$
   Step 1: $5x+5=-25$
   Step 2: $5x=-20$
   Step 3: $x=-4$

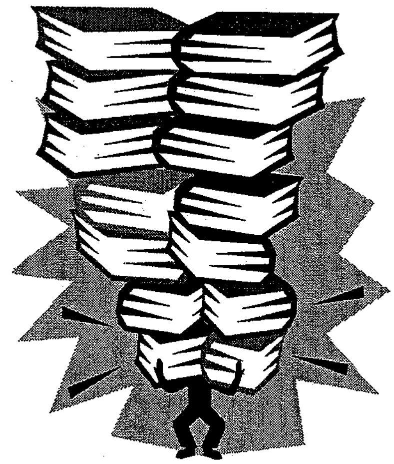
   Mistake in Step ____.
   Should have ________________________________
   instead of ________________________________

9. **Given:** $9m-3=6m+2$
   Step 1: $3m-3=2$
   Step 2: $3m=5$
   Step 3: $m=15$

   Mistake in Step ____.
   Should have ________________________________
   instead of ________________________________

Multi-Step Equations

Section 6.7
Solving Algebra Word Problems



In Section 4, you saw how to set up different types of algebra word problems. Now that you have seen how to solve algebraic equations, you should be able to set up and solve algebra word problems. Let's review the steps.

Example 1: **A company uses a perfect binder machine that can bind books at a rate of 3 books per minute. Yesterday, the machine bound 150 out of 600 books needed for an order. How many minutes will it take the machine to bind the remainder of the books?**

Step 1: What is being asked?

How long to bind remainder of books.

Step 2: What is given?

Rate of book-binding is 3 books per minute.
Remainder of books to be bound is 600 minus 150.

Step 3: What are the unknowns?

Let t = minutes to bind remainder of books

Step 4: What mathematical relationships are given?

$$600 - 150 = 3t$$

(600 − 150: remainder of books; 3: 3 books per minute; t: minutes)

$$\frac{3 \text{ books}}{\cancel{\text{minute}}} \times \frac{t\ \cancel{\text{minutes}}}{1} = 3t \text{ books}$$

You should recognize this as a rate problem.

Step 5: Answer the question.

The question asks for minutes, so you must solve this equation for t.

$$450 = 3t$$
$$t = 150 \text{ minutes}$$

Example 1 only talks about one quantity, but what if you had two quantities in the same problem and only one variable to express them both? You have to think a little harder about the relationship. But the great thing is that when you can talk about both quantities in terms of the same variable, you can set them equal.

Example 2: **This same company buys paper by the case. They bought 45 cases. If the paper had been \$2 a case less, they could have bought 5 more cases. How much does one case of paper cost?**

Step 1: What is being asked?

How much one case costs.

Step 2: What is given?

Bought 45 cases
If cost of 1 case is \$2 less, can buy 5 more cases
Five more cases would be 45 + 5 or 50

Step 3: What are the unknowns?

Let C = cost of one case

Step 4: What mathematical relationships are given?
Think. Forty-five cases at the old price is the same as 5 more (50) at the new price (the old price – \$2).

New price

$$45C = 50\,(C - 2)$$

Cost of 45 cases

Cost of 50 which is five more (45 + 5)

Step 5: Answer the question.

Solve for C (the old price per case).

$$45C = 50\,(C - 2)$$
$$45C = 50C - 100$$
$$-5C = -100$$
$$C = \$20$$

Practice

Set up and solve the following algebra word problems. Write the equation in the top blank and the answer in the bottom blank.

1. Will had two less than three times as many video games as Josh. If Will has 10 games, how many does Josh have?

____

____

2. Kayla purchased 3 large sodas at the movie theater. Before tax was added, the total cost of the 3 sodas was equal to the cost of 2 sodas plus \$5. What was the cost of one soda, s?

____

____

3. Katherine works flexible hours. This month she worked a total of 50 hours, which was 2 more than 3 times as many hours as she worked last month. How many hours did she work last month?

____

____

4. Matt is saving for college. He puts \$50 in his savings account each week. How many weeks, w, will it take for him to save \$10,000?

____

____

5. An electrician charged a customer \$425 for wiring a finished basement. The charge was based on a \$75 fixed service charge plus \$70 per hour of electrical work performed. How many hours, h, did the electrician work?

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____

6. An Internet company charges a shipping fee of 5% of the purchase cost, p. If the total cost with shipping is calculated to be \$26.25, what is the purchase price before shipping was added?

____

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7. The band sold candy as a fund raiser. The chocolate bars were \$2.00 each, and peanut rolls were \$1.50 each. In the first week, one band member sold a total of 25 pieces of candy. If the band member collected \$47.50, how many chocolate bars did she sell.

____

____

8. Jon makes a salary of \$280 per week plus 5% commission on sales, x. Last week, his total pay was \$425. What were his sales for last week?

____

____

Multi-Step Equations

Section 6 Review

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

1. What is the solution of the following equation?

$$-5a + 7 = 22$$

A $a = -3$
B $a = -5\frac{4}{5}$
C $a = 10$
D $a = 20$

Ⓐ Ⓑ Ⓒ Ⓓ

2. What is the solution of the following equation?

$$\frac{3}{5}y - 5 = 15$$

A $y = 6$
B $y = 12$
C $y = 16\frac{2}{3}$
D $y = 33\frac{1}{3}$

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3. What is the solution of the following equation?

$$\frac{2}{3}x - 4 = -1$$

A $x = -7\frac{1}{2}$
B $x = -3\frac{1}{3}$
C $x = 2$
D $x = 4\frac{1}{2}$

Ⓐ Ⓑ Ⓒ Ⓓ

4. What is the solution of the following equation?

$$0.6x + 1.2 = x - 2$$

A $x = -2.8$
B $x = -1.6$
C $x = 6.4$
D $x = 8$

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5. What is the solution of the following equation?

$$\frac{1}{2}x + \frac{2}{3} = \frac{3}{4}$$

A $x = -\frac{2}{3}$
B $x = -\frac{1}{12}$
C $x = \frac{1}{6}$
D $x = 6$

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6. What is the solution of the following equation?

$$3(a - 10) = 2(6 - 2a)$$

A $a = 4$
B $a = 6$
C $a = 18$
D $a = 42$

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7. Sheryl solved the equation 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

Ⓐ Ⓑ Ⓒ Ⓓ

8. Michael solved the equation below by using the steps shown.

Given: $4x - (2 + x) = 8$
Step 1: $4x - 2 + x = 8$
Step 2: $5x - 2 = 8$
Step 3: $5x = 10$
Step 4: $x = 2$

Which step contains Michael's first mistake?

A Step 1
B Step 2
C Step 3
D Step 4

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9. Stuart spent all the money he had to purchase 20 cupcakes for a birthday party. If the cupcakes had been $0.10 less, he could have purchased 4 more cupcakes. How much did each cupcake cost?

A $0.10
B $0.20
C $0.40
D $0.60

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10. Ernie opens a bagel shop and makes bagels to sell to the public. Ingredients to make the bagels cost $15 per batch of 100 bagels. He sells each bagel for $0.45. Rent for the bagel shop is $400 per month, and the utility cost is $80 per month. How many bagels must Ernie sell each month to pay just the rent and utilities?

A 160
B 1,067
C 1,600
D 3,200

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11. **Howard spends $15 on playing video games in an arcade. Some games are $1 each and other games are $0.75 each. If he played a total of 18 games, how many $1 games did he play?**

A 2

B 3

C 6

D 12

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12. **Joanne earns $150 per week plus a 5% commission on her sales. If she made $355 last week, what were her sales for the week?**

A $10.25

B $167.75

C $4,100

D $7,250

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13. **An amusement park charges $2.50 for some rides and $1.75 for other rides. Todd pays $30.75 for a total of 15 rides. How many rides did he purchase for $2.50?**

A 3

B 6

C 8

D 9

Ⓐ Ⓑ Ⓒ Ⓓ

14. **Jeff is four years less than twice his nephew's age. If Jeff is 18 years old, how old is his nephew?**

A 5

B 6

C 7

D 11

Ⓐ Ⓑ Ⓒ Ⓓ

15. **Nate wants to save $8,000 to buy a used car. He puts $175 per week into savings. How many weeks will it take for him to save enough for the car?**

A 40 weeks

B 46 weeks

C 50 weeks

D 140 weeks

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16. **At the high school football game, the Jackson family purchased 5 hotdogs. If each hotdog had cost $0.20 less, they could have purchased 6 hotdogs for the same amount. How much did each hotdog cost?**

A $1.00

B $1.20

C $1.25

D $2.50

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