MAT 070-Algebra I-Word Problems

Averages
Percents: sales, commissions, investments
Distance/rate/time

Objectives

- ***a*** *Solve problems involving averages.*
- ***b*** *Solve percentage problems, including sales, commissions and investments.*
- ***c*** *Solve distance/rate/time problems.*

---

a Averages

When presented with a set of numbers, it is often necessary to find a single number that can serve as a representative for the entire set. For example, Ramon received test grades of 84, 71, 88, 90 and 93 in his Algebra I class. What is his average test grade?

The **average** (also called the **arithmetic mean**) is determined by adding together all of the data elements in a data set and dividing by the total number of elements in the data set.

Example 1: Determine Ramon's average test grade in Algebra I.

Solution:

Step 1: As with the other word problems, the first step is to identify what you are looking for (the *unknown(s)*). Since the question asked, "what is his average test grade", let x = the average test grade.

Step 2: Write an equation that describes the information given in the question. Since we determine the average of a data set by adding up all of the data values and dividing by the total number of data elements, this gives us:

$$\text{words: average test grade} = \frac{\text{sum of the test grades}}{\text{number of tests}}$$

$$\text{algebra: } x = \frac{84 + 71 + 88 + 90 + 93}{5}$$

Step 3: Solve the equation

$$x = \frac{84 + 71 + 88 + 90 + 93}{5} = \frac{426}{5} = 85.2$$

Step 4: Answer the question given in the problem: "What is his average test grade?"

From Step 1: x = average test grade

85.2 = average test grade

Ramon's average test grade is 85.2%.

Practice Problem 1: As part of a debt consolidation plan, Rachel wanted to determine the average amount of her National Grid electric bill per month. From January through December, the family's electric bills were:

$135.27, $144.19, $129.75, $99.81, $75.21, $79.14,
$101.14, $138.71, $100.43, $71.45, $95.98, $121.40.

What is the average amount of money Rachel spends on her National Grid electric bill each month?

The solution to this Practice Problem may be found starting on page 25.

Not all examples involving averages expect you to find the average. There are times when you will know all but one score, and you'll know the average. You will want to find the score necessary to achieve the average. For example, have you ever asked yourself (or your instructor) what grade you will need on the final exam to get a particular grade in a class? Consider the next example.

Example 2: Rachel's Chemistry class has 4 unit exams and a final. She needs *at least* an average of 85 (a letter grade of B) in order to keep her scholarship. If her unit exam scores are 75, 89, 79 and 92, what is the grade Rachel needs on her final exam in order to keep her scholarship?

Solution: This problem is different than the previous examples in that the average is given and an exam score is missing. However, the problem is solved in a similar manner.

Step 1: Identify the unknown.

Let x = the grade needed on the final exam.

Step 2: Write an equation.

The formula for determining an average doesn't change: add up all of the scores and divide by the total number of scores. This yields

$$\text{words: } \frac{\text{sum of the test scores}}{\text{number of tests}} = 85$$

$$\text{algebra: } \frac{75+89+79+92+x}{5} = 85$$

Step 3: Solve the equation found in Step 2.

$$\frac{75+89+79+92+x}{5} = 85$$ • Original problem

$$\frac{335+x}{5} = 85$$ • Simplify

$$\frac{\cancel{5}}{1}\left(\frac{335+x}{\cancel{5}}\right) = 85 \cdot 5$$ • Multiply both sides by 5 to clear the fraction. Cancel and simplify.

$$335+x = 425$$

$$335-335+x = 425-335$$ • Subtract 335 from both sides to isolate x

$$x = 90$$

Step 4: Answer the question given in the problem: "What is the grade Rachel needs on her final exam in order to keep her scholarship?"

Rachel needs a 90 on the final exam to maintain an 85 average and keep her scholarship.

Practice Problem 2A: Fill in the steps necessary to solve the problem below.

Damien has budgeted $50 a week for groceries. So far this month, he has spent $35.12, $71.41 and $42.19. What is the amount of money Damien can spend during the fourth week and still stay within budget?

Step 1: Identify the unknown.

Let $x =$ _____ .

Step 2: Write an equation.

words: $\dfrac{\text{sum of the weekly grocery bills}}{\text{4 weeks}} = \text{average weekly grocery bill}$

algebra: $\dfrac{35.12 + 71.41 + 42.19 + x}{4} = 50$

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "What is the amount of money Damien can spend and still stay within budget?"

The solution to this Practice Problem may be found starting on page 26.

Practice Problem 2B: Dori needs to have her weekly sales average $2000 in order to get a $200 bonus at the end of the month. If her sales for the first 3 weeks of the month were $1950, $2175 and $1745, what must her sales be during the 4th week to have an average weekly sales of $2,000?

The solution to this Practice Problem may be found starting on page 26.

When looking at a set of data, not every data element has the same value. For example, consider a Statistics class where the first 3 exams count as 1 test each, but the final exam counts as 2 tests. Such problems are common when determining the final average in a college course. These types of problems are called **weighted means** because one grade "weighs" more than the others.

Example 3: Brendan's Statistics class has 3 exams, 1 project and a final exam. The project grade counts as 1 exam grade. The final exam counts as 2 exam grades. If Brendan's exam grades are 91, 87, and 75, and his project grade is a 95, what is the grade Brendan needs to have a course average of 90?

(Solution begins on next page)

Solution to Example 3:

Step 1: Identify the unknown.

Let x = the score needed on the final exam.

Step 2: Write the equation. Since the final exam counts as 2 exam grades, we place $2x$ in for the final. Notice this leaves us with 6 scores (3 test, 1 project and 2 for the final exam).

$$\text{words:} \quad \frac{\text{sum of the scores}}{\text{number of scores}} = \text{average score}$$

$$\text{algebra:} \quad \frac{91+87+75+95+2x}{6} = 90$$

Step 3: Solve the equation found in Step 2.

$$\frac{91+87+75+95+2x}{6} = 90 \qquad \bullet \text{ Original problem}$$

$$\frac{348+2x}{6} = 90 \qquad \bullet \text{ Simplify}$$

$$\frac{\cancel{6}}{1}\left(\frac{348+2x}{\cancel{6}}\right) = 90 \cdot 6 \qquad \bullet \text{ Multiply both sides by 6 to clear the fraction. Cancel and simplify.}$$

$$348+2x = 540$$

$$348-348+2x = 540-348 \qquad \bullet \text{ Subtract 348 from both sides}$$

$$\frac{2x}{2} = \frac{192}{2} \qquad \bullet \text{ Divide both sides by 2}$$

$$x = 96$$

Step 4: Answer the question given in the problem: "What is the grade Brendan needs to have a course average of 90?"

Brendan must get a 96 on the final to have a course average of 90.

Practice Problem 3A: Fill in the steps necessary to solve the problem below.

Marina's Business Management class has 3 exams, 1 term paper and a Final Exam, which counts as 3 exams. Marina hasn't been going to class every day and as a result her test grades are 71, 63 and 59. The grade on her term paper was a 79.

Since it is the 10th week of the semester, she needs to make a decision about withdrawing from the class. What is the Final Exam score Marina needs to get a transferable grade in Business Management? Should she withdraw from the class? Assume that Marina needs a 75% average to transfer.

Step 1: Identify the unknown.

Let $x =$ _____.

Step 2: Write an equation.

$$\text{words:} \quad \frac{\text{sum of the scores}}{\text{number of scores}} = \text{average score}$$

$$\text{algebra:} \quad \frac{71 + 63 + 59 + 79 + 3x}{7} = 75$$

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "What is the Final Exam score Marina needs to achieve a course average of 75%?"

The solution to this Practice Problem may be found starting on page 27.

Practice Problem 3B: Julio is a high school senior who wants to qualify for an athletic scholarship. The school requires him to have four courses in Physical Education and pass an endurance test. The endurance test counts as 2 test grades. The average of all scores must be 95. If Julio's Physical Education scores are 98, 99, 96 and 89, what grade must he achieve on the endurance test to qualify for the scholarship?

The solution to this Practice Problem may be found starting on page 29.

---

b Percent Problems

People encounter percent problems on a routine basis. Every Sunday paper has advertisements offering 20%, 40% or even higher percent off sales. In general, questions involving sales are of the form

Original price – Discount = Sale price

Consider the example below.

Example 4: In the June 11th Sunday supplement, Sears offered 40% off the original price of all FIELDMASTER sport shirts. If the original price of a sport shirt was $28.00, what was the sale price?

Solution:

Step 1: Identify the unknown. Since we want to know the sale price of a sport shirt

Let x = the sale price of a sport shirt.

Step 2: Write an equation relating the information from Step 1.

words:	original price	–	discount	=	sale price
algebra:	$28.00	–	$40\% \cdot \$28.00$	=	x

Step 3: Solve the equation found in Step 2.

$28 - 40\% \cdot 28 = x$ • Original problem

$28 - 0.40 \cdot 28 = x$ • Convert percent to decimal

$28 - 11.20 = x$ • Multiply

$\$16.80 = x$ • Subtract

Step 4: Answer the question given in the problem: "What is the sale price?"

The sale price of the sport shirt is $16.80.

Practice Problem 4A: Fill in the steps necessary to solve the problem below.

In the same ad, Sears offered 25% off all BARINGTON belts. If the original price of a selected belt was $15, what is the sales price?

Step 1: Identify the unknown. Since we want to know the sale price of a belt,

Let $x =$ _____ .

Step 2: Write an equation relating the information from Step 1.

words: original price – discount = sale price

algebra: $\$15.00 - 25\% \cdot \$15.00 = x$

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "What is the sale price?"

The solution to this Practice Problem may be found starting on page 30.

Practice Problem 4B: In the same ad, Sears offered 30% off EAGLE pique Polo shirts. If the original price of a selected Polo shirt was $24.00, what is the sale price?

The solution to this Practice Problem may be found starting on page 30.

Sometimes, you are given the sales price of an item and the percent off, but need to know the original price. These types of problems may sound different, but they are solved the same way. The only difference is in the unknown. As with all word problems, if you read them *carefully*, they won't be difficult.

Example 5: The sale price of a 1999 Saturn Wagon was $15,995. This was a 15% reduction off the original price. What was the original price?

Solution:

Step 1: Identify the unknown. Since we want to know the original price of the Saturn Wagon,

Let $x =$ the original price of the 1999 Saturn Wagon.

Step 2: Write an equation relating the information from Step 1.

$$\begin{array}{rccc} \text{words:} & \text{original price} & - \text{ discount} & = \text{ sale price} \\ \text{algebra:} & x & - \ 15\% \cdot x & = \ \$15,995 \end{array}$$

Step 3: Solve the equation found in Step 2.

$$\begin{aligned} x - 15\% \cdot x &= 15,995 && \bullet \text{ Original problem} \\ x - 0.15x &= 15,995 && \bullet \text{ Convert percent to decimal} \\ 1x - 0.15x &= 15,995 && \bullet \text{ Rewrite } x \text{ as } 1x \\ 0.85x &= 15,995 && \bullet \text{ Combine like terms on the left, using } 1x - 0.15x = 1.00x - 0.15x = (1.00 - 0.15)x = 0.85x \\ \frac{0.85x}{0.85} &= \frac{15,995}{0.85} && \bullet \text{ Divide both sides by } 0.85 \\ x &= 18,817.65 && \bullet \text{ Divide} \end{aligned}$$

Step 4: Answer the question given in the problem: "What was the original price?"

The original price of the 1999 Saturn wagon was $18,817.65.

Practice Problem 5A: Fill in the steps necessary to solve the problem below.

While preparing for a trip to England, Ken wanted to purchase new luggage. A SAMSONITE Excel 3 22" upright was on sale for $111.00. The sales price represented a 40% reduction off the original price. What was the original price?

Step 1: Identify the unknown. Since we want to know the original price of the luggage,

Let $x =$ _____ .

Step 2: Write an equation relating the information from Step 1.

$$\begin{array}{rccc} \text{words:} & \text{original price} & - \text{ discount} & = \text{ sale price} \\ \text{algebra:} & x & - \ 40\% \cdot x & = \ \$111.00 \end{array}$$

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "What was the original price?"

The solution to this Practice Problem may be found starting on page 31.

Practice Problem 5B: In the Sunday supplement, Bob's Stores offered men's shoes and work boots for 25% off. If a pair of Men's Timberland Boatshoes was on sale for $52.50, what was the original price?

The solution to this Practice Problem may be found starting on page 32.

Problems involving increases are similar to those involving decreases or discounts. For example,

Original salary + Increase = New salary

Example 6: Mac's salary next year will be $25,235. This represents a 3% cost of living adjustment over this year's salary. What is Mac's salary this year?

Solution:

Step 1: Identify the unknown.

Let x = Mac's salary this year.

Step 2: Write an equation relating the information from Step 1.

We know that Mac's salary this year plus an additional 3% of this year's salary is next year's salary. Algebraically, this gives us:

	original salary	+	increase	=	new salary
words:	this year's salary	+	3% of this year's salary	=	next year's salary
algebra:	x	+	$3\% \cdot x$	=	$\$25,235$

Step 3: Solve the equation found in Step 2.

$$x + 3\% \cdot x = 25{,}235 \quad \bullet \text{ Original problem}$$
$$x + 0.03x = 25{,}235 \quad \bullet \text{ Convert percent to decimal}$$
$$1x + 0.03x = 25{,}235 \quad \bullet \text{ Rewrite } x \text{ as } 1x$$
$$1.03x = 25{,}235 \quad \bullet \text{ Combine like terms on the left, using } 1x + 0.03x = 1.00x + 0.03x = (1.00 + 0.03)x = 1.03x$$
$$\frac{1.03x}{1.03} = \frac{25{,}235}{1.03} \quad \bullet \text{ Divide both sides by } 1.03$$
$$x = 24{,}500$$

Step 4: Answer the question given in the problem: "What is Mac's salary this year?" Mac's salary this year is $24,500.

Practice Problem 6A: Fill in the steps necessary to solve the problem below.

Andrew's salary this year is $30,975. This represents a 5% raise over last year's salary. What was his salary last year?

Step 1: Identify the unknown.

Let $x =$ _____ .

Step 2: Write an equation relating the information from Step 1.

We know that Andrew's salary last year plus an additional 5% of last year's salary accounts for his salary this year. Algebraically, this gives us:

	original salary	+	increase	=	new salary
words:	last year's salary	+	5% of last year's salary	=	this year's salary
algebra:	x	+	_____	=	_____

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "What was his salary last year?"

The solution to this Practice Problem may be found starting on page 33.

Practice Problem 6B: Bickert Enterprises is a high-tech company that manufactures Random Access Memory (RAM). Sales this month total $82,643. This represents a 10% increase over last month's sales. What was the total value of last month's sales?

The solution to this Practice Problem may be found starting on page 34.

Percent problems go beyond sales at the local mall and salary increases. Many sales people get a base salary plus a commission based on their sales. Consider the next example.

Example 7: Benjamin receives a base salary of $1800 a month plus a 7.5% commission based on his sales. If Benjamin wants his monthly income to be $2500, what must be the dollar value of his sales?

Solution:

Step 1: Identify the unknown. The question is asking for his total monthly sales.

Let x = the value of his monthly sales

Step 2: Write an equation relating the information from Step 1. From the Test 5 Supplement,

words:	base salary	+	commission	=	total salary
algebra:	$1800	+	$0.075x$	=	$2500

Step 3: Solve the equation found in Step 2.

$$1800 + 0.075x = 2500 \quad \bullet \text{ Original problem}$$

$$0.075x = 700 \quad \bullet \text{ Subtract 1800 from both sides}$$

$$\frac{0.075x}{0.075} = \frac{700}{0.075} \quad \bullet \text{ Divide both sides by 0.075}$$

$$x = 9333.33 \quad \bullet \text{ Divide. Round to the nearest hundredth because } x \text{ represents money.}$$

Step 4: Answer the question given in the problem: "For his monthly income to be $2,500, what must be the dollar value of his sales?"

Benjamin must make $9333.33 in sales each month in order for his monthly salary to be $2,500 a month.

Practice Problem 7A: Fill in the steps necessary to solve the problem below.

A realtor receives a 2% commission on all apartments he rents plus $500 a month for managing the office. If he wants to earn $1500 next month, what must the value of the rentals be?

Step 1: Identify the unknown. Since we want to know the minimum value of the rental sales,

Let $x =$ _____ .

Step 2: Write an equation relating the information from Step 1.

words:	base salary	+	commission	=	total salary
algebra:	$500	+	_____	=	_____

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "If he wants to earn $1,500 next month, what must be the value of his rentals?"

The solution to this Practice Problem may be found starting on page 35.

Practice Problem 7B: Sales associates at a local department store earn $275 a week plus a 2% commission based on their sales. Maria wants to purchase a car stereo that costs $350. How much merchandise must Maria sell in order for her to be able to buy the stereo with her next paycheck?

The solution to this Practice Problem may be found starting on page 36.

As a final example involving percents, consider investing money.

Example 8: Dominique received $10,000 as part of her grandfather's inheritance. She decided to invest the money for 1 year. Dominique invested part of her inheritance in an account that earned 9% interest and the rest in a second account that earned 12% interest. If the total interest earned from these two investments was $1080, how much money did Dominique invest in each account?

Solution:

Step 1: Identify the unknowns. Since the question is asking for the amount of money invested in both accounts, we have two related unknowns, similar to the comparison questions Objective 2 of the Test 5 Supplement.

Let x = the amount of money invested in the account that earned 9%

We still need to determine how much money Dominique invested in the account that earned 12% interest. In order to determine this, consider the following chart:

If Dominique invested this amount in the 9% account	Then she must have invested this amount in the 12% account
	$10,000 – amount in 9% account = amount in the 12% acct.
$1000	$10,000 – $1000 = $9000
$3000	$10,000 – $3000 = $7000
$6000	$10,000 – $6000 = $4000
$7500	$10,000 – $7500 = $2500
$x	**$10,000 – $x**

Therefore, let **10,000 – *x*** = the amount of money invested in the 12% account

Step 2: Write an equation relating the information from Step 1.

The interest earned from the 9% account equals the *amount invested* times the *percentage* rate of the return. Mathematically, this is

$$\text{amount invested} \cdot \text{percentage rate of return}$$
$$x \cdot 9\%$$
$$x \cdot 0.09,$$
or
$$0.09x$$

Similarly, the interest earned from the 12% account equals the *amount invested* times the *percentage* rate of the return. Mathematically, this is

$$\text{amount invested} \cdot \text{percentage rate of return}$$
$$(10,000 - x) \cdot 12\%$$
$$(10,000 - x) \cdot 0.12,$$
or
$$0.12(10,000 - x)$$

Putting this together gives:

words:	Interest from 9% account	+	Interest from 12% account	=	Total Interest Earned
algebra:	$0.09 \cdot x$	+	$0.12(10,000 - x)$	=	\$1,080

Step 3: Solve the equation found in Step 2.

$$0.09x + 0.12(10,000 - x) = 1080$$ • Original equation

$$0.09x + 1200 - 0.12x = 1080$$ • Distribute 0.12 to remove parentheses

$$-0.03x + 1200 = 1080$$ • Combine like terms on the left side

$$-0.03x + 1200 - 1200 = 1080 - 1200$$ • Subtract 1200 from both sides

$$-0.03x = -120$$

$$\frac{-0.03x}{-0.03} = \frac{-120}{-0.03}$$ • Divide both sides by –0.03

$$x = \$4,000$$ • Solution

Step 4: Answer the question given in the problem: "How much money did she invest in each account?"

From Step 1: x = the amount invested in the 9% account.

So, \$4,000 = the amount invested in the 9% account.

$10{,}000 - x$ = the amount invested in the 12% account.

$10{,}000 - x = 10{,}000 - 4{,}000 = 6{,}000$

So \$6,000 = the amount invested in the 12% account.

Practice Problem 8A: Fill in the steps necessary to solve the problem below.

Ana received a \$1500 holiday bonus. She decided to invest part of the money in a Mutual Fund that pays 8% and the rest of the money in a Money Market account that pays 5%. After 1 year, she earned \$102 in dividends. (NOTE: dividends are similar to interest). How much money was invested in each account?

Step 1: Identify the unknowns.

Let x = the amount invested in the 8% Mutual Fund.

Let $1500 - x =$ _____ .

Step 2: Write an equation relating the information from Step 1.

words:	Dividend from 8% Mutual Fund	+	Dividend from 5% Money Market	=	Total Dividends Earned
algebra:	$x \cdot 0.08$	+	$(1500 - x) \cdot 0.05$	=	\$102
	$0.08x$	+	$0.05 \cdot (1500 - x)$	=	\$102

Step 3: Solve the equation found in Step 2.

$x =$ _____ .

Step 4: Answer the question given in the problem: "How much money was invested in each account?"

amount invested in 8% Mutual Fund = $ _____ .

amount invested in 5% Money Market Account = $ _____ .

The solution to this Practice Problem may be found starting on page 37.

Practice Problem 8B: Jeremy decided to invest $1000 of the money he earned over the summer to help defray the cost of graduate school. He went to the Bank of New Hampshire and invested part of the money in a savings account that paid 2% and the rest in a Certificate of Deposit that paid 5%. After one year, he earned $40.25 in interest. How much was invested in each account?

The solution to this Practice Problem may be found starting on page 38.

---

c Solve distance/rate/time problems

Many algebraic problems involve using a formula to determine a solution. One formula you may be familiar with involves the relationship between distance, rate (or speed) and time:

$$\text{distance} = \text{rate} \cdot \text{time}$$
$$\text{or: } d = rt$$

Consider the example below.

Example 9A: Larry drove 180 miles down the Garden State Parkway in order to visit Cape May, NJ. The trip took 3 hours. What was Larry's average speed to Cape May?

Solution:

Step 1: Identify the unknown. We know there is a formula that relates distance, rate and time. The distance is 180 miles and the time is 3 hours. Let r = the rate since that is the unknown.

Step 2: Write an equation relating the information from Step 1.

$$\begin{aligned} \text{words:} \quad & \text{distance} = \text{rate} \cdot \text{time} \\ \text{algebra:} \quad & 180 = r \cdot 3 \end{aligned}$$

The equation is $180 = 3r$

Step 3: Solve the equation found in Step 2.

$$\begin{aligned} 180 &= 3r && \bullet \text{ Original equation} \\ \frac{180}{3} &= \frac{3r}{3} && \bullet \text{ Divide both sides by 3} \\ 60 &= r && \bullet \text{ Divide} \end{aligned}$$

Step 4: Answer the question given in the problem: "what was Larry's average speed to Cape May?"

Larry was traveling 60 miles per hour.

Example 9B: On the way back home from Cape May, Larry took the scenic route. The trip was 225 miles and took 5 hours to complete. What was Larry's average speed on the trip back home?

Solution:

Step 1: Identify the unknown. We know there is a formula that relates distance, rate and time. The distance is 225 miles and the time is 5 hours. Let r = the rate since that is the unknown.

Step 2: Write an equation relating the information from Step 1.

$$\begin{aligned} \text{words:} \quad & \text{distance} = \text{rate} \cdot \text{time} \\ \text{algebra:} \quad & 225 = r \cdot 5 \end{aligned}$$

The equation is $225 = 5r$

Step 3: Solve the equation found in Step 2.

$$\begin{aligned} 225 &= 5r && \bullet \text{ Original equation} \\ \frac{225}{5} &= \frac{5r}{5} && \bullet \text{ Divide both sides by 5} \\ 45 &= r && \bullet \text{ Divide} \end{aligned}$$

Step 4: Answer the question given in the problem: "What was Larry's average speed on the trip back home?

Larry was traveling at 45 miles per hour.

Example 9C: Looking at Examples 9A and 9B, on which trip did Larry travel at the faster speed and by how much?

Solution: Larry was traveling at 60 mph going to Cape May and 45 mph coming home. Obviously he traveled at a faster average speed going to Cape May than he did coming home. The difference was 60 mph − 45 mph = 15 mph.

Practice Problem 9A: Fill in the steps necessary to solve the problem below.

Nina took Interstates 91 and 95 to get from Brattleboro, VT to New York, NY, a distance of 208 miles. The trip took her 4 hours. In order to go shopping at some antique stores, she decided to take the trip home on Route 1 and Route 5. The distance home was 240.5 miles. Not including the shopping, the total travel time back home was 6.5 hours.

A) What was her average rate of speed going to New York?

B) What was her average rate of speed coming back to Brattleboro?

C) On which trip did she travel at a faster rate? How much faster?

***Part A* (the trip from Brattleboro to New York)**

Step 1: Identify the unknown. Use the formula $d = rt$.

distance: $d = 208$ miles

time: $t = 4$ hours

So let $r =$ _____ .

Step 2: Write an equation relating the information from Step 1.

words: distance = rate · time

algebra: $208 = r \cdot 4$

Step 3: Solve the equation found in Step 2.

$r =$ _____ .

Step 4: Answer the question given in Part A: "What was her average rate of speed going to New York?"

***Part B* (the trip from New York back to Brattleboro)**

Step 1: Identify the unknown. Use the formula $d = rt$.

distance: $d = 240.5$ miles

time: $t = 6.5$ hours

So let $r =$ _____ .

Step 2: Write an equation relating the information from Step 1.

$$\begin{aligned} \text{words:} \quad & \text{distance} = \text{rate} \cdot \text{time} \\ \text{algebra:} \quad & 240.5 = r \cdot 6.5 \end{aligned}$$

Step 3: Solve the equation found in Step 2.

$r =$ _____ .

Step 4: Answer the question given in Part B: "What was her average rate of speed coming back to Brattleboro?"

Part C: "On which trip did she travel at a faster rate? How much faster?"

The solution to this Practice Problem may be found starting on page 39.

Practice Problem 9B: Elvis drove from Nashville, TN to Knoxville, TN, a distance of approximately 159 miles, in 3 hours. On the trip home, he took a different route. The return trip took 3.5 hours and was a distance of 143.5 miles?

A) What was his average speed going from Nashville to Knoxville?

B) What was his average speed coming back to Nashville ?

C) On which trip did Elvis travel at a faster rate? How much faster?

The solution to this Practice Problem may be found starting on page 41.

Homework Problems

Answers to Homework Problems begin on page 44

a Averages

1. Diana flew on trips of 438, 1,442, 785, 819 and 3018 miles. What was the average number of miles per trip?

2. Don bowled three games with scores of 210, 185 and 172. What was his average bowling score?

3. Ted has budgeted $50 a week for entertainment. If during the first 3 weeks of the month he spent $75.13, $43.95 and $51.03, how much can he spend during the fourth week and still stay within budget?

4. During a week in July, the temperature in Boston on Monday through Thursday was 92°, 88°, 81°, and 80°, respectively. What temperature on Friday will produce an average of 85° for the 5-day period?

5. Micki's scores on her Psychology exams were 79, 80 and an 83. Her final exam counts as two exam scores. What is the grade Micki needs on her final exam to average an 80 for the course?

6. Joshua's scores in his English Literature class were 98, 94, 89 and an 88. His final exam counts as three exam scores. What is the grade Joshua needs in order to average a 90 for the course?

b Percent Problems

7. Penny's had dress shirts on sale for 25% off. If a dress shirt originally sold for $50,

a) What is the value of the discount?

b) What was the sale price of the item?

8. Lord & Bloomie's has evening dresses on sale for 30% off. If a gown originally sold for $250,

a) What is the value of the discount?

b) What was the sale price of the item?

9. The sale price of a new Cadillac is $35,991. This was a 10% reduction off the original price. What was the original price?

10. The sale price of a diamond necklace is $640. If the sale price was 20% off, what was the original price of the diamond necklace?

11. Eddie's salary this year is $51,627.50. This year's salary represents a 7% increase over last year's salary. What was Eddie's salary last year?

12. The cost of a haircut at Talia's Salon cost $50.40. This represents a 5% increase over the cost of a haircut last month. What was the price of a haircut last month?

13. Jerome is selling supplies for Commercial Photography Centers. He gets paid $600 per month plus 4% of the sales price of all the supplies he sells. If he wants to earn $2,500 this month, what value of products will he need to sell?

14. Melissa is selling supplies for MidCentral Medical Services. She gets paid $900 per month plus 3% of the sales price of all the medical supplies she sells. If she wants to earn $2,700 this month, what value of products will she need to sell?

15. Juan is selling supplies for restaurants. He gets paid $700 per month plus 8% of all the supplies he sells to restaurants. If he wants to earn $3,100 this month, what value of products will he need to sell?

16. Tom receives a fixed salary of $30,000 a year and a commission of 15% of the value of his sales. How much merchandise must Tom sell in order to make at least $45,000 this year?

17. The president of Drake Enterprises received a $20,000 bonus for reaching quota. She invested part of the money in an IRA that pays 8.25% interest and the rest in a mutual fund that pays 16%. At the end of one year, she received $3,045 in interest and dividends. How much money was invested in each account?

18. Steve invested $1,800 in two bond funds. The first fund paid 6% on his investment and the second fund paid 15%. If the total amount of money earned from these investments was $220.50, how much money was invested in each bond fund?

19. Ted and Linda invested $9,000 for one year. They invested part of it at 14% and the remainder at 9%, At the end of the year they had earned $1,135 in interest. How much did they invest at each rate?

20. Prior to going to college Carlos had saved $3,000. He invested it for one year. Part of it was invested at 7% and the remainder at 9%. At the end of one year he had earned $242 in interest. How much did he invest at each rate?

21. Eva invested $5,000 for one year. She invested part of it at 10% and part of it at 12%. At the end of the year she earned $566 in interest. How much did she invest at each rate?

C Solve distance/rate/time problems

22. Jackie drove 27 miles to her grandparent's house. The trip took 45 minutes (or $\frac{3}{4}$ of an hour). On her way home, she took the highway. The ride home was only 25 miles and took 30 minutes (or $\frac{1}{2}$ of an hour)

a) What was her average speed going to her grandparents' house?

b) What was her average speed returning home?

c) On which trip was her average speed faster, and by how much?

23. Wayne's trip to work took him 2 hours. He traveled 50 miles. His trip back home took him 1.5 hours, and he traveled 60 miles. In which direction did he travel faster and by how much?

a) What was his average speed going to work?

b) What was his average speed returning home?

c) On which trip was his average speed faster, and by how much?

24. Sammy took 6 hours to travel the 312 miles from Albuquerque, New Mexico to Colorado Springs, Colorado because he took the road through the mountains. The 320-mile return trip to Albuquerque on the highway took him 5 hours.

a) What was his average speed going to Colorado Springs?

b) What was his average speed returning to Albuquerque?

c) On which trip was his average speed faster, and by how much?

Solutions to Practice Problems

Practice Problem 1: As part of a debt consolidation plan, Rachel wanted to determine the average amount of her National Grid bill per year. From January through December, the family's electric bills were:

$135.27, $144.19, $129.75, $99.81, $75.21, $79.14,
$101.14, $138.71, $100.43, $71.45, $95.98, $121.40.

What is the average amount of money Rachel spends on her National Grid bill each month?

Step 1: Identify the unknown.

let x = the average monthly bill

Step 2: Write the equation

words: average monthly bill $=$ $\dfrac{\text{sum of the monthly bills}}{\text{number of bills}}$

algebra: $x = \dfrac{135.27+144.19+129.75+99.81+75.21+79.14+101.14+138.71+100.43+71.45+95.98+121.40}{12}$

Step 3: Solve the equation found in Step 2.

$$x = \frac{135.27 + 144.19 + 129.75 + 99.81 + 75.21 + 79.14 + 101.14 + 138.71 + 100.43 + 71.45 + 95.98 + 121.40}{12}$$

$$x = \frac{1292.48}{12}$$

$x = 107.71$ (rounded to the nearest cent)

Step 4: Answer the question given in the problem: "What is the average amount of money Rachel spends on her National Grid bill each month?"

Her average monthly electric bill is $ 107.71.

Practice Problem 2A: Damien has budgeted $50 a week for groceries. So far this month, he has spent $35.12, $71.41 and $42.19. What is the amount of money Damien can spend during the fourth week and still stay within budget?

Step 1: Identify the unknown.

Let x = the money spent during the fourth week.

Step 2: Write the equation.

words: $\dfrac{\text{sum of the weekly grocery bills}}{\text{4 weeks}} = \text{average weekly grocery bill}$

algebra: $\dfrac{35.12+71.41+42.19+x}{4} = 50$

Step 3: Solve the equation found in Step 2.

$$\frac{35.12+71.41+42.19+x}{4}=50$$ • Original problem

$$\frac{148.72+x}{4}=50$$ • Simplify

$$\frac{\cancel{4}}{1}\left(\frac{148.72+x}{\cancel{4}}\right)=50\cdot 4$$ • Multiply both sides by 4 to clear the fraction. Cancel and simplify.

$$148.72-148.72+x=200-148.72$$ • Subtract 148.72 from both sides to isolate x

$$x=51.28$$

Step 4: Answer the question given in the problem: "What is the amount of money Damien can spend during the fourth week and still stay within budget?"

Damien can spend $51.28 during the 4th week and still stay within budget.

Practice Problem 2B: Dori needs to have her weekly sales average $2000 in order to get a $200 bonus at the end of the month. If her sales for the first 3 weeks of the month were $1950, $2175 and $1745, what must her sales be during the 4th week to have an average weekly sales of $2,000?

Step 1: Identify the unknown.

Let x = sales during the 4th week.

Step 2: Write the equation.

$$\text{words: } \frac{\text{sum of the weekly sales}}{4 \text{ weeks}} = \text{average weekly sales}$$

$$\text{algebra: } \frac{1{,}950 + 2175 + 1745 + x}{4} = 2{,}000$$

Step 3: Solve the equation found in Step 2.

$$\frac{1{,}950 + 2{,}175 + 1{,}745 + x}{4} = 2{,}000$$ • Original problem

$$\frac{5{,}870 + x}{4} = 2{,}000$$ • Simplify

$$\frac{4}{1}\left(\frac{5{,}870 + x}{4}\right) = 2{,}000 \cdot 4$$ • Multiply both sides by 4 to clear the fraction. Cancel and simplify.

$$5{,}870 - 5{,}870 + x = 8{,}000 - 5{,}870$$ • Subtract 5,870 from both sides to isolate x

$$x = 2{,}130$$

Step 4: Answer the question given in the problem: "What must her sales be during the 4th week to have an average weekly sales of $2,000?"

Dori's fourth week sales must be $2,130.

Practice Problem 3A: Marina's Business Management class has 3 exams, 1 term paper and a Final Exam, which counts as 3 exams. Marina hasn't been going to class every day and as a result her test grades are 71, 63 and 59. The grade on her term paper was a 79. Since it is the 10th week of the semester, she needs to make a decision about withdrawing from the class. What is the Final Exam score Marina needs to get a transferable grade in Business Management? Should she withdraw from the class? Assume that Marina needs a 75% average to transfer.

Step 1: Identify the unknown.

Let x = score needed on the final exam.

Step 2: Write the equation. Since the Final Exam counts as 3 exam grades, we place $3x$ in for the Final. Notice this leaves us with 7 scores (3 exams, 1 term paper, and 3 for the Final Exam).

$$\text{words:} \quad \frac{\text{sum of the scores}}{\text{number of scores}} = \text{course average}$$

$$\text{algebra:} \quad \frac{71+63+59+79+\overbrace{3x}^{\text{final exam}}}{7} = 75$$

Step 3: Solve the equation found in Step 2.

$$\frac{71+63+59+79+3x}{7} = 75$$ • Original problem

$$\frac{272+3x}{7} = 75$$ • Simplify

$$\frac{\cancel{7}}{1}\left(\frac{272+3x}{\cancel{7}}\right) = 75 \cdot 7$$ • Multiply both sides by 7 to clear the fraction. Cancel and simplify.

$$272+3x = 525$$

$$272-272+3x = 525-272$$ • Subtract 272 from both sides

$$3x = 253$$

$$\frac{3x}{3} = \frac{253}{3}$$ • Divide both sides by 3

$$x = 84.3$$ • Divide. Answer is rounded to the nearest tenth.

Step 4: Answer the question given in the problem: "What score does Marina need on the Final Exam to achieve a course average of 75%?"

Marina needs to score 84.3 on the final exam to get a course average of 75% in Business Management. If she starts going to class, that grade may be attainable.

Practice Problem 3B: Julio is a high school senior who wants to qualify for an athletic scholarship. The school requires him to have four courses in Physical Education and pass an endurance test. The endurance test counts as 2 test grades. The average of all scores must be at least 95. If Julio's Physical Education scores are 98, 99, 96 and 89, what grade must he achieve on the endurance test to qualify for the scholarship?

Step 1: Identify the unknown.

Let x = score needed on the endurance test.

Step 2: Write the equation. Since the endurance test counts as counts as 2 test grades, we place $2x$ in for the endurance test. Notice this leaves us with 6 scores (4 physical education scores and 2 for the endurance test).

$$\text{words:} \quad \frac{\text{sum of the scores}}{\text{number of scores}} = \text{average score}$$

$$\text{algebra:} \quad \frac{98 + 99 + 96 + 89 + \overbrace{2x}^{\text{endurance test}}}{6} = 95$$

Step 3: Solve the equation found in Step 2.

$$\frac{98 + 99 + 96 + 89 + 2x}{6} = 95$$ • Original problem

$$\frac{382 + 2x}{6} = 95$$ • Simplify

$$\frac{\cancel{6}}{1}\left(\frac{382 + 2x}{\cancel{6}}\right) = 95 \cdot 6$$ • Multiply both sides by 6 to clear the fraction. Cancel and simplify.

$$382 + 2x = 570$$

$$382 - 382 + 2x = 570 - 382$$ • Subtract 382 from both sides

$$2x = 188$$

$$\frac{2x}{2} = \frac{188}{2}$$ • Divide both sides by 2

$$x = 94$$

Step 4: Answer the question given in the problem: "What score is needed on the endurance test to achieve an average score of 95?"

Julio must get a 94 on the endurance test achieve an average score of 95 and qualify for the scholarship.

Practice Problem 4A: In the June 11th Sunday supplement, Sears offered 25% off all BARINGTON belts. If the original price of a selected belt was \$15, what is the sales price?

Step 1: Identify the unknown.

Let x = the sales price of the belt

Step 2: Write the equation relating the information from Step 1.

$$\begin{array}{rrrrrr} \text{words:} & \text{original price} & - & \text{discount} & = & \text{sale price} \\ \text{algebra:} & \$15.00 & - & 25\% \cdot \$15.00 & = & x \end{array}$$

Step 3: Solve the equation found in Step 2.

$$\begin{aligned} 15.00 - 25\% \cdot 15.00 &= x && \bullet \text{ Original problem} \\ 15.00 - 0.25(15.00) &= x && \bullet \text{ Convert percent to decimal} \\ 15.00 - 3.75 &= x && \bullet \text{ Multiply} \\ 11.25 &= x && \bullet \text{ Subtract} \end{aligned}$$

Step 4: Answer the question given in the problem: "what is the sales price?"

From Step 1, x = the sale price.

So, \$11.25 = the sale price.

Practice Problem 4B: In the same ad, Sears offered 30% off EAGLE pique Polo shirts. If the original price of a selected Polo shirt was \$24.00, what is the sale price?

Step 1: Identify the unknown. Since we want to know the sale price of a polo shirt,

let x = the sale price

Step 2: Write an equation relating the information from Step 1.

words:	original price	–	discount	=	sale price	
algebra:	\$24.00	–	$30\% \cdot \$24.00$	=	x	

Step 3: Solve the equation found in Step 2.

$$24.00 - 30\% \cdot 24.00 = x \quad \bullet \text{ Original problem}$$
$$24.00 - 0.30 \cdot (24.00) = x \quad \bullet \text{ Convert percent to decimal}$$
$$24.00 - 7.20 = x \quad \bullet \text{ Multiply}$$
$$16.80 = x \quad \bullet \text{ Subtract}$$

Step 4: Answer the question given in the problem: "What is the sale price?"

From Step 1, x = the sale price.

So, \$16.80 = the sale price.

Practice Problem 5A: While preparing for a trip to England, Ken wanted to purchase new luggage. A SAMSONITE Excel 3 22" upright was on sale for \$111.00. The sales price represented a 40% reduction off the original price. What was the original price?

Step 1: Identify the unknown. Since we want to know the original price of the luggage,

Let x = the original price of the luggage.

Step 2: Write an equation relating the information from Step 1.

words:	original price	–	discount	=	sale price	
algebra:	x	–	$40\% \cdot x$	=	\$111.00	
	x	–	$0.40x$	=	\$111.00	

Step 3: Solve the equation found in Step 2.

$$x - 0.40x = 111.00 \quad \bullet \text{ Original problem}$$

$$1x - 0.40x = 111.00 \quad \bullet \text{ Rewrite } x \text{ as } 1x$$

$$0.60x = 111.00 \quad \bullet \text{ Combine like terms on the left, using } 1x - 0.40x = 1.00x - 0.40x = (1.00 - 0.40)x = 0.60x$$

$$\frac{0.60x}{0.60} = \frac{111.00}{0.60} \quad \bullet \text{ Divide both sides by } 0.60$$

$$x = 185 \quad \bullet \text{ Divide}$$

Step 4: Answer the question given in the problem: "What was the original price?"

From Step 1, x = the original price.

So, \$185 = the original price of the luggage.

Practice Problem 5B: In the Sunday supplement, Bob's Stores offered men's shoes and workboots for 25% off. If a pair of Men's Timberland Boatshoes was on sale for \$52.50, what was the original price?

Step 1: Identify the unknown.

Let x = the original price of the shoes.

Step 2: Write an equation relating the information from Step 1.

words:	original price	–	discount	=	sale price
algebra:	x	–	$25\% \cdot x$	=	\$52.50
	x	–	$0.25x$	=	\$52.50

Step 3: Solve the equation found in Step 2.

$$x - 0.25x = 52.50 \quad \bullet \text{ Original problem}$$

$$1x - 0.25x = 52.50 \quad \bullet \text{ Rewrite } x \text{ as } 1x$$

$$0.75x = 52.50 \quad \bullet \text{ Combine like terms on the left, using } 1x - 0.25x = 1.00x - 0.25x = (1.00 - 0.25)x = 0.75x$$

$$\frac{0.75x}{0.75} = \frac{52.50}{0.75} \quad \bullet \text{ Divide both sides by } 0.75$$

$$x = 70 \quad \bullet \text{ Divide}$$

Step 4: Answer the question given in the problem: "What was the original price?"

From Step 1, x = the original price of the shoes.

So, \$70 = the original price of the shoes.

Practice Problem 6A: Andrew's salary this year is \$30,975. This represents a 5% raise over last year's salary. What was his salary last year?

Step 1: Identify the unknowns.

Let x = last year's salary

Step 2: Write the equation .

			the increase		
words:	last year's salary	+	5% of last year's salary	=	this year's salary
algebra:	x	+	$5\% \cdot x$	=	\$30,975
	x	+	$0.05x$	=	\$30,975

Step 3: Solve the equation found in Step 2.

$$x + 0.05x = 30,975 \quad \bullet \text{ Original problem}$$

$$1x + 0.05x = 30,975 \quad \bullet \text{ Rewrite } x \text{ as } 1x$$

$$1.05x = 30,975 \quad \bullet \text{ Combine like terms on the left, using } 1x + 0.05x = 1.00x + 0.05x = (1.00 + 0.05)x = 1.05x$$

$$\frac{1.05x}{1.05} = \frac{30,975}{1.05} \quad \bullet \text{ Divide both sides by } 1.05$$

$$x = 29,500 \quad \bullet \text{ Divide}$$

Step 4: Answer the question given in the problem: "What was his salary last year?"

From Step 1: x = last year's salary

So, \$29,500 = last year's salary.

Practice Problem 6B: Bickert Enterprises is a high-tech company that manufactures Random Access Memory (RAM). Sales this month total \$82,643. This represents a 10% increase over last month's sales. What was the total value of last month's sales?

Step 1: Identify the unknown.

let x = last month's salary

Step 2: Write the equation.

$$\text{words: last month's sales} + \overbrace{\text{10\% of last month's sales}}^{\text{the increase}} = \text{this month's sales}$$

$$\text{algebra: } x + 10\% \cdot x = \$82,643$$

$$x + 0.10x = \$82,643$$

Step 3: Solve the equation from Step 2.

$$x + 0.10x = 82,643 \quad \bullet \text{ Original problem}$$
$$1x + 0.10x = 82,643 \quad \bullet \text{ Rewrite } x \text{ as } 1x$$
$$1.10x = 82,643 \quad \bullet \text{ Combine like terms on the left, using } 1x + 0.10x = 1.00x + 0.10x = (1.00 + 0.10)x = 1.10x$$
$$\frac{1.10x}{1.10} = \frac{82,643}{1.10} \quad \bullet \text{ Divide both sides by 1.10}$$
$$x = 75,130 \quad \bullet \text{ Divide}$$

Step 4: Answer the question given in the problem: "What were last month's sales?"

From Step 1: x = last month's sales

So, \$75,130 = last month's sales.

Practice Problem 7A: A realtor receives a 2% commission on all apartments he rents plus \$500 a month for managing the office. If he wants to earn \$1500 next month, what must the value of the rentals be?

Step 1: Identify the unknown.

Let x = the value of the rentals.

Step 2: Write the equation.

words:	base income	+	commission	=	total income
algebra:	\$500	+	$2\% \cdot x$	=	\$1,500
	\$500	+	$0.02x$	=	\$1,500

Step 3: Solve the equation found in Step 2.

$$500 + 0.02x = 1,500 \quad \bullet \text{ Original problem}$$
$$0.02x = 1,000 \quad \bullet \text{ Subtract 500 from both sides}$$
$$\frac{0.02x}{0.02} = \frac{1,000}{0.02} \quad \bullet \text{ Divide both sides by 0.02}$$
$$x = 50,000 \quad \bullet \text{ Divide}$$

Step 4: Answer the question given in the problem: "What must be the value of the rentals?"

From Step 1: x = the value of the rentals

So, \$50,000 = the value of the rentals.

Practice Problem 7B: Sales associates at a local department store earn \$275 a week plus a 2% commission based on their sales. Maria wants to purchase a car stereo that costs \$350. How much merchandise must Maria sell in order for her to be able to buy the stereo with her next paycheck?

Step 1: Identify the unknown.

Let x = the value of the merchandise sold.

Step 2: Write the equation.

words:	base income	+	commission	=	total income
algebra:	\$275	+	$2\% \cdot x$	=	\$350
	\$275	+	$0.02x$	=	\$350

Step 3: Solve the equation found in Step 2.

$$275 + 0.02x = 350 \quad \bullet \text{ Original problem}$$

$$0.02x = 75 \quad \bullet \text{ Subtract 275 from both sides}$$

$$\frac{0.02x}{0.02} = \frac{75}{0.02} \quad \bullet \text{ Divide both sides by 0.02}$$

$$x = 3,750 \quad \bullet \text{ Divide}$$

Step 4: Answer the question given in the problem: "How much merchandise must Maria sell?"

From Step 1: x = the value of the merchandise sold

So, \$3,750 = the value of the merchandise that Maria must sell.

Practice Problem 8A: Ana received a $1500 holiday bonus. She decided to invest part of the money in a Mutual Fund that pays 8% and the rest of the money in a Money Market account that pays 5%. After 1 year, she earned $102 in dividends. (NOTE: dividends are similar to interest). How much money was invested in each account?

Step 1: Identify the unknowns.

Let x = the amount invested in the 8% Mutual Fund.

Let $1500 - x$ = the amount invested in the 5% Money Market account.

Step 2: Write an equation relating the information from Step 1.

words:	Dividend from 8% Mutual Fund	+	Dividend from 5% Money Market Account	=	Total Dividends Earned
algebra:	$x \cdot 8\%$	+	$(1500 - x) \cdot 5\%$	=	102
	$x \cdot 0.08$	+	$(1500 - x) \cdot 0.05$	=	102
	$0.08x$	+	$0.05(1500 - x)$	=	102

Step 3: Solve the equation found in Step 2.

$0.08x + 0.05(1500 - x) = 102$ • Original equation

$0.08x + 75 - 0.05x = 102$ • Distribute 0.05 to remove parentheses

$0.03x + 75 = 102$ • Combine like terms on the left side

$0.03x = 27$ • Subtract 75 from both sides

$\frac{0.03x}{0.03} = \frac{27}{0.03}$ • Divide both sides by 0.03

$x = \$900$ • Solution.

Step 4: Answer the question given in the problem: "How much money was invested in each account?"

From Step 1: x = the amount invested in the 8% Mutual Fund

So, \$900 = the amount invested in the 8% Mutual Fund

$1500 - x$ = the amount invested in the 5% Money Market account

$1500 - x = 1,500 - 900 = 600$

So \$600 = the amount invested in the 5% Money Market account

Practice Problem 8B: Jeremy decided to invest \$1000 of the money he earned over the summer to help defray the cost of graduate school. He went to the Bank of New Hampshire and invested part of the money in a savings account that paid 2% and the rest in a Certificate of Deposit that paid 5%. After one year, he earned \$40.25 in interest. How much was invested in each account?

Step 1: Identify the unknowns.

Let x = the amount invested in the savings account (interest rate of 2%)

Let $1000 - x$ = the amount invested in the certificate of deposit (interest rate of 5%)

Step 2: Write an equation relating the information from Step 1.

words:	interest from savings account	+	interest from certificate of deposit	=	total interest
algebra:	$x \cdot 2\%$	+	$(1000 - x) \cdot 5\%$	=	40.25
	$x \cdot 0.02$	+	$(1000 - x) \cdot 0.05$	=	40.25
	$0.02x$	+	$0.05(1000 - x)$	=	40.25

Step 3: Solve the equation found in Step 2.

$$0.02x + 0.05(1000 - x) = 40.25 \quad \bullet \text{ Original equation}$$
$$0.02x + 50 - 0.05x = 40.25 \quad \bullet \text{ Remove parentheses}$$
$$-0.03x + 50 = 40.25 \quad \bullet \text{ Combine like terms on the left side}$$
$$-0.03x + 50 - 50 = 40.25 - 50 \quad \bullet \text{ Subtract 50 from both sides}$$
$$-0.03x = -9.75$$
$$\frac{-0.03x}{-0.03} = \frac{-9.75}{-0.03} \quad \bullet \text{ Divide both sides by } -0.03$$
$$x = \$325 \quad \bullet \text{ Divide. Mind the signs!}$$

Step 4: Answer the question given in the problem: "How much money was invested in each account?"

From Step 1: x = the amount invested in the savings account

So, \$325 = the amount invested in the savings account

$1000 - x$ = the amount invested in the certificate of deposit

$1000 - x = 1000 - 325 = 675$

So \$675 = the amount invested in the certificate of deposit

Jeremy invested \$325 in the savings account and \$675 in the CD.

Practice Problem 9A: Nina took Interstates 91 and 95 to get from Brattleboro, VT to New York, NY, a distance of 208 miles. The trip took her 4 hours. In order to go shopping at some antique stores, she decided to take the trip home on Route 1 and Route 5. The distance home was 240.5 miles. Not including the shopping, the total travel time back home was 6.5 hours.

A) What was her average rate of speed going to New York?

B) What was her average rate of speed coming back to Brattleboro?

C) On which trip did she travel at a faster rate? How much faster?

Part A What was her average rate of speed going to New York?

Step 1: Identify the unknown.

Let r = the average rate of speed.

Step 2: Write an equation relating the information from Step 1.

words: distance = rate · time

algebra: $208 = r \cdot 4$

$$208 = 4r$$

Step 3: Solve the equation found in Step 2.

$$208 = 4r \quad \bullet \text{ Original equation}$$
$$\frac{208}{4} = \frac{4r}{4} \quad \bullet \text{ Divide both sides by 4}$$
$$52 = r \quad \bullet \text{ Divide}$$

Step 4: Answer the question to Part A: "What was her average rate of speed going to New York?"

Her average speed going to New York was 52 mph.

Part B What was her average rate of speed coming back to Brattleboro?

Step 1: Identify the unknown.

Let r = the average rate of speed.

Step 2: Write an equation relating the information from Step 1.

words: distance = rate · time

algebra: $240.5 = r \cdot 6.5$

$$240.5 = 6.5r$$

Step 3: Solve the equation found in Step 2.

$$240.5 = 6.5r \quad \bullet \text{ Original equation}$$

$$\frac{240.5}{6.5} = \frac{6.5r}{6.5} \quad \bullet \text{ Divide both sides by 6.5}$$

$$37 = r \quad \bullet \text{ Divide}$$

Step 4: Answer the question to Part B: "What was her average rate of speed coming back to Brattleboro?"

Her average speed returning to Brattleboro was 37 mph.

Part C On which trip did she travel at a faster rate? How much faster?

Answer: Nina's average speed was faster going to New York than coming back home. The difference was $52 - 37 = 15$ mph.

Practice Problem 9B: Elvis drove from Nashville, TN to Knoxville, TN, a distance of approximately 159 miles, in 3 hours. On the trip home, he took a different route. The return trip took 3.5 hours and was a distance of 143.5 miles?

A) What was his average speed going from Nashville to Knoxville?

B) What was his average speed coming back to Nashville ?

C) On which trip did Elvis travel at a faster rate? How much faster?

Part A What was his average speed going from Nashville to Knoxville?

Step 1: Identify the unknown.

Let r = the average rate of speed.

Step 2: Write an equation relating the information from Step 1.

words: distance = rate · time

algebra: $159 = r \cdot 3$

$$159 = 3r$$

Step 3: Solve the equation found in Step 2.

$$\begin{aligned} 159 &= 3r && \bullet \text{ Original equation} \\ \frac{159}{3} &= \frac{3r}{3} && \bullet \text{ Divide both sides by 3} \\ 53 &= r && \bullet \text{ Divide} \end{aligned}$$

Step 4: Answer the question to Part A: "What was his average speed going from Nashville to Knoxville?"

His average speed going from Nashville to Knoxville was 53 mph.

Part B What was his average speed coming back to Nashville.

Step 1: Identify the unknown.

Let r = the average rate of speed.

Step 2: Write an equation relating the information from Step 1.

words: distance = rate · time

algebra: $143.5 = r \cdot 3.5$

$$143.5 = 3.5r$$

Step 3: Solve the equation found in Step 2.

$$\begin{aligned} 143.5 &= 3.5r && \bullet \text{ Original equation} \\ \frac{143.5}{3.5} &= \frac{3.5r}{3.5} && \bullet \text{ Divide both sides by 3.5} \\ 41 &= r && \bullet \text{ Divide} \end{aligned}$$

Step 4: Answer the question to Part B: "What was his average speed coming back to Nashville?"

His average speed coming back to Nashville was 41 mph.

Part C On which trip did Elvis travel at a faster rate? How much faster?

Answer: Elvis' average speed was faster going to Knoxville. The difference was $53 - 41 = 12$ mph.

Answers to Homework Problems

1. Diana averaged 1300.4 miles per trip.

2. Don averaged a 189.

3. Ted can spend $29.89 on entertainment during the last week of the month and stay within budget.

4. The temperature in Boston must be at least 84° to average 85° for the 5-day period.

5. Micki needs a grade of at least a 79 to average an 80 for the course.

6. Joshua needs a grade of at least an 87 to average a 90 for the course.

7. a) The amount of the discount is $12.50.

b) The sale price of the dress shirt is $37.50.

8. a) The value of the discount is $75.

b) The sale price of the gown is $175.

9. The original price of the Cadillac is $39,990.

10. The original price of the diamond necklace was $800.

11. Last year, Eddie earned $48,250.

12. Last year, a haircut cost $48.

13. Jerome must sell at least $47,500 worth of merchandise.

14. Melissa must sell at least $60,000 worth of merchandise.

15. Juan must sell at least $30,000 worth of merchandise.

16. Tom must sell at least $100,000 worth of merchandise.

17. $2,000 in the 8.25% IRA account
$18, 000 in the 16% mutual fund

18. $550 in the 6% fund.
$1,250 in the 15% fund

19. $6,500 at 14%
$2,500 at 9%

20. $1,400 at 7%
$1,600 at 9%

21. $3,300 at 12%
$1,700 at 10%

22. a) Jackie's trip to her grandparents was at an average rate of 36 mph.

b) Her trip back home was at an average rate of 50 mph.

c) Her average speed was faster on the way home by 14 mph.

23. a) Wayne's average speed traveling to work was 25 mph.

b) His average rate back home was 40 mph.

c) He averaged 15 mph faster on the way home.

24. a) His average speed going to Colorado Springs was 52 mph.

b) His average speed returning to Albuquerque was 64 mph.

c) He averaged 12 mph faster on the return (or highway) trip.