CHAPTER 5
Word Problems in Real-Life Situation

5-1. Solving Word Problems Using Linear Models

In SAT verbal problems, the construction of mathematical models that represent real-world scenarios is a critical skill. Linear equations can be used to model many types of real life situation word problems, such as cost, profit, speed, distance and time problems. To solve the verbal problems, you need to interpret the situation described in the problem into an equation, then solve the problem by solving the equation.

Plan for Solving a Word Problem

1. **Find out what numbers are asked** for from the given information.
2. **Choose a variable** to represent the number(s) described in the problem. Sketch or a chart may be helpful.
3. **Write an equation** that represents relationships among the numbers in the problem.
4. **Solve the equation** and find the required numbers.
5. **Answer** the original question. **Check** that your answer is reasonable.

A **linear function** $\boldsymbol{y = mx + b}$ can be used as a model for many types of real life word problems which involve a constant rate of change.

Example 1 □ A person travels home from work at a constant speed. Ten minutes after leaving work he is 20 miles from home, and 20 minutes after leaving work he is 12 miles from home. If he continues to travel at the same speed, how long will it take him to arrive home from work?

Solution □ 1. The problem asks for the number of minutes it takes to travel from work to home.

2. Start with the linear equation $y = mx + b$, in which y is the distance in miles from home, and x is the time in minutes.

3. When $x = 10$, $y = 20$.
   When $x = 20$, $y = 12$.

4. $20 = 10m + b$ — First equation
   $12 = 20m + b$ — Second equation
   By subtracting the second equation from the first equation we get $8 = -10m$.
   $\frac{8}{-10} = \frac{-10m}{-10}$ — Divide each side by -10.
   $m = -\frac{4}{5}$ — Simplify.
   $20 = 10(-\frac{4}{5}) + b$ — Substitute $m = -\frac{4}{5}$ into the first equation.
   $20 = -8 + b$ — Simplify.
   $b = 28$ — Simplify.
   $y = -\frac{4}{5}x + 28$ — Replace m with $-\frac{4}{5}$ and b with 48.
   $0 = -\frac{4}{5}x + 28$ — When he arrives home, $y = 0$.
   $x = 35$ — Solve for x.

5. It takes 35 minutes from work to home.

Exercises - Problem Solving Using Linear Models

1

At the beginning of a trip, the tank of Chloe's car was filled with 12 gallons of gas. When she travels constantly on the highway 60 miles per hour, the car consumes 1 gallon of gas per 35 miles. If she traveled 5 hours and 15 minutes on the highway with a constant speed of 60 miles per hour, how many gallons of gas are left in the tank?

A) 3

B) 4

C) 5

D) 6

2

A rock climber is climbing up a 450 feet high cliff. By 9:30 AM. the climber reached 90 feet up the cliff and by 11:00 AM he has reached 210 feet up the cliff. If he climbs with a constant speed, by what time will he reach the top of the cliff?

A) 1:45 PM

B) 2:00 PM

C) 2:15 PM

D) 2:30 PM

3

In 2005 a house was purchased for $280,000 and in 2013 it was sold at $334,000. Assuming that the value of the house increased at a constant annual rate what will be the price of the house in the year 2018?

A) $354,250

B) $361,000

C) $367,750

D) $374,500

4

To join Eastlake Country Club one must pay d dollars for a one time membership fee and pay w dollars for a monthly fee. If the first month is free for the club, what is the total amount, y, x months after a person joined the club, in terms of d, w, and x?

A) $y = wx - 1 + d$

B) $y = w(x-1) + d$

C) $y = d(x-1) + w$

D) $y = dx - 1 + w$

5

From 1990 to 2000 The population of city A rose from 12,000 to 28,000 and the population of city B rose from 18,000 to 24,000. If the population of the two cities increased at a constant rate, in what year was the population of both cities the same?

6

An empty 1,200 gallon tank is filled with water at a rate of 6 gallons of water per minute. At the same time, another 1,200 gallon tank full of water is being drained at a rate of 9 gallons per minute. How many minutes will it take for the amount of water in both tanks to become the same?

5-2. Solving Word Problems Using Equations

Cost, Profit, and Value Problems

Total value = number of items × value per item

Profit = selling cost − buying cost

Example 1 □ A music store owner purchased x compact discs for \$6.50 each. He sold all but 19 of them for \$12.00 each. If he made a profit of \$564.00 from the compact discs, what is the value of x ?

Solution □ 1. The problem asks for the value of x .

2. x is given as the number of compact discs purchased.

3. Selling cost = number of items sold × value per item = $(x-19)\times 12$
   Buying cost = number of items bought × value per item = $x \times 6.50$
   Profit = selling cost − buying cost = $(x-19)\times 12 - 6.5x$

4. $564 = (x-19)\times 12 - 6.5x$
   $564 = 12x - 228 - 6.5x = 5.5x - 228$
   $792 = 5.5x$
   $x = 144$

5. The number of compact discs purchased is 144.

Distance, Rate, and Time Problems

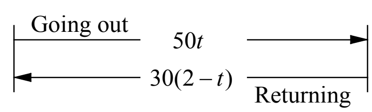
Distance = rate × time , $\boldsymbol{d = rt}$ **Average speed** = $\dfrac{\text{total distance}}{\text{total time}}$, $\boldsymbol{r = \dfrac{d}{t}}$ **Average time** = $\dfrac{\text{total distance}}{\text{average speed}}$, $\boldsymbol{t = \dfrac{d}{r}}$

Example 2 □ Carl drove from his home to the beach at a speed of 50 mph and returned home along the same route at a speed of 30mph. If his total driving time for the trip was two hours, how many minutes did it take him to drive from his home to the beach?

Solution □ 1. The problem asks for the time it took for Carl to drive to the beach.

2. Let t = the time in hours it took for Carl to drive to the beach.
   Then $2-t$ = the time spent for the return trip.
   Make a chart and a sketch showing the given facts.

	Rate ×	Time =	Distance
Going out	50	t	$50t$
Returning	30	$2-t$	$30(2-t)$



3. $50t = 30(2-t)$ The distance going out = the distance returning.
   $50t = 60 - 30t$ Distributive Property
   $80t = 60$ Add $30t$ on each side.

4. $t = \dfrac{60}{80} = \dfrac{3}{4}$ hours Solve for t .

5. It took Carl $\dfrac{3}{4}$ hours, or $\dfrac{3}{4}\times 60 = 45$ minutes, to drive from his home to the beach.

Exercises - Problem Solving with Equations

1

	Distance to Finish Line (meters)
Jason	$-8t+200$
Mary	$-7.5t+200$

Jason and Mary are running on a 200 meter track. The expressions in the table above show the distance to the finish line t seconds after they started the race. How many meters will Mary have left to finish the race when Jason is on the finish line?

A) 10.5 meters

B) 11.5 meters

C) 12.5 meters

D) 13.5 meters

2

At a bagel shop the first 6 bagels purchased cost 55 cents apiece, and additional bagels cost c cents apiece. If a customer paid \$5.70 for 12 bagels, what is the value of c?

A) 25

B) 30

C) 35

D) 40

3

Manny bought c candies at a price of 70 cents each. He sold all but k candies at a price of \$1.25, and made a profit of p dollars. Which of the following represents p in terms of c and k?

A) $p=1.25(c-k)-0.7c$

B) $p=1.25c-0.7k$

C) $p=1.25c-0.7(c-k)$

D) $p=1.25(c-k)-0.7k$

4

David used $\frac{1}{10}$ of his monthly salary for groceries and $\frac{3}{18}$ of his remaining money for his car payment. He also paid twice as much money for rent as for his car payment. If David has \$1,620 left after paying for groceries, car payment, and rent, how much is his monthly salary?

A) \$3,240

B) \$3,320

C) \$3,480

D) \$3,600

5

In a school election, 680 students voted for one of two candidates for president. If the winner received 120 more votes than the loser, how many votes did the winner receive?

6

If a gas tank contains 15 liters of gas and is $\frac{3}{8}$ full, how many additional liters of gas are needed to fill up the tank?

5-3. Solving Word Problems Using Systems of Equations

A problem involving two unknown quantities can be solved by using a system of equations.

Example 1 □ At a museum, Elly bought 3 student tickets and 2 adult tickets for \$29.00. At the same museum Samantha bought 5 student tickets and 4 adult tickets for \$54.00. How much does one student ticket and one adult ticket cost?

Solution □ 1. The problem asks for the cost of one student ticket plus one adult ticket.

2. Let $s =$ the price of student ticket and
   and $a =$ the price of adult ticket.

3. $\begin{Bmatrix}\text{number of} \\ \text{student ticket}\end{Bmatrix} \cdot \begin{Bmatrix}\text{price of} \\ \text{student ticket}\end{Bmatrix} + \begin{Bmatrix}\text{number of} \\ \text{adult ticket}\end{Bmatrix} \cdot \begin{Bmatrix}\text{price of} \\ \text{adult ticket}\end{Bmatrix} = \text{total cost}$

   $3s + 2a = 29$ First equation
   $5s + 4a = 54$ Second equation

4. $-6s - 4a = -58$ First equation multiplied by -2.
   $5s + 4a = 54$ Second equation
   By adding the two equations we get $-s = -4$ or $s = 4$.
   Substitute $s = 4$ in the first equation.
   $3(4) + 2a = 29$
   $12 + 2a = 29$
   $2a = 17$
   $a = 8.5$

5. $s + a = 4 + 8.5 = 12.5$
   The cost of one student ticket and one adult ticket is \$12.50.

Example 2 □ On the second weekend of July, Eric hiked 10 less than twice the number of miles that he hiked on the first weekend of July. In these two weeks he hiked a total of 38 miles. How many miles did he hike on the first weekend?

Solution □ 1. The problem asks for the number of miles Eric hiked on the first week of July.

2. Let $f =$ the number of miles Eric hiked on the first week
   and $s =$ the number of miles Eric hiked on the second week.

3. $\begin{Bmatrix}\text{number of miles hiked} \\ \text{on the second weekend}\end{Bmatrix} = \begin{Bmatrix}\text{10 miles less than twice the number} \\ \text{of miles he hiked on the first weekend}\end{Bmatrix}$

   $\{\text{total number of miles hiked in the two weekends}\} = 38$

   $s = 2f - 10$ First equation
   $f + s = 38$ Second equation

4. $f + (2f - 10) = 38$ $s = 2f - 10$ is substituted to the second equation.
   $3f - 10 = 38$ Simplify.
   $3f - 10 + 10 = 38 + 10$ Add 10 to each side.
   $3f = 48$ Simplify.
   $f = 16$ Divide each side by 3.

5. Eric hiked 16 miles on the first weekend.

Exercises - Solving Word problems Using Systems of Equations

1

Adam and Betty purchased a printer together for \$258. If Adam paid \$18 less than twice Betty, how much money did Adam pay for the printer?

A) 172

B) 166

C) 158

D) 146

2

There are 28 tables for customers at Mesa Grill Restaurant. The tables are either two-seat tables or four-seat tables. When all the tables are full, there will be 90 customers in the restaurant. How many two-seat tables are at the restaurant?

A) 11

B) 13

C) 15

D) 17

3

In a basketball, a field goal is either 2 or 3 points. In a college basketball tournament, Jim made 73 more 2-point field goals than 3-point field goals. If he scored a total of 216 goals in the tournament how many 3-point field goals did he make?

A) 12

B) 14

C) 16

D) 18

4

In a car dealership, all of the vehicles are either a sedan or a SUV. If 36 sedans are sold and 36 SUVs are added, there will be an equal number of sedans and SUVs. If 8 SUVs are sold and 8 sedans are added, there will be twice as many sedans as SUVs. How many sedans were at the dealership before any vehicle was sold?

A) 132

B) 144

C) 156

D) 168

5

At a coffee shop, a 16 ounce bag of coffee is on sale at \$5.25 less than the regular price. The cost of 4 bags of coffee at regular price is the same as the cost of 6 bags of coffee at sale price. Let r be the regular price of coffee and s be the sale price of coffee. Which of the following systems of equations can be used to find the values of variables r and s?

A) $\begin{cases} s = r - 16 \\ r = 6s \end{cases}$

B) $\begin{cases} s = r - 5.25 \\ 4r = 16 \end{cases}$

C) $\begin{cases} s = r - 5.25 \\ 4r = 6s \end{cases}$

D) $\begin{cases} s = r + 5.25 \\ 4r = 6s \end{cases}$

5-4. Solving Word Problems Using Inequalities

Many of the real-life word problems can be solved algebraically by translating the given information into an inequality and then solving the inequality.

Example 1 □ Apex Car Rental charges a flat fee of \$40.00 per day plus \$0.54 per mile to rent a car. Jason Car Rental charges a flat fee of \$65.00 per day plus \$0.36 per mile to rent a car. If a car is rented for three days, at least how many miles would you have to drive, to the nearest mile, to make the Jason Car Rental company the better option?

Solution □ 1. The problem asks for how many miles you would have to drive to make Jason Car Rental the better option.

2. Let $x =$ the number of miles of driving which would make Jason Car Rental the better option.

3. $\left\{\begin{matrix}\text{Apex Car Rental's} \\ \text{rental charge for 3 days}\end{matrix}\right\} > \left\{\begin{matrix}\text{Jason Car Rental's} \\ \text{rental charge for 3 days}\end{matrix}\right\}$

$40 \cdot 3 + 0.54x > 65 \cdot 3 + 0.36x$

4.
$120 + 0.54x > 195 + 0.36x$	Simplify.
$120 + 0.54x - 0.36x > 195 + 0.36x - 0.36x$	Subtract $0.36x$ from each side.
$120 + 0.18x > 195$	Simplify.
$120 + 0.18x - 120 > 195 - 120$	Subtract 120 from each side.
$0.18x > 75$	Simplify.
$\dfrac{0.18x}{0.18} > \dfrac{75}{0.18}$	Divide each side by 0.18.
$x > 416.67$	Simplify.

5. You need to drive 417 miles or more to make Jason Car Rental the better option.

Example 2 □ A 38 inch long wire is cut into two pieces. The longer piece has to be at least 3 inches longer than twice the shorter piece. What is the maximum length of the shorter piece, to the nearest inch?

Solution □ 1. The problem asks for the maximum length of the shorter piece, to the nearest inch.

2. Let $x =$ the length of the shorter piece,
and $38 - x =$ the length of the longer piece.

3. $\{\text{The longer piece is at least 3 inches longer than twice the shorter piece.}\}$

$38 - x \geq 2x + 3$

4.
$38 - x + x \geq 2x + 3 + x$	Add x to each side.
$38 \geq 3x + 3$	Simplify.
$38 - 3 \geq 3x + 3 - 3$	Subtract 3 from each side.
$35 \geq 3x$	Simplify.
$\dfrac{35}{3} (\approx 11.66) \geq x$	Divide each side by 3.

5. The maximum length of the shorter piece, to the nearest inch, is 11.

Exercises - Solving Word Problems Using Inequalities

1

Tom wants to rent a truck for two days and pay no more than \$300. How far can he drive the truck if the truck rental cost \$49 a day plus \$0.40 a mile?

A) 490

B) 505

C) 520

D) 535

2

Tim has 140 paperback and hard cover copies in his book shelf. If the hard cover copies do not exceed one sixth the number of paperback copies, what is the minimum number of paperback copies in Tim's book shelf?

A) 114

B) 116

C) 118

D) 120

3

The number of students in a geometry class is four fifths the number of students in a Spanish class. The total number of students in both classes does not exceed 54. What is the greatest possible number of students in the Spanish class?

A) 30

B) 32

C) 34

D) 36

4

At a sporting goods store, Jay paid \$172 for a pair of shoes and a pair of pants. The pants cost less than two thirds of what the shoes cost. What is the minimum price of the shoes to the nearest dollar?

5

Ty earns \$14 an hour working on weekdays and \$21 an hour working on weekends. If he wants to make at least \$600 by working a total of 36 hours in a week, to the nearest hour, at least how many hours does he need work on the weekends?

Chapter 5 Practice Test

Questions 1 - 3 refer to the following information.

The manager of an apartment building needs an electrician to repair the power generator for the building. The table below shows the fixed amount for a time service call and hourly charges for two different companies.

Company	Fixed amount for a service call	Hourly Rate
A	\$40	\$55
B	\$75	\$48

1

Which of the following equations gives the total cost, y, of repairing the power generator in terms of the total number of hours, x, from company A?

A) $y = 48x + 75$

B) $y = 75x + 48$

C) $y = 40x + 55$

D) $y = 55x + 40$

2

For what number of hours, x, will the total cost of repairing the generator for company B be less than or equal to the total cost of repairing the generator for company A?

A) $x \geq \frac{5}{2}$

B) $x \leq \frac{5}{2}$

C) $x \geq 5$

D) $x \leq 5$

3

Company B's total cost, y, is the fixed amount for a service call plus the hourly rates. If the relationship between Company B's total cost, y, and the number of hours, x, is graphed in the xy- plane, what does the slope of the line represent?

A) Fixed amount for a service call

B) Hourly Rate

C) Total amount for one day

D) Total amount for repairing the power generator

4

Apex Car Rental company charges a flat fee of \$40.00 per day plus \$0.75 per mile to rent a car. Jason Car Rental company charges a flat fee of \$64.00 per day plus \$0.60 per mile to rent a car. If a car is rented for three days, at how many miles would the rental charges of the two companies be the same?

A) 480

B) 450

C) 420

D) 380

5

It took Sara a total of 42 minutes to jog from home to the park and back again, by the same path. If she averaged 8 miles per hour going to the park and 6 miles per hour coming back, what is the distance from her home to the park?

A) 2.4 miles

B) 2.8 miles

C) 3.2 miles

D) 3.6 miles

6

Carl drove from his home to the beach at an average speed of 50 mph and returned home along the same route at an average speed of 30 mph. His total driving time for the trip was 2 hours. Solving which of the following systems of equations yields, x, the time it took for Carl to drive to the beach and, y, the time spent for the return trip?

A) $x = y + 2$
$50x = 30y$

B) $x + y = 2$
$30x = 50y$

C) $x + y = 2$
$50x = 30y$

D) $y = x + 2$
$30x = 50y$

7

To join Ace Gym, one must pay a \$180 membership fee plus dues of \$35 per month. To join Best Gym, one must pay a \$300 membership fee plus dues of \$23 per month. At how many months would the total cost of either gym be the same?

A) 7

B) 8

C) 9

D) 10

8

At a county fair the admission is \$8.00 and each ride costs \$1.25. If you go to the fair with \$20.00, what is the maximum number of rides you can go on?

A) 8

B) 9

C) 10

D) 11

9

A car averages 18 miles per gallon of gas for city driving and 27 miles per gallon of gas for highway driving. What is the total number of gallons of gas needed to drive $6x$ miles in the city and $18x$ miles on the highway?

A) x

B) $2x$

C) $3.5x$

D) $4.5x$

10

One section of a grocery store display only water bottles. The water bottles are in either 6-bottle packages or 8-bottle packages. Let x represent the number of 6-bottle packages and y represent the number of 8-bottle packages. The total number of packages displayed are 270 and the total number of bottles are 1,860. To find the values of variables x and y, which of the following systems of equations can be used?

A) $\begin{cases} x + y = 1{,}860 \\ 6x + 8y = 270 \end{cases}$

B) $\begin{cases} 6x + 8y = 1{,}860 \\ x + y = 270 \end{cases}$

C) $\begin{cases} 8x + 6y = 1{,}860 \\ x + y = 270 \end{cases}$

D) $\begin{cases} x + y = 1{,}860 \\ 8x + 6y = 270 \end{cases}$

Answer Key

Section 5-1

1. A	2. B	3. C	4. B	5. 1996
6. 80				

Section 5-2

1. C	2. D	3. A	4. D	5. 400
6. 25				

Section 5-3

1. B	2. A	3. B	4. D	5. C

Section 5-4

1. B	2. D	3. A	4. 104	5. 14

Chapter 5 Practice Test

1. D	2. C	3. B	4. A	5. A
6. C	7. D	8. B	9. A	10. B

Answers and Explanations

Section 5-1

1. A

Distance traveled

$= \text{speed} \times \text{time} = \dfrac{60 \text{ miles}}{1 \text{ hour}} \times 5\dfrac{1}{4} \text{ hours} = 315 \text{ miles}$

Number of gallons of gas used

$= \dfrac{1 \text{ gallon}}{35 \text{ miles}} \times 315 \text{ miles} = 9 \text{ gallons}$

Since the tank of Chloe's car was filled with 12 gallons of gas at the beginning, $12-9$,or 3 gallons of gas are left in the tank.

2. B

Average rate of climbing per hour

$= \dfrac{\text{height gained}}{\text{time}} = \dfrac{210-90}{11-9.5} = \dfrac{120}{1.5}$

$= 80 \text{ feet / hour}$

By 11:00 AM he has reached 210 feet up the cliff, so, the remaining height is $450-210$, or 240 feet. Since he is climbing up 80 feet per hour, it will take him $\dfrac{240}{80}$, or 3 more hours to reach the top of the cliff. Three hour later from 11:00 am is 2 pm.

3. C

Average rate of change in the price of the house

$= \dfrac{334,000-280,000}{2013-2005} = \dfrac{54,000}{8}$

$= 6,750 / \text{year}$

The purchase price of the house in the year 2018 will be $334,000 + 5 \times 6,750$, or \$367,750.

4. B

Since the first month is free for the club, the amount of monthly fee x months after a person joined the club will be $w \times (x-1)$, and the total amount including the one time membership fee will be $w \times (x-1) + d$.

Choice B is the correct.

5. 1996

Average rate of change in the population of city A

$= \dfrac{28,000-12,000}{2000-1990} = \dfrac{16,000}{10}$

$= 1,600 / \text{year}$

Average rate of change in the population of city B

$= \dfrac{24,000-18,000}{2000-1990} = \dfrac{6,000}{10}$

$= 600 / \text{year}$

Let $x =$ the number of years from 1990, and let $y =$ the population after 1990.
The population of city A after 1990 will be $y = 1600x + 12,000$ and the population of city B after 1990 will be $y = 600x + 18,000$.
To find the year the population of both cities were the same, let the two equations be equal.
$1600x + 12,000 = 600x + 18,000$

Solving the equation for x yields $x = 6$.
The correct answer is 1996.

6. 80

Let $x =$ the time in minutes it takes for the amount of water in both tanks to become the same. During x minutes, $6x$ gallons of water filled in the empty tank and $9x$ gallons of water were drained from the 1,200 gallon tank. If the amount of water in the two tanks are the same, $6x = 1200 - 9x$.

Solving the equation for x gives $x = 80$.

Section 5-2

1. C

To find out the time it took for Jason to reach the finish line, solve the equation $-8t+200=0$ for t. Solving the equation for t gives $t=25$. Substitute 25 for t in the expression $-7.5t+200$.

$-7.5(25)+200=12.5$

Therefore, Mary has 12.5 meters left to finish when Jason is on the finish line.

2. D

First 6 bagels cost 55 cents each and the additional bagels cost c cents each. The total for 12 bagels is \$5.70. So, the other 6 bagels cost c cents each.

$6\times 0.55+6c=5.70$
$3.3+6c=5.70$
$6c=2.4$
$c=0.4$

The value of c is 40 cents.

3. A

Buying cost of candies $=0.7c$
Number of candies sold $=c-k$
Selling price $=1.25(c-k)$

Profit $=$ selling price $-$ buying cost
$=1.25(c-k)-0.7c$

4. D

Let $x=$ David's monthly salary, then

$\frac{1}{10}x=$ grocery cost,

$\frac{9}{10}x=$ remaining salary,

$\frac{3}{18}\cdot\frac{9}{10}x=$ car payment,

$2\cdot\frac{3}{18}\cdot\frac{9}{10}x=$ rent.

David's monthly salary x is equal to the sum of his grocery, car payment, rent, and \$1,620.

$x=\frac{1}{10}x+\frac{3}{18}\cdot\frac{9}{10}x+2\cdot\frac{3}{18}\cdot\frac{9}{10}x+1620$

$x=\frac{99}{180}x+1440 \Rightarrow x-\frac{99}{180}x=1620$

$\Rightarrow x-\frac{99}{180}x=1440 \Rightarrow \frac{81}{180}x=1620$

$\Rightarrow x=1620\cdot\frac{180}{81}=3600$

5. 400

Let $x=$ the number of votes the winner received, then $x-120=$ the number of votes the loser received. The sum of the votes both the winner and the loser received equals 680.

$x+(x-120)=680$
$2x-120=680$
$2x=800$
$x=400$

6. 25

Let $x=$ the total capacity of the gas tank in liters.

Since $\frac{3}{8}$ of the gas tank is equivalent to 15 liters,

$\frac{3}{8}x=15$.

$\frac{3}{8}x=15 \Rightarrow x=15\cdot\frac{8}{3}=40$

Since the gas tank is $\frac{3}{8}$ full, we need $\frac{5}{8}x$ more liters to fill up the gas tank.

$\frac{5}{8}x=\frac{5}{8}(40)=25$ liters

Section 5-3

1. B

Let $x=$ the amount Betty paid for the printer, then $2x-18=$ the amount Adam paid for the printer. Total amount they paid together is \$258.

$$\underbrace{(2x-18)}_{\text{amount Adam paid}}+\underbrace{x}_{\text{amount Betty paid}}=258$$

$\Rightarrow 3x-18=258 \Rightarrow 3x=276 \Rightarrow x=92$

The amount Adam paid
$=2x-18=2(92)-18=166$

2. A

Let $x=$ the number of two-seat tables, then $28-x=$ the number of four-seat tables. When all the tables are full, there will be 90 customers in the restaurant. Therefore,

$2x+4(28-x)=90$
$\Rightarrow 2x+112-4x=90 \Rightarrow -2x+112=90$
$\Rightarrow -2x=-22 \Rightarrow x=11$

There are 11 two-seat tables.

3. B

Let $x =$ the number of 3-point field goals,
then $x+73 =$ the number of 2-point field goals.
He scored a total of 216 goals in the tournament.

$$\underbrace{3x}_{\text{number of points made through 3-point field goal}} + \underbrace{2(x+73)}_{\text{number of points made through 2-point field goal}} = \underbrace{216}_{\text{total number of points}}$$

$3x+2(x+73)=216 \Rightarrow 3x+2x+146=216$
$\Rightarrow 5x+146=216 \Rightarrow 5x=70 \Rightarrow x=14$

4. D

Let $x =$ the original number of sedans.
Then $x-36 =$ the number of sedans left after 36 of them are sold and $x+8 =$ the number of sedans after 8 are added.
Let $y =$ the original number of SUVs.
Then $y+36 =$ the number of SUVs after 36 of them are added and $y-8 =$ the number of SUVs after 8 of them are sold.

If 36 sedans are sold and 36 SUV are added then there will be an equal number of sedans and SUVs, and if 8 SUV are sold and 8 sedans are added then there will be twice as many sedans as SUVs.
The equations that represent these relationships are $x-36 = y+36$ and $x+8=2(y-8)$.

Solving the first equation for y gives $y = x-72$.
Substituting $x-72$ for y in the second equation yields $x+8=2(x-72-8)$.

$x+8=2(x-72-8) \Rightarrow x+8=2(x-80)$
$\Rightarrow x+8=2x-160 \Rightarrow 168 = x$

Choice D is correct.

5. C

The sale price of coffee, s, is \$5.25 less than the regular price, r. The equation that represents this relationship is $s = r-5.25$.
The cost of 4 bags of coffee at regular price is the same as the cost of 6 bags of coffee at sale price. The equation that represents this relationship is $4r = 6s$.

Choice C is correct.

Section 5-4

1. B

The truck rental cost \$49 a day, so for two days it will cost $2\times\$49$, or \$98. In addition, it cost \$0.40 per mile. If Tom drives m miles the total cost will be $98+0.4m$ dollars. This cost will not be more than \$300 if $98+0.4m \le 300$.

$98+0.4m \le 300 \Rightarrow 0.4m \le 202$
$\Rightarrow m \le \dfrac{202}{0.4} \Rightarrow m \le 505$

2. D

Let $p =$ the number of paperback copies and let $h =$ the number of hard cover copies.

$p+h=140$	There are 140 paperback and hard cover copies.
$h \le \frac{1}{6}p$	Hard cover copies do not exceed one sixth the number of paperback copies,

Solving the equation for h gives $h = 140-p$.
Substitute $140-p$ for h in the inequality.

$140-p \le \frac{1}{6}p \Rightarrow 140-p+p \le \frac{1}{6}p+p$
$\Rightarrow 140 \le \frac{7}{6}p \Rightarrow \frac{6}{7}\cdot 140 \le \frac{6}{7}\cdot\frac{7}{6}p$
$\Rightarrow 120 \le p$

Therefore, the minimum number of paperback copies in Tim's book shelf is 120.

3. A

Let $g =$ the number of students in geometry class and let $s =$ the number of students in Spanish class.

$g = \frac{4}{5}s$	The number of students in a geometry class is four fifths the number of students in a Spanish class.
$g+s \le 54$	The total number of students in both classes does not exceed 54.

Substitute $\frac{4}{5}s$ for g into the inequality.

$\frac{4}{5}s+s \le 54 \Rightarrow \frac{9}{5}s \le 54$
$\Rightarrow \frac{5}{9}\cdot\frac{9}{5}s \le \frac{5}{9}\cdot 54$
$\Rightarrow s \le 30$

Therefore, the greatest possible number of students in the Spanish class is 30.

4. 104

Let $s =$ the price of shoes and
let $p =$ the price of pants.

$s + p = 172$ Jay paid \$172 for a pair of shoes and a pair of pants.

$p < \frac{2}{3}s$ The pants cost less than two thirds of what the shoes cost.

Solving the equation for p gives $p = 172 - s$.
Substitute $172 - s$ for p in the inequality.

$172 - s < \frac{2}{3}s \Rightarrow 172 - s + s < \frac{2}{3}s + s$

$\Rightarrow 172 < \frac{5}{3}s \Rightarrow \frac{3}{5} \cdot 172 < \frac{3}{5} \cdot \frac{5}{3}s$

$\Rightarrow 103.2 < s$

Therefore, the minimum price of the shoes to the nearest dollar is \$104.

5. 14

Let $e =$ the number of hours Ty needs to work on weekends, then $36 - e =$ the number of hours Ty works on weekdays.
Ty earns \$14 an hour working on weekdays and \$21 an hour working on weekends and he wants to make at least \$600. The inequality that represents this relationship is $14(36 - e) + 21e \geq 600$.

$14(36 - e) + 21e \geq 600 \Rightarrow 504 - 14e + 21e \geq 600$

$\Rightarrow 504 + 7e \geq 600 \Rightarrow 7e \geq 96$

$\Rightarrow e \geq \frac{96}{7} (\approx 13.7)$

Therefore, he needs to work at least 14 hours on the weekends.

Chapter 5 Practice Test

1. D

If the apartment manager hires an electrician from company A, he needs to pay 55 dollars per hour. So for x hours, he has to pay $55x$ dollars plus 40 dollars for a service call. Therefore, the total cost, y, of repairing the power generator will be $y = 55x + 40$.

2. C

The total cost, y, of repairing the generator for company B will be $y = 48x + 75$. If the cost of repairing the generator for company B is less than or equal to the total cost of repairing the generator for company A, then $48x + 75 \leq 55x + 40$.

$48x + 75 \leq 55x + 40$

$\Rightarrow 48x + 75 - 48x \leq 55x + 40 - 48x$

$\Rightarrow 75 \leq 7x + 40 \Rightarrow 75 - 40 \leq 7x + 40 - 40$

$\Rightarrow 35 \leq 7x \Rightarrow 5 \leq x$

Choice C is correct.

3. B

The total cost, y, for a service call and hourly charge from company B is given by the equation $y = 48x + 75$. If the relationship is graphed on the xy- plane, the slope of the graph is 48, which is the hourly rate for company B.

Choice B is correct.

4. A

If a car is rented for three days and driven for x miles, the rental charges of Apex Car Rental will be $3 \times 40 + 0.75x$ and the rental charges of Jason Car Rental will be $3 \times 64 + 0.6x$.
The two company's charges will be the same if

$3 \times 40 + 0.75x = 3 \times 64 + 0.6x$.
$120 + 0.75x = 192 + 0.6x$
$120 + 0.75x - 0.6x = 192 + 0.6x - 0.6x$
$120 + 0.15x = 192$
$120 + 0.15x - 120 = 192 - 120$
$0.15x = 72$
$x = 480$

5. A

Let $d =$ the distance in miles from Sara's home to the park. Since average time $= \frac{\text{total distance}}{\text{average speed}}$,

the time it took to jog from home to the park $= \frac{d}{8}$

and the time it took to jog from the park to her home $= \frac{d}{6}$. Since the total time for the round trip was 42 minute, or $\frac{42}{60}$ hours, $\frac{d}{8} + \frac{d}{6} = \frac{42}{60}$.

By multiplying each side of the equation by 120, we have $120(\frac{d}{8} + \frac{d}{6}) = 120(\frac{42}{60})$.

$\Rightarrow 15d + 20d = 84 \Rightarrow 35d = 84$

$\Rightarrow d = \frac{84}{35} = 2.4$

6. C

The time it took for Carl to drive to the beach plus the time spent for the return trip equals 2 hours. Therefore $x + y = 2$.
Also the distance of going to the beach equals the returning distance. Use the formula $d = rt$.

The distance to the beach equals to $50x$ and the returning distance equals $30y$. Thus $50x = 30y$. Choice C is correct.

7. D

Let $x =$ number of months at which both gyms cost the same.
The total cost x months after joining Ace Gym is $180 + 35x$ and the total cost x months after joining Best Gym is $300 + 23x$. If $180 + 35x = 300 + 23x$ the total cost of either gym will be the same.

$180 + 35x - 23x = 300 + 23x - 23x$
$180 + 12x = 300$
$180 + 12x - 180 = 300 - 180$
$12x = 120$
$x = 10$

8. B

If you pay for admission and take r rides, the total cost will be $\$(8 + 1.25r)$.
The total cost does not exceed \$20 if $8 + 1.25r \le 20$.
$8 + 1.25r \le 20 \ \Rightarrow\ 8 + 1.25r - 8 \le 20 - 8$
$\Rightarrow\ 1.25r \le 12 \ \Rightarrow\ r \le \dfrac{12}{1.25} \ \Rightarrow\ r \le 9.6$

Therefore, the maximum number of rides you can go on is 9.

9. A

The number of gallons of gas needed to drive $6x$ miles in the city $= \dfrac{6x}{18} = \dfrac{1}{3}x$.
The number of gallons of gas needed to drive $18x$ miles on the highway $= \dfrac{18x}{27} = \dfrac{2}{3}x$.
Total number of gallons of gas needed equals $\dfrac{1}{3}x + \dfrac{2}{3}x$, or x.

10. B

If x represents the number of 6-bottle packages and y represents the number of 8-bottle packages, then $x + y$ represents the total number of packages. Thus, $x + y = 270$.
If x is the number of 6-bottle packages, then there are $6x$ water bottles and if y is the number of 8-bottle packages , then there are $8y$ water bottles. Thus, $6x + 8y = 1860$.

Choice B is correct.