

8th Grade
Textbook Packet
4/6/2020-4/10/2020

The Spirit of Reform

1820–1860

ESSENTIAL QUESTIONS • Why do societies change?
• What motivates people to act? • How do new ideas change the way people live?



Emily Dickinson was a brilliant poet of the mid-1800s.

networks

There's More Online about the issues that American reformers tackled in the mid-1800s.

CHAPTER 16

Lesson 1

Social Reform

Lesson 2

The Abolitionists

Lesson 3

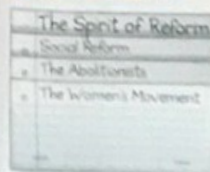
The Women's Movement

The Story Matters . . .

Young Emily Dickinson excels at school, especially in Latin, science, and writing. Dickinson even takes the then-unusual step of attending college for a year, but she finds its strict rules unsuited to her creative energy.

As an adult, she spends less and less time in public. After the age of 40, she dresses only in white. She does not travel and chooses not to meet most visitors. She spends much of her time writing, eventually producing 1,800 brilliant gems of poetry. She is a literary pioneer—though few people at the time know it. Only 10 of her poems ever appear in print during her lifetime. Only in death is she recognized among the era's many women of achievement.

FOLDABLES



Go to the Foldables® library in the back of your book to make a Foldable® that will help you take notes while reading this chapter.

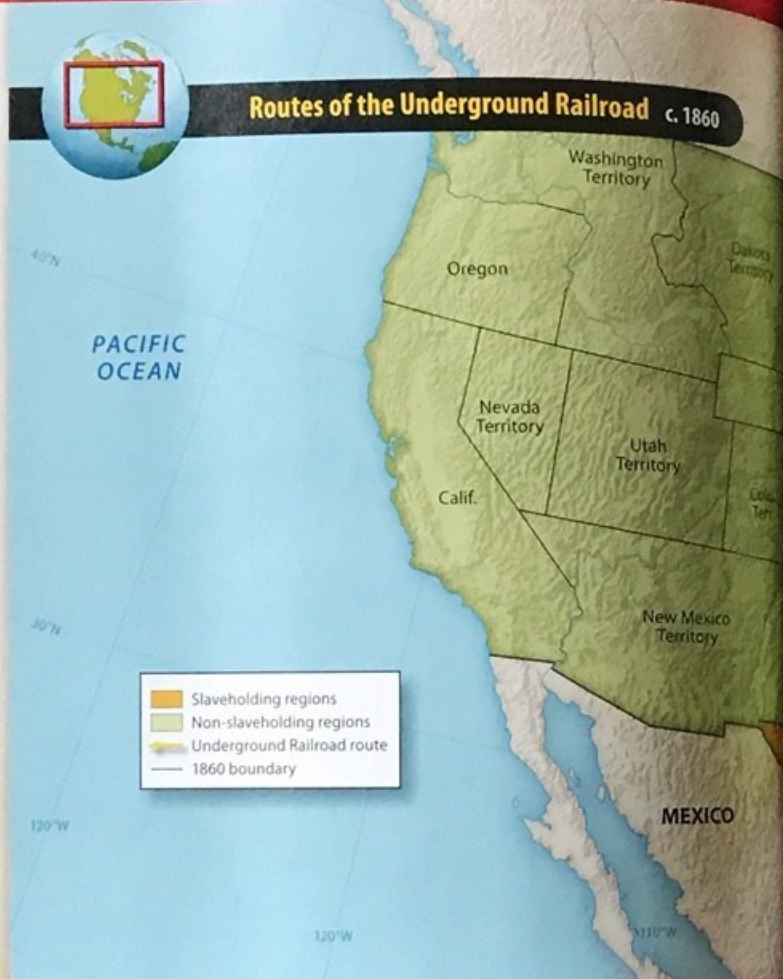
Place and Time: United States 1820 to 1860

During this period, many men and women, including whites and African Americans, worked to abolish slavery. Other people wanted to reform laws and customs that limited women's choices and created harsh conditions for the poor and people with disabilities.

Step Into the Place

MAP FOCUS One of the main reforms people sought in the mid-1800s was the abolition of slavery. Reformers also tried to help enslaved people escape to freedom in the North or outside the country. Some of the routes to freedom are noted on the map.

- LOCATION** On the map, locate the cities of Toledo, Cleveland, and Buffalo. Why do you think these cities became important points for people trying to escape slavery? 29c
- CRITICAL THINKING Speculating** Why do you think some enslaved people traveled to Canada instead of stopping when they reached a free Northern state?



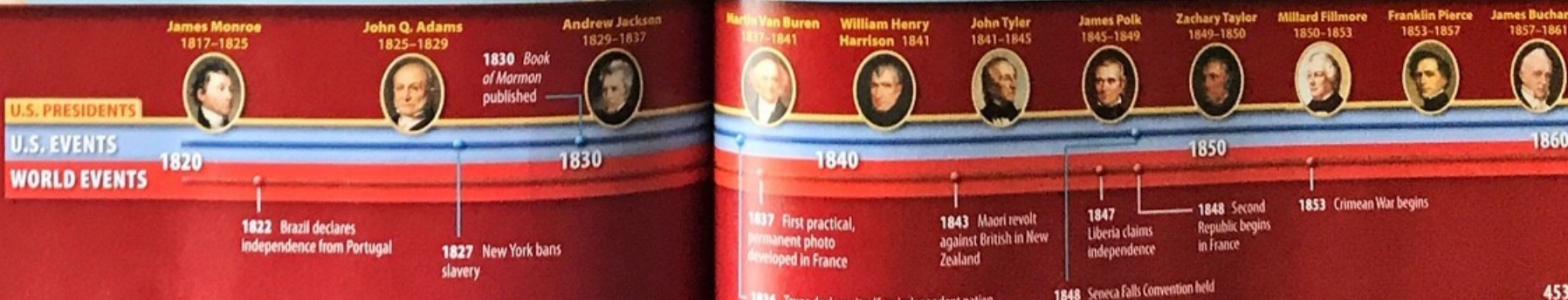
networks **MAP** Explore the interactive version of this map on NETWORKS. **TIME LINE** Explore the interactive version of this time line on NETWORKS.

There's More Online!



Step Into the Time

TIME LINE Look at the time line. Who was president when New York banned slavery? 29c



There's More Online!

- ✓ **IMAGE** The American School for the Deaf
- ✓ **PRIMARY SOURCE** Lyman Beecher's Sermon on Slavery
- ✓ **SELF-CHECK QUIZ**
- ✓ **VIDEO**



Lesson 1

Social Reform

ESSENTIAL QUESTION *Why do societies change?*

IT MATTERS BECAUSE

Developments in the early 1800s helped shape the social and cultural fabric of the United States.



TEKS Texas Essential Knowledge and Skills

- 1A** Identify the major eras and events in U.S. history through 1877, including colonization, revolution, drafting of the Declaration of Independence, creation and ratification of the Constitution, religious revivals such as the Second Great Awakening, early republic, the Age of Jackson, westward expansion, reform movements, sectionalism, Civil War, and Reconstruction, and describe their causes and effects.
- 22B** Describe the contributions of significant political, social, and military leaders of the United States such as Frederick Douglass, John Paul Jones, James Monroe, Stonewall Jackson, Susan B. Anthony, and Elizabeth Cady Stanton.
- 24B** Evaluate the impact of reform movements, including educational reform, temperance, the women's rights movement, prison reform, abolition, the labor reform movement, and care of the disabled.
- 25B** Describe religious motivation for immigration and influence on social movements, including the impact of the first and second Great Awakenings.
- 26A** Describe developments in art, music, and literature that are unique to American culture such as the Hudson River School artists, John James Audubon, "Battle Hymn of the Republic," transcendentalism, and other cultural activities in the history of the United States.
- 26C** Analyze the relationship between fine arts and continuity and change in the American way of life.

Religion and Reform

GUIDING QUESTION *What was the effect of the Second Great Awakening?*

In the 1800s, some Americans began to fear that the country was becoming too secular, or not religious, and began a series of religious meetings called **revivals**. Reverend James B. Finley described an early nineteenth-century revival this way:

PRIMARY SOURCE

“The noise was like the roar of Niagara [Falls]. The vast sea of human beings seemed to be agitated as if by a storm. . . . Some of the people were singing, others praying, some crying for mercy. . . . While witnessing these scenes, a peculiarly strange sensation, such as I had never felt before, came over me. My heart beat tumultuously [violently], my knees trembled, my lip quivered, and I felt as though I must fall to the ground.”

—from *Autobiography of Rev. James B. Finley*

At this time, people traveled great distances to hear preachers speak and to pray, sing, weep, and shout. This wave of religious interest—known as the Second Great Awakening—stirred the nation.

Also at this time, a new spirit of reform took hold in the United States. This spirit brought changes to American religion, education, and literature. Some reformers sought to improve society by forming **utopias** (yu•TOH•pee•uhs)—communities

Reading HELPDESK

Taking Notes: Identifying

As you read, use a diagram like this one to identify the reformers' contributions.

Reformer	Contribution
Thomas Gallaudet	
Dorothea Dix	

Content Vocabulary

- **revival**
- **utopia**
- **temperance**
- **normal school**
- **civil disobedience**

based on a vision of the perfect society. Most of these communities did not last. A few groups, such as the Mormons, did form lasting communities.

The Impact of Religion

Attending revivals often made men and women eager to reform their own lives and the world. Some people became involved in missionary work or social reform movements. Among those movements was the push to ban alcohol.

Connecticut minister Lyman Beecher was a leader of this movement. He wanted to protect society from “rum-selling, tippling folk, infidels, and ruff-scuff.” Beecher and other reformers called for **temperance**, or drinking little or no alcohol. They used **lectures**, pamphlets, and revival-style rallies to warn people of the dangers of liquor.

The temperance movement persuaded Maine and some other states to outlaw the manufacture and sale of alcohol. States later repealed most of these laws.

Changing Education

Reformers also wanted to improve education. Most schools had little money, and many teachers lacked training. Some people opposed the idea of compulsory, or required, education.

Religious revivals could attract thousands of people for days of prayers and song.

► CRITICAL THINKING

Analyzing Images Who are the people standing and sitting on the platform?



revival a religious meeting
utopia a community based on a vision of the perfect society

temperance drinking little or no alcohol

Academic Vocabulary

lecture a speech meant to provide information, similar to what a teacher presents

In addition, some groups faced barriers to schooling. Parents often kept girls at home. They thought someone who was likely to become a wife and mother did not need much education. Many schools also denied African Americans the right to attend.

Massachusetts lawyer Horace Mann was a leader of educational reform. He believed education was a key to wealth and economic opportunity for all. Partly because of his efforts, in 1839 Massachusetts founded the nation's first state-supported **normal school**—a school for training high school graduates to become teachers. Other states soon adopted Mann's reforms.

New colleges and universities opened their doors during the age of reform. Most of them admitted only white men, but other groups also began winning access to higher education. Oberlin College of Ohio, for example, was founded in 1833. The college admitted both women and African Americans.

Helping People with Disabilities

Reformers also focused on teaching people with disabilities. Thomas Gallaudet (ga•luh•DEHT) developed a method to teach those with hearing impairments. He opened the Hartford School for the Deaf in Connecticut in 1817. At that same time, Samuel Gridley Howe was helping people with vision impairments. He printed books using an alphabet created by Louis Braille, which used raised letters a person could “read” with his or her fingers. Howe headed the Perkins Institute, a school for the visually impaired, in Boston.

Schoolteacher Dorothea Dix began visiting prisons in 1841. She found some prisoners chained to the walls with little or no clothing, often in unheated cells. Dix also learned that some inmates were guilty of no crime. Instead, they were suffering from mental illnesses. Dix made it her life's work to educate the public about the poor conditions for prisoners and the mentally ill. Her efforts resulted in states' improving prisons and mental facilities.

READING PROGRESS CHECK

Describing How did Samuel Howe help people with vision impairments?



This picture shows students with hearing impairments receiving specialized instruction. The education of people with disabilities greatly advanced during the early and mid-1800s.

SKILLS PRACTICE

Write vocabulary words on cards. Draw pictures on the back to show what they mean.

Reading HELPDESK

normal school a state-supported school for training high school graduates to become teachers

civil disobedience the refusal to obey laws considered unjust

Academic Vocabulary

author a writer of books, articles, or other written works

Culture Changes

GUIDING QUESTION What type of American literature emerged in the 1820s?

Art and literature of the time reflected the changes in society and culture. American **authors** and artists developed their own style and explored American themes.

Writers such as Margaret Fuller, Ralph Waldo Emerson, and Henry David Thoreau stressed the relationship between humans and nature and the importance of the individual conscience. This literary movement was known as Transcendentalism. Emerson urged people to listen to the inner voice of conscience and to overcome prejudice. Thoreau practiced **civil disobedience** (dihs•oh•BEE•dee•uhns)—the refusal to obey laws considered unjust. For example, Thoreau went to jail in 1846 rather than pay a tax to support the U.S.-Mexican War, which he believed was fought to expand slavery.

In poetry, Henry Wadsworth Longfellow wrote narrative, or story, poems such as the *Song of Hiawatha*. Walt Whitman captured the new American spirit and confidence in his *Leaves of Grass*. Emily Dickinson wrote hundreds of simple, deeply personal poems, many of which celebrated the natural world.

American artists also explored American topics and developed a purely American style. Beginning in the 1820s, a group of landscape painters known as the Hudson River School focused on scenes of the Hudson River Valley. Printmakers Nathaniel Currier and James Merritt Ives created popular prints that celebrated holidays, sporting events, and rural life.

READING PROGRESS CHECK

Explaining What themes did the Transcendentalists focus on in their writings?

FOLDABLES Study Organizer

Include this lesson's information in your Foldable®.

The Spirit of Reform
o Social Reform
o The Abolitionists
o The Women's Movement

Ralph Waldo Emerson's house in Concord, Massachusetts, was a gathering place for many of the leaders of the Transcendentalist movement.



LESSON 1 REVIEW



Review Vocabulary

1. Examine the three terms below. Then write a sentence or two explaining how these terms were related to each other during the period of social reform. **24B**
 - a. revival
 - b. utopia
 - c. temperance

Answer the Guiding Questions

2. **Analyzing** What was the relationship between the Second Great Awakening and the reform movements of the early 1800s? **1A; 25B**

3. **Describing** How did the work of American authors reflect a unique American culture? **26A**
4. **Comparing and Contrasting** How was the work of Dorothea Dix similar to that of Thomas Gallaudet? How was it different? **22B; 24B**
5. **PERSUASIVE WRITING** Create a brochure for the newly established Oberlin College to send to potential students. Explain why the college differs from others, and describe the advantages of this college experience. **30D**

BIOGRAPHIES

- Mary Lyon
- Maria Mitchell

GAME Identification

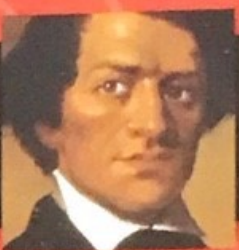
GRAPHIC ORGANIZER

Women's Rights Leaders

TIME LINE Opportunity and Achievement for Women

SELF-CHECK QUIZ

VIDEO



Lesson 3

The Women's Movement

ESSENTIAL QUESTION *How do new ideas change the way people live?*

IT MATTERS BECAUSE

Women began the long quest for expanded rights, including the right to vote, in the mid-1800s.

Reform for Women

GUIDING QUESTION *What did women do to win equal rights?*

For women such as Lucretia Mott, causes such as abolition and women's rights were linked. Like many other women reformers, Mott was a Quaker. Quaker women enjoyed an unusual degree of equality in their communities. Mott was actively involved in helping runaway enslaved workers. She organized the Philadelphia Female Anti-Slavery Society. At an antislavery convention in London, Mott met Elizabeth Cady Stanton. The two found they also shared an interest in women's rights.

The Seneca Falls Convention

In July 1848, Stanton and Mott helped organize the first women's rights convention in Seneca Falls, New York. About 300 people, including 40 men, attended.

A highlight of the convention was debate over a Declaration of Sentiments and Resolutions. These resolutions called for an end to laws that discriminated against women. They also demanded that women be allowed to enter the all-male world of trades, professions, and businesses. The most controversial issue, however, was the call for woman **suffrage**, or the right to vote in elections.

TEKS Texas Essential Knowledge and Skills

1A Identify the major eras and events in U.S. history through 1877, including colonization, revolution, drafting of the Declaration of Independence, creation and ratification of the Constitution, religious revivals such as the Second Great Awakening, early republic, the Age of Jackson, westward expansion, reform movements, sectionalism, Civil War, and Reconstruction, and describe their causes and effects.

22B Describe the contributions of significant political, social, and military leaders of the United States such as Frederick Douglass, John Paul Jones, James Monroe, Stonewall Jackson, Susan B. Anthony, and Elizabeth Cady Stanton.

23D Analyze the contributions of people of various racial, ethnic, and religious groups to our national identity.

23E Identify the political, social, and economic contributions of women to American society.

24B Evaluate the impact of reform movements, including educational reform, temperance, the women's rights movement, prison reform, abolition, the labor reform movement, and care of the disabled.

Reading HELPDESK

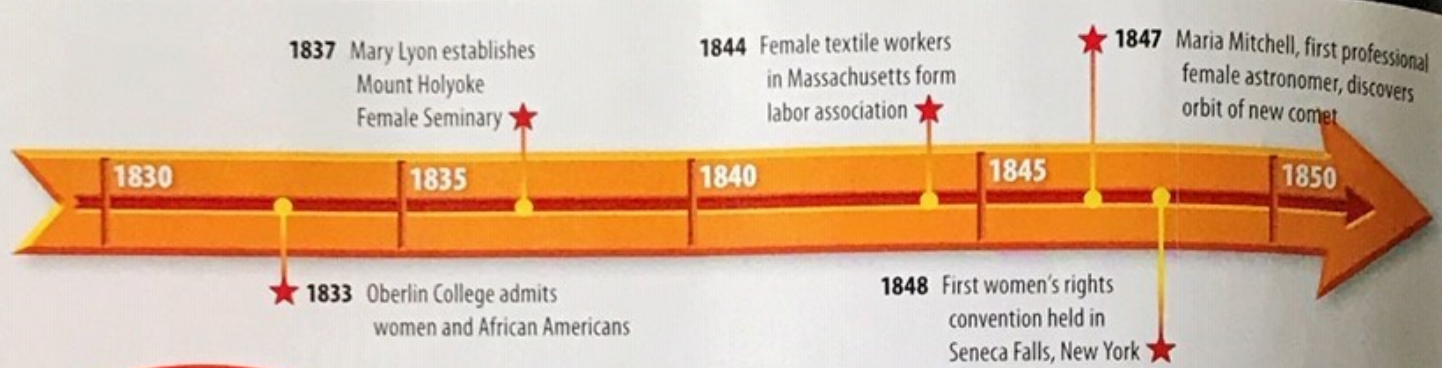
Taking Notes: Summarizing

As you read, use a diagram like this one to summarize the contributions each individual made to the women's movement.

Individual	Contribution
Lucretia Mott	→ <input type="text"/>
Elizabeth Cady Stanton	→ <input type="text"/>
Susan B. Anthony	→ <input type="text"/>

Content Vocabulary

- **suffrage**
- **coeducation**



INFOGRAPHIC

In the mid-1800s, women began to argue for—and earn—their own rights and an equal place in society.

- 1 **IDENTIFYING** Which items on the time line reflect growing opportunities for women to learn and gain skills?
- 2 **CRITICAL THINKING**
Analyzing Which items on the time line suggest women were using their education to achieve great things?

Elizabeth Cady Stanton insisted the resolutions include a demand for woman suffrage. Some delegates worried that the idea was too radical. Mott told her friend, “Lizzie, thee will make us ridiculous.” Standing with Stanton, Frederick Douglass argued powerfully for women’s right to vote. After a heated debate, the convention voted to include in their declaration the demand for woman suffrage in the United States.

The Seneca Falls Declaration

The first women’s rights convention called for women’s equality and for their right to vote, to speak publicly, and to run for office. The convention issued a Declaration of Sentiments and Resolutions modeled on the Declaration of Independence. Just as Thomas Jefferson had in 1776, women announced the need for revolutionary change based on a claim of basic rights:

PRIMARY SOURCE

“When, in the course of human events, it becomes necessary for one portion of the family of man to assume among the people of the earth a position different from that which they have hitherto [before] occupied, but one to which the laws of nature and of nature’s God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes that impel them to such a course.”

In this passage, two important words—“and women”—are added to Thomas Jefferson’s famous phrase:

“We hold these truths to be self-evident: that all men and women are created equal; that they are endowed by their Creator with certain inalienable rights; that among these are life, liberty, and the pursuit of happiness. . . .”

Reading HELPDESK

suffrage the right to vote

SKILLS PRACTICE

Before you explain something, think about the important and interesting details. Use as many of these details as you can.

The women's declaration called for an end to laws that discriminated against women. It demanded that women be free to enter the all-male world of trades, professions, and businesses.

“The history of mankind is a history of repeated injuries and [wrongful takings of power] on the part of man toward woman, having in direct object the establishment of an absolute tyranny over her. To prove this, let facts be submitted to a candid world. . . .

Now, in view of this entire [withholding of rights] of one-half the people of this country, their social and religious degradation,—in view of the unjust laws above mentioned, and because women do feel themselves aggrieved, oppressed, and fraudulently deprived of their most sacred rights, we insist that they have immediate admission to all the rights and privileges which belong to them as citizens of the United States.”

—Seneca Falls Convention Declaration of Sentiments

The Women's Movement Grows

The Seneca Falls Convention helped launch a wider movement. In the years to come, reformers held several national conventions, with the first taking place in Worcester, Massachusetts, in 1850. Both male and female reformers joined the cause.

Among the movement's leaders was Susan B. Anthony, the daughter of a Quaker abolitionist. She called for equal pay and college training for women, and **coeducation** (koh•eh•juh•KAY•shuhn)—the teaching of males and females together. Anthony also organized the country's first women's temperance association, the Daughters of Temperance. Anthony met Elizabeth Cady Stanton at a temperance meeting in 1851. They became lifelong friends and partners in the struggle for women's rights and suffrage.

Opportunities for women increased greatly in the late 1800s. Beginning with Wyoming in 1890, several states granted woman suffrage. Yet not until 1920 and the Nineteenth Amendment to the Constitution did women gain the right to vote everywhere.

READING PROGRESS CHECK

Evaluating What did the Seneca Falls Convention do to help the women's movement grow?

coeducation the teaching of males and females together

Elizabeth Cady Stanton (left), seen here with Susan B. Anthony, was an organizer of the Seneca Falls Convention.





Maria Mitchell was the first woman to work as a professional astronomer. "It seems to me that the needle is the chain of woman. . . . Emancipate her from the 'stitch, stitch, stitch,' . . . and she would have time for studies which would engross as the needle never can."

► **CRITICAL THINKING**

Paraphrasing Restate the quote from Mitchell above using your own words.

Mount Holyoke Female Seminary in South Hadley, Massachusetts, was the first women's college in the United States.

► **CRITICAL THINKING**

Analyzing Primary Sources What do you think Lyon meant when she referred to women's education as "the great secret"?

Women Make Gains

GUIDING QUESTION *In what areas did women make progress in achieving equality?*

Pioneers in women's education began to call for more opportunity. Early champions such as Catharine Beecher believed that women should be educated for their traditional roles in life. The Milwaukee College for Women used Beecher's ideas "to train women to be healthful, intelligent, and successful wives, mothers, and housekeepers."

Other people thought that women could be trained to be **capable** teachers and to fill other professional roles. These pioneers broke down the barriers to female education and helped other women do the same.

One of these pioneers, Emma Willard, educated herself in subjects considered suitable only for males, such as science and mathematics. In 1821 Willard set up the Troy Female Seminary in upstate New York. Willard's seminary taught mathematics, history, geography, and physics, as well as the usual homemaking subjects.

Mary Lyon, after working as a teacher for 20 years, began raising funds to open a women's college. She established Mount Holyoke Female Seminary in Massachusetts in 1837, modeling its curriculum on that of nearby Amherst College. Lyon became the school's first principal, believing that "the great secret . . . is female education."



Reading **HELP**DESK

Academic Vocabulary

capable skillful

ministry the job of a religious leader

Marriage and the Family

Prior to the mid-1800s, women had few rights. They depended on men for support. Anything a woman owned became the property of her husband if she married. She had few options if she was in an unhappy or abusive relationship.

During the mid- to late-1800s, women made some gains in marriage and property laws. New York, Pennsylvania, Indiana, Wisconsin, Mississippi, and the new state of California recognized the right of married women to own property.

Some states passed laws allowing divorced women to share guardianship of their children with their former husbands. Indiana was the first of several states that allowed women to seek divorce if their husbands abused alcohol.

Breaking Barriers

In the 1800s, women had few career choices. They could become elementary school teachers—often at lower wages than a male teacher received. Jobs in professions dominated by men were even more difficult. Women had to struggle to become doctors or work in the **ministry**. Some strong-minded women succeeded.

Elizabeth Blackwell tried and failed repeatedly to get into medical school. Finally accepted by Geneva College in New York, Blackwell graduated first in her class and achieved fame as a doctor.

Maria Mitchell was another groundbreaking woman. She was educated by her father and, in 1847, became the first person to discover a comet with a telescope. The next year, she became the first woman elected to the American Academy of Arts and Sciences. In 1865 Mitchell joined the faculty of Vassar College.

Women's gains in the 1800s were remarkable—but far from complete. Women remained limited by social customs and expectations. In fact, women had just begun the long struggle to achieve their goal of equality.

READING PROGRESS CHECK

Describing What gains did women make in the field of education?

Connections to TODAY

Women's Colleges

Mount Holyoke is one of the Seven Sisters—a group of outstanding colleges founded to educate women. Today, Mount Holyoke and several of the Seven Sisters still provide a woman-only educational experience. Some of the Seven Sisters now admit men.

FOLDABLES Study Organizer

Include this lesson's information in your Foldable®.

The Spirit of Reform
Social Reform
o The Abolitionists
o The Women's Movement

LESSON 3 REVIEW



Review Vocabulary

1. Explain ways that *suffrage* and *coeducation* could offer women in the 1800s new ways to participate in society. 30A

Answer the Guiding Questions

2. **Describing** What contributions did Susan B. Anthony and Elizabeth Cady Stanton make to American society? 23E

3. **Evaluating** How did the rights of married women improve in the 1800s? 1A

4. **PERSUASIVE WRITING** You are a woman who attended the Seneca Falls Convention. What arguments might you use to support suffrage? Write a paragraph explaining why women should have the right to vote. 29D; 29E

CAMBRIDGE LATIN COURSE

Unit 3



Fifth Edition

Navigation



ROMA

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NOX

I

nox erat. lūna stēllaeque in caelō serēnō fulgēbant. tempus erat quō hominēs quiēscere solent. Rōmae tamen nūlla erat quiēs, nūllum silentium.

magnīs in domibus, ubi dīvitēs habitābant, cēnae splendidae cōnsūmēbantur. cibus sūmptuosus ā servīs offerēbātur; vīnum optimum ab ancillīs fundēbātur; carmina ā citharoedīs perītissimīs cantābantur.

in altīs autem īnsulīs, nūllae cēnae splendidae cōnsūmēbantur, nūllī citharoedī audiēbantur. ibi pauperēs, famē paene cōfectī, vītā miserrimā agēbant. aliī ad patrōnōs epistulās scribēbant ut auxilium eōrum peterent, aliī scelera committere parābant.

prope forum magnus strepitus audiēbātur. nam arcus magnificus in Viā Sacrā exstruēbātur. ingēns polyspaston arcuī imminēbat. fabrī, quī arcum exstruēbant, diligentissimē labōrābant. aliī figurās in arcū sculpēbant; aliī titulum in fronte arcūs īnscribēbant; aliī marmor ad summum arcum tollēbant. omnēs strēnuē labōrābant ut arcum ante lūcem perficerent. nam Imperātor Domitiānus hunc arcum frātrī Titō postrīdīē dēdicāre volēbat. Titum vīvum oderat; sed Titum mortuum honōrāre cupiēbat. Domitiānus enim populum Rōmānum, quī Titum maximē dilēxerat, nunc sibi favēre volēbat.

II

praeerat huic operī Quīntus Haterius Latrōniānus, redēptor nōtissimus. eā nocte ipse fabrōs furēns incitābat. aderat quoque Gāius Salvius Liberālis, Hateriī patrōnus, quī eum invicem incitābat ut opus ante lūcem perficeret. anxius enim erat Salvius quod Imperātōrī persuāserat ut Haterium operī praeficeret. hic igitur fabrīs, quamquam omnīnō fessī erant, identidem imperāvīt nē labōre dēsisterent.

Glītus, magister fabrōrum, Haterium lēnīre temptābat. “ecce, domine!” inquit. “fabrī iam arcum paene perfēcērunt. ultimae litterae tituli nunc īnscribuntur; ultimae figurāe sculpuntur; ultimae marmoris massae ad summum arcum tolluntur.”

serēnō: serēnus *calm, clear*
fulgēbant: fulgēre *shine*
tempus *time*

Rōmae *in Rome*

quiēs *rest*

domibus: domus *house, home*

carmina: carmen *song*

altīs: altus *high*

īnsulīs: insula *apartment building*

5 **famē:** famēs *hunger*

cōfectī: cōfectus *worn out, exhausted*

patrōnōs: patrōnus *patron*

arcus *arch*

10 **Via Sacrā:** Via Sacra *the Sacred Way (road running through the Forum)*

polyspaston *crane*

fabrī: faber *craftsman, workman*

15 **figurās:** figurā *figure, shape*

sculpēbant: sculpere *carve*

titulum: titulus *inscription*

fronte: frōns *front*

20 **īnscribēbant:** īnscribere *write, inscribe*

marmor *marble*

ante *before*

lūcem: lūx *light, daylight*

perficerent: perficere *finish*

dēdicāre *dedicate*

operī: opus *work, construction*

redēptor *contractor, builder*

invicem *in turn*

5 **identidem** *repeatedly*

lēnīre *soothe, calm down*

10 **ultimae:** ultimus *last*

litterae: littera *letter*

massae: massa *block*

paulō ante hōram prīmam, fabrī labōre cōfectī arcum perfēcērunt. paulisper urbs silēbat.

ūnus faber tamen, domum per forum rediēns, subitō trīstēs fēminārum duārum clāmōrēs audīvit. duae enim captivāe, magnō dolōre affectae, in carcere cantābant:

“mī Deus! mī Deus! respice mē! quārē mē dēsenuistī?”

15 **paulisper:** *for a short time*
silēbat: silēre *be silent*

dolōre: dolor *grief*

affectae: affectus *overcome*

respice: respicere *look at, look*

quārē? *why?*



“ecce, domine! fabrī iam arcum paene perfēcērunt.”

About the language 1: active and passive voice

1 In Unit 1, you met sentences like these:

puer clāmōrem **audit**. ancilla vīnum **fundēbat**.
*A boy **hears** the shout.* *A slave girl **was pouring** wine.*

The words in **boldface** are **active** forms of the verb.

2 In Stage 29, you have met sentences like these:

clāmōr ā puerō **auditur**. vīnum ab ancillā **fundēbatur**.
*The shout **is heard** by a boy.* *Wine **was being poured** by a slave girl.*

The words in **boldface** are **passive** forms of the verb.

3 Compare the following active and passive forms:

	PRESENT TENSE
<i>present active</i>	<i>present passive</i>
portat	portātur
<i>s/he carries, s/he is carrying</i>	<i>s/he is carried, or s/he is being carried</i>
portant	portantur
<i>they carry, they are carrying</i>	<i>they are carried, or they are being carried</i>

	IMPERFECT TENSE
<i>imperfect active</i>	<i>imperfect passive</i>
portābat	portābātur
<i>s/he was carrying</i>	<i>s/he was being carried</i>
portābant	portābantur
<i>they were carrying</i>	<i>they were being carried</i>

4 Further examples of the present passive:

- a cēna nostra ā coquō nunc parātur.
- b multa scelera in hāc urbe cotīdiē committuntur.
- c laudantur; dūcitur; rogātur; mittuntur.

Further examples of the imperfect passive:

- d candidātī ab amīcīs salūtābantur.
- e fābula ab āctōribus in theātrō agēbātur.
- f audiēbantur; laudābātur; necābantur; tenēbātur.

Solve each equation. If the equation is an identity or if it has no solution, write *identity* or *no solution*. (3-5)

53. $10w = 8w + 14$

54. $x = 45 - 4x$

55. $48 - 6k = -12k$

56. $9m + 3 = 6m + 21$

57. $27 + u = 3 - 3u$

58. $4n + 1 = -1 + 4n$

59. $2(v - 8) = 6v$

60. $3x = 5(x - 6)$

61. $7y - 3 = 6(y + 2)$

62. $\frac{1}{3}(18 - 9c) = 6 - 3c$

63. $m - 5 = \frac{1}{2}(12 - 14m)$

64. $\frac{4}{5}(25x - 15) = 50x + 38$

65. $5(3 + h) = 4(h + 2)$

66. $(6x - 3)2 = (4x + 7)3$

67. $7(n - 3) = 5(n - 3)$

Solve. Use a chart to help you solve the problem.

(3-6, 3-7)

68. Jay's salary is $\frac{2}{3}$ of his wife's salary. In January, when they both get \$2000 raises, their combined income will be \$49,000. What are their current salaries?
69. Erin's three test scores were consecutive odd integers. If her next test score is 18 points more than the highest score of the three tests, her total number of points will be 328. Find Erin's test scores.
70. Julius weighs twice as much as each of his twin brothers. If each of the twins gains 5 lb and Julius gains twice that amount, the sum of the three brothers' weights will be 240 lb. How much does each weigh now?
71. The width of a rectangle is 6 cm less than the length. A second rectangle, with a perimeter of 54 cm, is 3 cm wider and 2 cm shorter than the first. What are the dimensions of each rectangle?
72. Martha has some nickels and dimes worth \$6.25. She has three times as many nickels as dimes. How many nickels does she have?
73. Elliot paid \$1.50 a dozen for some flowers. He sold all but 5 dozen of them for \$2 a dozen, making a profit of \$18. How many dozen flowers did he buy?
74. Rachel spent \$16.18 for some cans of dog food costing 79 cents each and some cans of cat food costing 69 cents each. She bought two more cans of cat food than of dog food. How many cans of each did she buy?
75. Victor earns \$3 an hour working after school and \$4 an hour working on Saturdays. Last week he earned \$43, working a total of 13 h. How many hours did he work on Saturday?

State a reason for each step in Exercises 76–78.

(3-8)

76. $6 + (15 + 4) = 6 + (4 + 15)$ $\underline{\quad ? \quad}$
 $\quad = (6 + 4) + 15$ $\underline{\quad ? \quad}$
 $\quad = 10 + 15 = 25$ $\underline{\quad ? \quad}$

77. $20 + (-4) = (16 + 4) + (-4)$ $\underline{\quad ? \quad}$
 $\quad = 16 + [4 + (-4)]$ $\underline{\quad ? \quad}$
 $\quad = 16 + 0$ $\underline{\quad ? \quad}$
 $\quad = 16$ $\underline{\quad ? \quad}$

2. Aaron, Betsy, and Charita work part-time at the public library. Betsy works 4 h more each week than Aaron, and together they work half as many hours as Charita. How long does each person work if their total time is 45 h?
3. Zach's last quiz score was 30 points less than twice his first score. What was his first quiz score if the sum of his two scores is 150?
4. The length of a rectangle is 18 cm more than the width. A second rectangle is 6 cm shorter and 3 cm wider than the first and has a perimeter of 126 cm. Find the dimensions of each rectangle.
5. Becky has as many dimes as Ryan and Amy have together. Ryan has 2 more dimes than Amy, and Amy has one third as many dimes as Becky has. How many dimes does each have?
6. A cup of skim milk has 10 more than half the calories of a cup of whole milk. A cup of whole milk has 40 more calories than a glass of apple juice. If the total number of calories in one cup of each is 370, find the number of calories in each.

Solve.

(3-7)

1. A collection of quarters and dimes is worth \$6.75. The number of dimes is 4 less than three times the number of quarters. How many of each are there?
2. A total of 720 people attended the school basketball game. Adult tickets cost \$2.50 each and student tickets cost \$1.50 each. If \$1220 worth of tickets were sold, how many students and how many adults attended?
3. A worker earns \$9 per hour for a regular workday and \$13.50 per hour for additional hours. If the worker was paid \$114.75 for an 11-hour workday, what is the length of a regular workday?
4. Carrots cost 75¢ per kilogram and potatoes cost 70¢ per kilogram. A shopper bought 9 kg of the vegetables for \$6.60. How many kilograms of each did the shopper buy?
5. A collection of 102 nickels, dimes, and quarters is worth \$13.60. There are 14 more nickels than dimes. How many quarters are there?

Chapter 4

Solve.

(4-8)

1. Two trains leave a station at the same time, heading in opposite directions. One train is traveling at 80 km/h, the other at 90 km/h. How long will it take for the trains to be 425 km apart?
2. Grace leaves home at 8:00 A.M. Ten minutes later, Will notices Grace's lunch and begins bicycling after her. If Grace walks at 5 km/h and Will cycles at 15 km/h, how long will it take him to catch up with her?

Chapter 4

Simplify.

1. 7^3

5. $7 + 5^2$

9. $5^3 \div (3^2 + 4^2)$

2. $(-5)^4$

6. $(8 - 4)^3$

3. $-3 \cdot 2^4$

7. $6 - 2^5$

10. $(8^2 - 6^2) \div 7$

4. $(-2 \cdot 5)^3$

8. $(4 + 7)^2$

11. $4(9^2 - 4^3)$

Evaluate if $a = -3$ and $b = 2$.

12. $3a + b^2$

16. $7 + ab^2$

13. $(3a + b)^2$

17. $(7 + ab)^2$

14. $4a - b^3$

18. $-\frac{3a}{b^2}$

15. $(4a - b)^3$

19. $\left(-\frac{3a}{b}\right)^2$

Add.

20. $\begin{array}{r} 4x - 3 \\ 7x + 8 \end{array}$

24. $\begin{array}{r} 5k - 6l + 4 \\ -5k + 8l + 2 \end{array}$

26. $\begin{array}{r} 2m^2 - 3mn - 5n \\ -8m^2 \quad \quad - n \end{array}$

21. $\begin{array}{r} 3b + 4 \\ -2b - 6 \end{array}$

22. $\begin{array}{r} 5m + 8 \\ 4m + 3 \end{array}$

25. $\begin{array}{r} 6x^2 - 2xy + 3y^2 \\ 4x^2 - xy - y^2 \end{array}$

27. $\begin{array}{r} 5a^2 - 6ab \\ -2a^2 + 9ab - b^2 \end{array}$

23. $\begin{array}{r} -2t - 7 \\ 6t - 3 \end{array}$

28–35. In Exercises 20–27, subtract the lower polynomial from the upper one.

Simplify.

36. $e^6 \cdot e^3 \cdot e$

39. $(-2gh^2)(5g^3h)$

42. $\left(\frac{8}{3}x^5y\right)\left(\frac{9}{2}xy^6\right)$

45. $3^w \cdot 3^{5-w} \cdot 3$

48. $(3p^5)(5p^2) + (7p^3)(2p^4)$

50. $(w^5)^2$

54. $(a^n)^3$

58. $(5f)^2$

62. $(2u^3v)^5$

66. $(3k)^2(3k)^4$

37. $(4f^3)(2f^4)$

40. $(3mn)(6m^2n)(2n^2)$

43. $(-6a^3)\left(\frac{1}{6}a^3\right)$

46. $4^2 \cdot 4^{a+1} \cdot 4^a$

49. $(8d^3)(2d^7) - (3d^6)(4d^4)$

52. $y^2 \cdot y^5$

56. $c^3 \cdot c^n$

60. $(6m^3)^2$

64. $(-7x^4)^2$

68. $-(4t^2)^2(3t)^3$

38. $(-3c^2d)(-4cd^2)$

41. $(-5j^4k^2)(4jl^3)(-3kl^2)$

44. $(3u^2v)(-7v^3)\left(\frac{4}{9}u^2\right)$

47. $2^5 \cdot 2^{b+3} \cdot 2^{3-b}$

53. $z^n \cdot z^n$

57. $d^n \cdot d^n \cdot d^n$

61. $(4mn^5)^3$

65. $-(8x^5)^3$

69. $(5x^2y)^3 \cdot 3xy^2$

Multiply.

70. $7(x + 3)$

74. $3n(n + 5)$

78. $9a(a^2 - 3a - 4)$

80. $\frac{1}{3}c(6c^2 - 3cd + 9d^2)$

82. $(m + 4)(m + 2)$

85. $(5x - 2)(x + 7)$

88. $(u + 3)(u^2 + 2u + 5)$

91. $\frac{7x - 4y}{3x - 2y}$

92. $\frac{5a - 8b}{4a + b}$

93. $\frac{e^2 + ef + f^2}{e + f}$

94. $\frac{3m^2 - 4mn + n^2}{5m + n}$

71. $5(y - 4)$

75. $-4t(3 - 2t)$

72. $-3(n - 2)$

76. $6k(2k - 7)$

79. $-5b^2(3b^2 - 2b + 6)$

81. $\frac{1}{2}uv^2(10u^2 - 4uv + 8v^2)$

83. $(n - 3)(n + 5)$

86. $(4y - 2)(3y - 1)$

89. $(v - 1)(3v^2 + 4v + 7)$

84. $(a - 6)(a - 7)$

87. $(6m + 4)(5m + 3)$

90. $(3c - 5)(2c^2 - c + 8)$

(4-5, 4-6)

73. $-8(1 + 4m)$

77. $-5h(8h + 3)$

Solve the given formula for the variable shown in color. State the restrictions, if any, for the formula obtained to be meaningful.

(4-7)

95. $A = \frac{1}{2}ap$; a

96. $V = \frac{1}{3}Bh$; h

97. $A = \frac{1}{2}h(b_1 + b_2)$; b_1

98. $y = mx + b$; b

99. $A = \pi r^2$; r

100. $S = (n - 2)180$; n

101. $F = \frac{9}{5}C + 32$; C

102. $P = \frac{A}{1 + rt}$; A

103. $r = \frac{I}{Pt}$; t

Solve. Use a chart to help you solve the problem.

(4-8)

104. Two buses leave a depot at the same time, one traveling north and the other south. The speed of the northbound bus is 15 mi/h greater than the speed of the southbound bus. After 3 h on the road, the buses are 255 mi apart. What are their speeds?

105. Exactly 10 min after Alex left his grandparents' house, his cousin Alison set out from there to overtake him. Alex drives at 36 mi/h. Alison drives at 40 mi/h. How long did it take Alison to overtake Alex?

106. A plane flew from the Sky City airport to the Plainsville airport at 800 km/h and then returned to Sky City at 900 km/h. The return trip took 30 min less than the flight to Plainsville. How far apart are the airports and how long did the trip to Plainsville take?

107. A poster is three times as long as it is wide. It is framed by a mat such that there is a 4 in. border around the poster. Find the dimensions of the poster if the area of the mat is 488 in².

(4-9)

108. A square piece of remnant material is on sale. A rectangular piece of the same material, whose length is 1 yd longer than a side of the square and whose width is $\frac{5}{9}$ yd shorter than a side of the square, is also on sale. If the square and the rectangle have the same area and you purchase both remnants, how much material will you get?

- A jet took one hour longer flying to Lincoln from Adams at 800 km/h than to return at 1200 km/h. Find the distance from Lincoln to Adams.
- Gene spent 10 min riding his bicycle to a friend's house. He left his bike there and, with his friend, walked for 15 min to the gym. Gene rides his bicycle 10 km/h faster than he walks. If the entire trip covered a distance of 2.75 km, how far is it from his friend's house to the gym?
- At noon, Sheila left a boat landing and paddled her canoe 20 km downstream and 20 km back. If she traveled 10 km/h downstream and 4 km/h upstream, what time did she arrive back at the landing?

Solve.

(4-9)

- A rectangle is 4 m longer than it is wide. If the length and width are both increased by 5 m, the area is increased by 115 m^2 . Find the original dimensions.
- A rectangle is 3 cm longer and 2 cm narrower than a square with the same area. Find the dimensions of each figure.
- A rectangular swimming pool is 4 m longer than it is wide. It is surrounded by a cement walk 1 m wide. The area of the walk is 32 m^2 . Find the dimensions of the pool.
- When the length of a square is increased by 6 and the width is decreased by 4, the area remains unchanged. Find the dimensions of the square.
- A print is 10 cm longer than it is wide. It is mounted in a frame 1.5 cm wide. The area of the frame is 399 cm^2 . Find the dimensions of the print.

Solve.

(4-10)

- Find two consecutive integers whose sum is 104.
- A plane averaged 1000 km/h on the first half of a round trip, but heavy winds slowed its speed on the return trip to 600 km/h. If the entire trip took 6 h, find the total distance.
- Jill earned 12 more points on her quiz than Jack. If they both get 8 bonus points, Jill will have three times as many points as Jack does. How many points does each have?
- The side of a square is 2 cm longer than the side of a second square. The area of the first square exceeds that of the second by 220 cm^2 . Find the side of each square.
- Find three consecutive integers whose sum is four times the greatest integer.

Chapter 5

(5-13)

Solve.

- The sum of a number and its square is 132. Find the number.
- The sum of the squares of two consecutive positive odd integers is 202. Find the numbers.

Chapter 5

List all pairs of factors of each integer.

(5-1)

1. 42 2. 80 3. 91 4. 72 5. 52

6-10. Find the prime factorization of each integer in Exercises 1-5.

Give the GCF of each group of numbers.

(5-1)

11. 126, 168 12. 144, 84 13. 65, 52 14. 90, 330

Simplify. Assume that no denominator equals 0.

(5-2)

15. $\frac{12x^5}{4x}$ 16. $\frac{25m^4n}{-15mn^6}$ 17. $\frac{-7ab}{21ab^5}$ 18. $\frac{-8(uv)^7}{-10(uv)^5}$
 19. $\frac{(w^4)^2}{(w^5)^4}$ 20. $\frac{(5k)^2}{5k^2}$ 21. $\frac{(-3y)^3}{(y^3)^2}$ 22. $\frac{(2c^5)(4c^3)}{(8c^2)^3}$

(5-3)

Divide.

23. $\frac{12e + 8}{4}$ 24. $\frac{6x - 9y + 12}{3}$ 25. $\frac{2x^3 + 6x^2 + x}{x}$
 26. $\frac{18ab - 24a^2}{-6a}$ 27. $\frac{15m - 25m^2 - 5m^3}{5m}$ 28. $\frac{28h^5k^3 - 35hk^2}{7hk^2}$

(5-3)

Factor each polynomial as the product of its greatest monomial factor and another polynomial.

29. $15w^2 - 10w + 5$ 30. $9x^2 + 18x$ 31. $7u^3 + 14u^2$
 32. $12a^3 - 6a^2 + 18a$ 33. $15c^2 + 3cd$ 34. $8m^2n - 24mn^2$

(5-4)

Write each product as a trinomial.

35. $(x + 5)(x + 3)$ 36. $(b - 2)(b - 4)$ 37. $(n - 3)(n + 7)$
 38. $(e - 8)(e + 6)$ 39. $(3 + m)(2 + m)$ 40. $(3f + 2)(f + 5)$
 41. $(4y - 3)(2y - 1)$ 42. $(8z + 7)(z - 2)$ 43. $(5n - 3)(4n - 2)$
 44. $a(6a - 4)(5a - 3)$ 45. $h(3h + 7)(4h + 9)$ 46. $2x(9x - 1)(2x + 3)$

(5-5)

Write each product as a binomial.

47. $(k - 5)(k + 5)$ 48. $(3 - y)(3 + y)$ 49. $(4d - 8)(4d + 8)$
 50. $(w^2 - 6)(w^2 + 6)$ 51. $(5m^2 + n)(5m^2 - n)$ 52. $(ab + c^2)(ab - c^2)$

(5-5)

Factor. You may use a calculator or the table of squares.

53. $16e^2 - 9$ 54. $36u^2 - 25$ 55. $81 - f^2$ 56. $144a^2 - 64b^2$
 57. $49 - 100y^2$ 58. $v^4 - w^4$ 59. $s^6 - 4$ 60. $16x^8 - 625$

...riding his bicycle to a friend's house. He left his bike
there and, with his friend, walked for 15 min to the gym. Gene rides his
bicycle 10 km/h faster than he walks. If the entire trip covered a distance
of 2.75 km, how far is it from his friend's house to the gym?

5. At noon, Sheila left a boat landing and paddled her canoe 20 km down-
stream and 20 km back. If she traveled 10 km/h downstream and 4 km/h
upstream, what time did she arrive back at the landing?

Solve.

1. A rectangle is 4 m longer than it is wide. If the length and width are both increased by 5 m, the area is increased by 115 m^2 . Find the original dimensions. (4-9)
2. A rectangle is 3 cm longer and 2 cm narrower than a square with the same area. Find the dimensions of each figure.
3. A rectangular swimming pool is 4 m longer than it is wide. It is surrounded by a cement walk 1 m wide. The area of the walk is 32 m^2 . Find the dimensions of the pool.
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Solve.

1. Find two consecutive integers whose sum is 104. (4-10)
2. A plane averaged 1000 km/h on the first half of a round trip, but heavy winds slowed its speed on the return trip to 600 km/h. If the entire trip took 6 h, find the total distance.
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5. Find three consecutive integers whose sum is four times the greatest integer.

Chapter 5

Solve.

1. The sum of a number and its square is 132. Find the number. (5-13)
2. The sum of the squares of two consecutive positive odd integers is 202. Find the numbers.

3. A rectangle is 8 cm longer than it is wide. The area is 240 cm^2 . Find the dimensions.
4. The sum of two numbers is 12 and the sum of their squares is 74. Find the numbers.
5. A rectangular flower garden is planted in a rectangular yard that is 16 m by 12 m. The garden occupies $\frac{1}{6}$ of the area of the yard and leaves a uniform strip of grass around the edges. Find the dimensions of the garden.
6. The edge of one cube is 4 cm longer than the edge of a second cube. The volumes of the cubes differ by 316 cm^3 . Find the length of the edge of each cube.

Chapter 7

Solve.

1. Two numbers are in the ratio 2:3 and their sum is 125. Find the numbers. (7-1)
2. The measures of the angles of a triangle are in the ratio 2:3:5. Recall that the sum of the measures of the angles of a triangle is 180° . Find the measure of each angle.
3. Three numbers are in the ratio 2:3:5 and their sum is 200. Find the numbers.
4. The ratio of teachers to assistants to children at a day care center is 2:1:9. Of the 96 people at the center, how many are children?
5. A collection of quarters, dimes, and nickels is worth \$22.80. If the ratio of quarters to dimes to nickels is 5:3:7, how many coins are there?
6. Two trains leave a station at the same time heading in opposite directions. After 2 h, the trains are 376 km apart. If the ratio of their speeds is 22:25, find the speed of each train.

Solve.

1. A 1.5-lb steak costs \$5.80. Find the cost of a 2-lb steak. (7-2)
2. A poll showed that 400 voters out of 625 favor Question 1 in the town election. If there are 7500 voters altogether, how many can be expected to vote in favor of the question?
3. Group-rate admissions to a museum cost \$140.70 for a group of 42. How much would it cost for a group of 50?
4. The tax on a restaurant meal that costs \$24 is \$1.44. Find the tax on a meal that costs \$35.
5. The Sommers' scale is inaccurate. If it registers 120 lb for Karen, who actually weighs 116 lb, how much will it register for Neil, who actually weighs 174 lb?

Express each square as a trinomial.

61. $(g + 7)^2$

65. $(2m + 3n)^2$

62. $(k - 3)^2$

66. $(7a - 5b)^2$

63. $(2x + 6)^2$

67. $(ef - 8)^2$

64. $(5y - 3)^2$

68. $(-4 + 9f)^2$

(5-6)

Factor.

69. $x^2 - 6x + 9$

72. $64x^2 + 80xy + 25y^2$

70. $e^2 + 18e + 81$

73. $4m^2 - 36mn + 81n^2$

71. $4 - 28h + 49h^2$

74. $16w^2 + 24wz + 9z^2$

(5-6)

Factor. Check by multiplying the factors. If the polynomial is not factorable, write *prime*.

(5-7, 5-8, 5-9)

75. $k^2 + 8k + 7$

78. $35 + 12u + u^2$

81. $x^2 + 13xy + 42y^2$

84. $c^2 + 3c - 18$

87. $h^2 - 7h - 18$

90. $a^2 - 2ab - 3b^2$

93. $2x^2 + 11x + 12$

96. $-10 - 26y - 12y^2$

99. $15x^2 + 13xy + 2y^2$

76. $v^2 - 9v + 20$

79. $n^2 - 16n + 48$

82. $m^2 - 10mn + 21n^2$

85. $x^2 - 2x - 35$

88. $b^2 + 7b - 30$

91. $u^2 + 3uv - 4v^2$

94. $10e^2 - 12e + 3$

97. $-7 - 39z - 18z^2$

100. $8a^2 - 22ab + 12b^2$

77. $a^2 - 2a + 1$

80. $w^2 + 18w + 80$

83. $e^2 - 15ef + 44f^2$

86. $k^2 + 8k - 32$

89. $y^2 - 4y - 45$

92. $m^2 - mn - 20n^2$

95. $10d^2 + d - 3$

98. $-10 + 24z - 8z^2$

101. $14m^2 - mn - 3n^2$

Factor. Check by multiplying.

(5-10)

102. $8(m - 3) - 5m(3 - m)$

104. $u(u - 2v) - (2v - u)$

106. $a^2 + 2a + ab + 2b$

108. $n^3 + n^2 - 6n - 6$

103. $6a(a + 2) + 4(a + 2)$

105. $b(b - 2)(b + 1) - 3 - 3b$

107. $7cw + 3c - 7w^2 - 3w$

109. $64 - 64m^2 + m^4 - m^6$

Factor completely. Check by multiplying.

(5-11)

110. $42x^3 + 68x^2 + 16x$

113. $16a^4 - 144a^2$

116. $36m^2 + 24mn + 4n^2$

111. $60y^3 - 18y^2 - 6y$

114. $4n^5 - 100n$

117. $24cd - 12c^2 - 12d^2$

112. $12x^5 - 20x^4 + 3x^3$

115. $28w^7 - 102w^5$

118. $-7x^3 + 14x^2y - 7xy^2$

Solve and check.

(5-12)

119. $(a + 13)(a + 8) = 0$

122. $(6h - 5)(6h + 5) = 0$

125. $a^2 + 7a + 6 = 0$

128. $y^2 - 7y - 18 = 0$

131. $6 - 23z - 4z^2 = 0$

134. $e^2 - 49 = 0$

120. $(f - 16)(f - 27) = 0$

123. $7w(4w + 3) = 0$

126. $q^2 - 21q = -20$

129. $c^2 - 36 = -5c$

132. $3m^2 + 1 = 4m$

135. $36g^2 = 16$

121. $(2x - 4)(3x - 5) = 0$

124. $m(2m + 7)(3m - 4) = 0$

127. $d^2 = 14d - 45$

130. $h^2 = -3h + 54$

133. $2n^2 = 10 + n$

136. $w^3 - 9w = 0$

3. A rectangle is 8 cm longer than it is wide. The area is 240 cm^2 . Find the dimensions.
4. The sum of two numbers is 12 and the sum of their squares is 74. Find the numbers.
5. A rectangular flower garden is planted in a rectangular yard that is 16 m by 12 m. The garden occupies $\frac{1}{4}$ of the area of the yard and leaves a uniform strip of grass around the edges. Find the dimensions of the garden.
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Solve.

(7-1)

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Solve.

(7-2)

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5. The Sommers' scale is inaccurate. If it registers 120 lb for Karen, who actually weighs 116 lb, how much will it register for Neil, who actually weighs 174 lb?

Write each expression as a fraction in simplest form.

$$90. 7\frac{1}{3}$$

$$91. 5 + \frac{1}{n}$$

$$94. 6 - \frac{5}{k+3}$$

$$95. \frac{n}{n-2} + 7$$

$$98. 3y + \frac{y}{2y+7}$$

$$99. 5 - \frac{e+3}{e^2-1}$$

$$102. n - \frac{7}{n+2} - \frac{3n-1}{n+2}$$

$$103. \frac{v}{u+v} + \frac{u}{v-u} + 1$$

$$100. a + \frac{5a+3}{a+3}$$

$$104. \frac{x}{x-4} + \frac{x}{x+4} - 3$$

$$89. \frac{u}{u-4} + \frac{3}{4-u}$$

(6-6)

$$93. \frac{x}{y} + 3$$

$$97. 8h - \frac{h}{h+3}$$

$$101. 2w - \frac{w+3}{w-3}$$

Divide. Write the answer as a polynomial or mixed expression.

$$105. \frac{x^2 + 7x + 10}{x+2}$$

$$106. \frac{y^2 - 2y - 35}{y-7}$$

$$107. \frac{a^2 - 5a - 3}{a+2}$$

$$108. \frac{n^2 - 16}{n+4}$$

$$109. \frac{7 + k^2 - 4k}{k-5}$$

$$110. \frac{8y^2 + 6}{2y-1}$$

$$111. \frac{b^3 - 1}{b+1}$$

$$112. \frac{x^3 + 5}{x+3}$$

$$113. \frac{w^3 + w^2 + 2w - 4}{w-1}$$

$$114. \frac{u^3 + 2u^2 - 16}{u-2}$$

$$115. \frac{2n^2 - 13n + 20}{2n-5}$$

$$116. \frac{2 - 9h + 7h^2}{7h-2}$$

$$117. \frac{v^3 + v^2 + v + 1}{v-2}$$

$$118. \frac{5n^2 + 6n^3 + 9}{3+2n}$$

(6-7)

Chapter 7

Write each ratio in simplest form.

$$1. 40 \text{ s} : 2 \text{ min}$$

$$2. 4 \text{ m} : 250 \text{ cm}$$

$$3. 3 \text{ kg} : 45 \text{ g}$$

$$4. 6y : 15y$$

$$5. 36d^2 : 10d$$

$$6. (4a)^2 : 6a$$

7. The ratio of old cars to new cars if there are 180 cars and 55 are new.

8. The ratio of wins to losses for a baseball team that played 84 games and won 48 of them.

Solve each proportion.

$$9. \frac{3}{5} = \frac{x}{15}$$

$$10. \frac{5}{7} = \frac{25}{a}$$

$$11. \frac{24}{7} = \frac{4}{c}$$

$$12. \frac{3x}{2} = \frac{2}{5}$$

$$13. \frac{15a}{64} = \frac{45}{32}$$

$$14. \frac{17d}{25} = \frac{51}{125}$$

$$15. \frac{x-4}{x} = \frac{7}{9}$$

$$16. \frac{3w}{10w+2} = \frac{2}{7}$$

$$17. \frac{8a-5}{5a-4} = \frac{13}{8}$$

(7-2)

Solve and check. If the equation has no solution, write *No Solution*.

(7-3, 7-4)

18. $\frac{a}{3} - \frac{a}{9} = 2$

19. $\frac{2x}{3} - \frac{x}{2} = 12$

20. $\frac{6}{7}x - \frac{1}{2}x = 5$

21. $\frac{2}{3}x - \frac{5}{9}x = -1$

22. $\frac{y+2}{2} = \frac{2y}{3}$

23. $\frac{x+1}{5} - \frac{3}{2} = \frac{3x-6}{10}$

24. $\frac{12}{z} = \frac{4+4z}{z}$

25. $\frac{1}{x} + \frac{1}{3} = \frac{1}{2}$

26. $\frac{4}{5y} + \frac{y-2}{y} = -\frac{1}{5}$

27. $\frac{c}{c+3} = \frac{2}{5}$

28. $\frac{3m+5}{6} - \frac{10}{m} = \frac{m}{2}$

29. $\frac{h}{2h+4} - \frac{1}{h+2} = 1$

Evaluate.

(7-5)

30. 80% of 700

31. 45% of 450

32. 3.25% of 48

33. 18 is 60% of what number?

34. 63 is 150% of what number?

35. What percent of 180 is 45?

36. What percent of 36 is 54?

Solve.

(7-5, 7-6, 7-7, 7-8)

37. $1.2x = 48$

38. $0.6z = 180$

39. $0.08y = 64$

40. $0.4a - 0.7 = 2.9$

41. $0.3b + 0.03b = 99$

42. $0.05c = 6.6 - 0.06c$

43. How many kilograms of zinc are contained in 30 kg of an alloy containing 28% zinc?

44. Ed Jefferson bought a new suit that cost \$140. If he also paid \$6.30 in sales tax, find the sales tax rate.

45. A camera that originally cost \$150 is on sale at 15% off the original price. Find the sale price.

46. How many kilograms of water must be added to 12 kg of a 30% salt solution to produce a 20% solution?

47. How many kilograms of water must be evaporated from 40 kg of a 10% salt solution to produce a 25% solution?

48. A coin-sorting machine can sort a certain number of coins in 15 min. A second machine can sort the same number of coins in 30 min. How long would it take both machines working together to do the job?

49. An air conditioner takes 20 min to cool a room. If a second air conditioner is used together with the first, it takes only 12 min to cool the room. How long would it take the second air conditioner alone to cool the room?

Evaluate.

(7-9)

50. 6^{-2}

51. 5^{-3}

52. 7^{-2}

53. 9^{-3}

54. $2^{-4} \cdot 2^{-3}$

55. $(6^{-2})^{-1}$

56. $\frac{3^{-4}}{3^{-3}}$

57. $\frac{8^{-2}}{8^{-4}}$

6. On a wall map, 1 cm represents 25 km. Colorado is represented by a rectangle 25.8 cm long and 18.4 cm wide. Find the approximate area of Colorado in square kilometers.

Solve.

1. Juan spent \$2 more on books than Sylvia did. If they each spent \$4 less, Sylvia would have spent exactly $\frac{5}{8}$ of what Juan spent. How much did each spend?
2. Three fifths of a number added to one fourth of the number is 51. Find the number.
3. Bart's age is one third of his mother's age. Seven years ago, his age was one fifth of hers. How old are both now?
4. A rectangle is 11 cm narrower than it is long. The length is two sevenths of the perimeter. Find the length and the width.
5. Two thirds of the coins in a collection of quarters and dimes are quarters. The collection is worth \$12. How many dimes are there?
6. A bus, traveling at 90 km/h, takes 15.2 h longer to get from Ardmore to Zepher than a plane flying at 850 km/h. How far is it from Ardmore to Zepher?

(7-3)

Solve.

1. The sum of a number and its reciprocal is $\frac{25}{12}$. Find the number.
2. The sum of a number and its reciprocal is $\frac{29}{10}$. Find the number.
3. The denominator of a fraction is 2 more than the numerator. If the numerator and denominator are increased by 2, the new fraction is $\frac{4}{15}$ greater than the original fraction. Find the original fraction.
4. The denominator of a fraction is 2 more than the numerator. The sum of the fraction and its reciprocal is $\frac{34}{15}$. Find the fraction.
5. If the speed limit is decreased by 10 km/h on a 100 km stretch of a highway, the trip will take a half hour longer than usual. What is the usual speed limit?
6. Sue can ride her bike 14 km/h faster than she can walk. It takes 17.5 min longer to walk 2.5 km than to ride. Find Sue's walking speed.

(7-4)

(7-5)

Solve.

1. If there is a 6% tax on clothing, find the tax on a suit that costs \$175.
2. A real estate agent makes a 7% commission on all sales. How much does the agent make on a sale of \$182,500?
3. A discount store sold a sweater for \$32. If the discount was 20%, find the original price.
4. If the Gannons' \$84 monthly gas bill goes up 8%, what will be their new monthly payment?

Solve each equation. If the equation is an identity or if it has no solution, write identity or no solution. (3-5)

53. $10w = 8w + 14$ {7}
 56. $9m + 3 = 6m + 21$ {6}
 59. $2(v - 8) = 6v$ {-4}
 62. $\frac{1}{3}(18 - 9c) = 6 - 3c$
 65. $5(3 + h) = 4(h + 2)$ {-7}
63. $\left\{\frac{11}{8}\right\}$ 64. $\left\{-\frac{5}{3}\right\}$
 54. $x = 45 - 4x$ {9}
 57. $27 + u = 3 - 3u$ {-6}
 60. $3x = 5(x - 6)$ {15}
 63. $m - 5 = \frac{1}{2}(12 - 14m)$
 66. $(6x - 3)2 = (4x + 7)3$
 no solution
55. $48 - 6k = -12k$ {-8}
 58. $4n + 1 = -1 + 4n$ no sol.
 61. $7y - 3 = 6(y + 2)$ {15}
 64. $\frac{4}{5}(25x - 15) = 50x + 38$
 67. $7(n - 3) = 5(n - 3)$ {3}

Solve. Use a chart to help you solve the problem. (3-6, 3-7)

68. Jay's salary is $\frac{2}{3}$ of his wife's salary. In January, when they both get \$2000 raises, their combined income will be \$49,000. What are their current salaries? **Jay, \$18,000; wife, \$27,000**
69. Erin's three test scores were consecutive odd integers. If her next test score is 18 points more than the highest score of the three tests, her total number of points will be 328. Find Erin's test scores. **75, 77, 79, 97**
70. Julius weighs twice as much as each of his twin brothers. If each of the twins gains 5 lb and Julius gains twice that amount, the sum of the three brothers' weights will be 240 lb. How much does each weigh now?
Julius, 110 lb; twins, 55 lb each
71. The width of a rectangle is 6 cm less than the length. A second rectangle, with a perimeter of 54 cm, is 3 cm wider and 2 cm shorter than the first. What are the dimensions of each rectangle?
**16 cm by 10 cm;
 14 cm by 13 cm**
72. Martha has some nickels and dimes worth \$6.25. She has three times as many nickels as dimes. How many nickels does she have? **75 nickels**
73. Elliot paid \$1.50 a dozen for some flowers. He sold all but 5 dozen of them for \$2 a dozen, making a profit of \$18. How many dozen flowers did he buy? **56 dozen**
74. Rachel spent \$16.18 for some cans of dog food costing 79 cents each and some cans of cat food costing 69 cents each. She bought two more cans of cat food than of dog food. How many cans of each did she buy?
10 cans dog food; 12 cans cat food
75. Victor earns \$3 an hour working after school and \$4 an hour working on Saturdays. Last week he earned \$43, working a total of 13 h. How many hours did he work on Saturday? **4 h**

State a reason for each step in Exercises 76-78. (3-8)

76. $6 + (15 + 4) = 6 + (4 + 15)$? Comm. prop. of add.
 $= (6 + 4) + 15$? Assoc. prop. of add.
 $= 10 + 15 = 25$? Substitution principle
77. $20 + (-4) = (16 + 4) + (-4)$? Substitution principle
 $= 16 + [4 + (-4)]$? Assoc. prop. of add.
 $= 16 + 0$? Prop. of opposites
 $= 16$? Ident. prop. of add.

$$\begin{aligned}
 78. \quad -7 + 19 &= 19 + (-7) \\
 &= 12 + 7 + (-7) \\
 &= 12 + 0 \\
 &= 12
 \end{aligned}$$

$\frac{?}{?}$ Comm. prop. of add.
 $\frac{?}{?}$ Substitution principle
 $\frac{?}{?}$ Prop. of opposites
 $\frac{?}{?}$ Identity prop. of add.

Chapter 4

Simplify.

1. 7^3 343
 2. $(-5)^4$ 625
 3. $-3 \cdot 2^4 - 48$
 4. $(-2 \cdot 5)^3 - 1000$
 5. $7 + 5^2$ 32
 6. $(8 - 4)^3$ 64
 7. $6 - 2^5 - 26$
 8. $(4 + 7)^2$ 121
 9. $5^3 \div (3^2 + 4^2)$ 5
 10. $(8^2 - 6^2) \div 7$ 4
 11. $4(9^2 - 4^3)$ 68

Evaluate if $a = -3$ and $b = 2$.

12. $3a + b^2 - 5$
 13. $(3a + b)^2 - 49$
 14. $4a - b^3 - 20$
 15. $(4a - b)^3 - 2744$
 16. $7 + ab^2 - 5$
 17. $(7 + ab)^2 - 1$
 18. $-\frac{3a}{b^2} \frac{9}{4}$
 19. $\left(-\frac{3a}{b}\right)^2 \frac{81}{4}$

Add.

20. $4x - 3$
 $\frac{7x + 8}{11x + 5}$
 21. $3b + 4$
 $\frac{-2b - 6}{b - 2}$
 22. $5m + 8$
 $\frac{4m + 3}{9m + 11}$
 23. $-2t - 7$
 $\frac{6t - 3}{4t - 10}$
 24. $5k - 6l + 4$
 $\frac{-5k + 8l + 2}{2l + 6}$
 25. $6x^2 - 2xy + 3y^2$
 $\frac{4x^2 - xy - y^2}{10x^2 - 3xy + 2y^2}$
 26. $2m^2 - 3mn - 5n$
 $\frac{-8m^2}{-n - 6m^2 - 3mn - 6n}$
 27. $5a^2 - 6ab$
 $\frac{-2a^2 + 9ab - b^2}{3a^2 + 3ab - b^2}$

28–35. In Exercises 20–27, subtract the lower polynomial from the upper one.

- Simplify. 41. $60j^5k^3l^5$ 44. $-\frac{28u^4v^4}{3}$
 36. $e^6 \cdot e^3 \cdot e^{10}$ 37. $(4f^3)(2f^4) 8f^7$ 38. $\frac{12c^3d^3}{(-3c^2d)(-4cd^2)}$
 39. $(-2gh^2)(5g^3h) - 10g^4h^3$ 40. $(3mn)(6m^2n)(2n^2) 36m^3n^4$ 41. $(-5j^4k^2)(4jl^3)(-3kl^2)$
 42. $\left(\frac{8}{3}x^5y\right)\left(\frac{9}{2}xy^6\right) 12x^6y^7$ 43. $(-6a^3)\left(\frac{1}{6}a^3\right) -a^6$ 44. $(3u^2v)(-7v^3)\left(\frac{4}{9}u^2\right)$
 45. $3^w \cdot 3^{5-w} \cdot 3$ 729 46. $4^2 \cdot 4^{a+1} \cdot 4^a 4^{2a+3}$ 47. $2^5 \cdot 2^{b+3} \cdot 2^{3-b} 2048$
 48. $(3p^5)(5p^2) + (7p^3)(2p^4) 29p^7$ 49. $(8d^3)(2d^7) - (3d^6)(4d^4) 4d^{10}$
 50. $(w^5)^2 w^{10}$ 51. $(x^2)^5 x^{10}$ 52. $y^2 \cdot y^5 y^7$ 53. $z^n \cdot z^n z^{2n}$
 54. $(a^n)^3 a^{3n}$ 55. $(b^3)^n b^{3n}$ 56. $c^3 \cdot c^n c^{n+3}$ 57. $d^n \cdot d^n \cdot d^n d^{3n}$
 58. $(5f)^2 25f^2$ 59. $(gh)^4 g^4h^4$ 60. $(6m^3)^2 36m^6$ 61. $(4mn^5)^3 64m^3n^{15}$
 62. $(2u^3v)^5 32u^{15}v^5$ 63. $(3a^5b^4)^2 9a^{10}b^8$ 64. $(-7x^4)^2 49x^8$ 65. $-(8x^5)^3 -512x^{15}$
 66. $(3k)^2(3k)^4$ 67. $(-2x^3)^3 \cdot (5x^2)^2$ 68. $-(4t^2)^2(3t)^3$ 69. $(5x^2y)^3 \cdot 3xy^2$
 $729k^6$ $-200x^{13}$ $-432t^7$ $375x^7y^5$

Additional Answers

28. $-3x - 11$
 29. $5b + 10$
 30. $m + 5$
 31. $-8t - 4$
 32. $10k - 14l + 2$
 33. $2x^2 - xy + 4y^2$
 34. $10m^2 - 3mn - 4n$
 35. $7a^2 - 15ab + b^2$
 41. $60j^5k^3l^5$
 44. $-\frac{28u^4v^4}{3}$

Additional Answers

- 82. $m^2 + 6m + 8$
- 83. $n^2 + 2n - 15$
- 84. $a^2 - 13a + 42$
- 85. $5x^2 + 33x - 14$
- 86. $12y^2 - 10y + 2$
- 87. $30m^2 + 38m + 12$
- 95. $a = \frac{2A}{p}; p \neq 0$
- 96. $h = \frac{3V}{B}; B \neq 0$
- 97. $b_1 = \frac{2A - b_2h}{h}; h \neq 0$
- 98. $b = y - mx$
- 99. $r = \sqrt{\frac{A}{\pi}}, A \geq 0$
- 100. $n = \frac{S + 360}{180}$
- 101. $C = \frac{5}{9}(F - 32)$
- 102. $A = P + Prt$
- 103. $t = \frac{I}{Pr}; Pr \neq 0$

Multiply.

- 70. $7(x + 3)$
- 71. $5(y - 4)$
- 72. $-3(n - 2)$
- 74. $3n(n + 5)$
- 75. $-4t(3 - 2t)$
- 76. $6k(2k - 7)$
- 77. $-5h(8h + 3)$
- 78. $9a(a^2 - 3a - 4)$
- 79. $-5b^2(3b^2 - 2b + 6)$
- 80. $\frac{1}{3}c(6c^2 - 3cd + 9d^2)$
- 81. $\frac{1}{2}uv^2(10u^2 - 4uv + 8v^2)$
- 82. $(m + 4)(m + 2)$
- 83. $(n - 3)(n + 5)$
- 84. $(a - 6)(a - 7)$
- 85. $(5x - 2)(x + 7)$
- 86. $(4y - 2)(3y - 1)$
- 87. $(6m + 4)(5m + 3)$
- 88. $(u + 3)(u^2 + 2u + 5)$
- 89. $(v - 1)(3v^2 + 4v + 7)$
- 90. $(3c - 5)(2c^2 - c + 6)$
- 91. $\frac{7x - 4y}{3x - 2y}$
- 92. $\frac{5a - 8b}{4a + b}$
- 93. $\frac{e^2 + ef + f^2}{e + f}$
- 94. $3m^2 - 4mn + 5m + n$

$21x^2 - 26xy + 8y^2$ $20a^2 - 27ab - 8b^2$ $e^3 + 2e^2f + 2ef^2 + f^3$ $15m^3 - 17m^2n + mn^2$

Solve the given formula for the variable shown in color. State the restrictions, if any, for the formula obtained to be meaningful.

- 95. $A = \frac{1}{2}ap; a$
- 96. $V = \frac{1}{3}Bh; h$
- 97. $A = \frac{1}{2}h(b_1 + b_2);$
- 98. $y = mx + b; b$
- 99. $A = \pi r^2; r$
- 100. $S = (n - 2)180; n$
- 101. $F = \frac{9}{5}C + 32; C$
- 102. $P = \frac{A}{1 + rt}; A$
- 103. $r = \frac{I}{Pt}; t$

Solve. Use a chart to help you solve the problem.

- 104. Two buses leave a depot at the same time, one traveling north and the other south. The speed of the northbound bus is 15 mi/h greater than the speed of the southbound bus. After 3 h on the road, the buses are 255 mi apart. What are their speeds? **35 mi/h, 50 mi/h**
- 105. Exactly 10 min after Alex left his grandparents' house, his cousin Alison set out from there to overtake him. Alex drives at 36 mi/h. Alison drives at 40 mi/h. How long did it take Alison to overtake Alex? **90 min**
- 106. A plane flew from the Sky City airport to the Plainsville airport at 800 km/h and then returned to Sky City at 900 km/h. The return trip took 30 min less than the flight to Plainsville. How far apart are the airports and how long did the trip to Plainsville take? **3600 km; 4.5 h**
- 107. A poster is three times as long as it is wide. It is framed by a mat such that there is a 4 in. border around the poster. Find the dimensions of the poster if the area of the mat is 488 in². **13.25 in. by 39.75 in.**
- 108. A square piece of remnant material is on sale. A rectangular piece of the same material, whose length is 1 yd longer than a side of the square and whose width is $\frac{5}{9}$ yd shorter than a side of the square, is also on sale. If the square and the rectangle have the same area and you purchase both remnants, how much material will you get? **$3\frac{1}{8}$ yd²**

Chapter 5

List all pairs of factors of each integer.

1. 42 2. 80 3. 91 4. 72 5. 52

(5-1)

6-10. Find the prime factorization of each integer in Exercises 1-5.

6. $2 \cdot 3 \cdot 7$ 7. $2^4 \cdot 5$ 8. $7 \cdot 13$ 9. $2^3 \cdot 3^2$ 10. $2^2 \cdot 13$

Give the GCF of each group of numbers.

(5-1)

11. 126, 168 42 12. 144, 84 12 13. 65, 52 13 14. 90, 330 30

Simplify. Assume that no denominator equals 0.

(5-2)

15. $\frac{12x^5}{4x} \cdot 3x^4$ 16. $\frac{25m^4n}{-15mn^6} - \frac{5m^3}{3n^5}$ 17. $\frac{-7ab}{21ab^5} - \frac{1}{3b^4}$ 18. $\frac{-8(uv)^7}{-10(uv)^5} \cdot \frac{4u^2v^2}{5}$
 19. $\frac{(w^4)^2}{(w^5)^4} \cdot \frac{1}{w^{12}}$ 20. $\frac{(5k)^2}{5k^2} \cdot 5$ 21. $\frac{(-3y)^3}{(y^3)^2} - \frac{27}{y^3}$ 22. $\frac{(2c^5)(4c^3)}{(8c^2)^3} \cdot \frac{c^2}{64}$

Divide.

(5-3)

23. $\frac{12e + 8}{4} \cdot 3e + 2$ 24. $\frac{6x - 9y + 12}{3} \cdot 2x - 3y + 4$ 25. $\frac{2x^2 + 6x + 1}{2x^3 + 6x^2 + x} \cdot x$
 26. $\frac{18ab - 24a^2}{-6a} \cdot -3b + 4a$ 27. $\frac{15m - 25m^2 - 5m^3}{5m} \cdot 3 - 5m - m^2$ 28. $\frac{28h^5k^3 - 35hk^2}{7hk^2} \cdot 4h^4k - 5$

Factor each polynomial as the product of its greatest monomial factor and another polynomial.

(5-3)

29. $5(3w^2 - 2w + 1)$ 30. $9x(x + 2)$ 31. $7u^2(u + 2)$
 $15w^2 - 10w + 5$ $9x^2 + 18x$ $7u^3 + 14u^2$
 32. $6a(2a^2 - a + 3)$ 33. $3c(5c + d)$ 34. $8mn(m - 3n)$
 $12a^3 - 6a^2 + 18a$ $15c^2 + 3cd$

Write each product as a trinomial.

(5-4)

35. $(x + 5)(x + 3) \cdot x^2 + 8x + 15$ 36. $(b - 2)(b - 4) \cdot b^2 - 6b + 8$ 37. $(n - 3)(n + 7)$
 38. $(e - 8)(e + 6) \cdot e^2 - 2e - 48$ 39. $(3 + m)(2 + m) \cdot 6 + 5m + m^2$ 40. $(3f + 2)(f + 5)$
 41. $(4y - 3)(2y - 1) \cdot 8y^2 - 10y + 3$ 42. $(8z + 7)(z - 2) \cdot 8z^2 - 9z - 14$ 43. $(5n - 3)(4n - 2)$
 44. $a(6a - 4)(5a - 3) \cdot 30a^3 - 38a^2 + 12a$ 45. $h(3h + 7)(4h + 9) \cdot 12h^3 + 55h^2 + 63h$ 46. $2x(9x - 1)(2x + 3) \cdot 36x^3 + 50x^2 - 6x$

Write each product as a binomial.

(5-5)

47. $(k - 5)(k + 5) \cdot k^2 - 25$ 48. $(3 - y)(3 + y) \cdot 9 - y^2$ 49. $(4d - 8)(4d + 8) \cdot 16d^2 - 64$
 50. $(w^2 - 6)(w^2 + 6) \cdot w^4 - 36$ 51. $(5m^2 + n)(5m^2 - n) \cdot 25m^4 - n^2$ 52. $(ab + c^2)(ab - c^2) \cdot a^2b^2 - c^4$

Factor. You may use a calculator or the table of squares.

(5-5)

53. $16e^2 - 9$ 54. $36u^2 - 25$ 55. $81 - f^2$ 56. $144a^2 - 64b^2$
 57. $49 - 100y^2$ 58. $v^4 - w^4$ 59. $s^6 - 4$ 60. $16x^8 - 625$
 $(7 - 10y)(7 + 10y)$ $(v - w)(v + w)(v^2 + w^2)$ $(s^3 - 2)(s^3 + 2)$

60. $(2x^2 - 5)(2x^2 + 5)(4x^4 + 25)$

Extra Practice 647

Additional Answers

1. 1, 42; 2, 21; 3, 14; 6, 7; -1, -42; -2, -21; -3, -14; -6, -7
 2. 1, 80; 2, 40; 4, 20; 5, 16; 8, 10; -1, -80; -2, -40; -4, -20; -5, -16; -8, -10
 3. 1, 91; 7, 13; -1, -91; -7, -13
 4. 1, 72; 2, 36; 3, 24; 4, 18; 6, 12; 8, 9; -1, -72; -2, -36; -3, -24; -4, -18; -6, -12; -8, -9
 5. 1, 52; 2, 26; 4, 13; -1, -52; -2, -26; -4, -13

Additional Answers

75. $(k + 7)(k + 1)$
 76. $(v - 5)(v - 4)$
 77. $(a - 1)^2$
 78. $(7 + u)(5 + u)$
 79. $(n - 12)(n - 4)$
 80. $(w + 8)(w + 10)$
 81. $(x + 6y)(x + 7y)$
 82. $(m - 7n)(m - 3n)$
 83. $(e - 4f)(e - 11f)$
 84. $(c + 6)(c - 3)$
 85. $(x - 7)(x + 5)$
 86. prime
 87. $(h - 9)(h + 2)$
 88. $(b + 10)(b - 3)$
 89. $(y - 9)(y + 5)$
 90. $(a - 3b)(a + b)$
 91. $(u + 4v)(u - v)$
 92. $(m - 5n)(m + 4n)$
 93. $(2x + 3)(x + 4)$
 94. prime
 95. $(5d + 3)(2d - 1)$
 96. $-2(5 + 3y)(1 + 2y)$
 97. prime
 98. $-2(2z - 1)(2z - 5)$
 99. $(5x + y)(3x + 2y)$
 100. $2(a - 2b)(4a - 3b)$
 101. $(7m + 3n)(2m - n)$
 110. $2x(3x + 4)(7x + 2)$
 111. $6y(5y + 1)(2y - 1)$
 112. $x^3(6x - 1)(2x - 3)$
 113. $16a^2(a - 3)(a + 3)$
 114. $4n(n^2 - 5)(n^2 + 5)$
 115. $2w^5(14w^2 - 51)$
 116. $4(3m + n)^2$
 117. $-12(c - d)^2$
 118. $-7x(x - y)^2$

Express each square as a trinomial.

61. $g^2 + 14g + 49$
 62. $k^2 - 6k + 9$
 63. $4x^2 + 24x + 36$
 64. $25y^2 - 30y + 9$
 65. $(2m + 3n)^2$
 66. $(7a - 5b)^2$
 67. $(ef - 8)^2$
 68. $(-4 + 9f)^2$
 69. $4m^2 + 12mn + 9n^2$
 70. $49a^2 - 70ab + 25b^2$
 71. $e^2f^2 - 16ef + 64$
 72. $81f^2 - 72f + 16$

Factor.

69. $x^2 - 6x + 9$
 70. $e^2 + 18e + 81$
 71. $4 - 28h + 49h^2$
 72. $64x^2 + 80xy + 25y^2$
 73. $4m^2 - 36mn + 81n^2$
 74. $16w^2 + 24wz + 9z^2$
 75. $x^2 - 6x + 9$
 76. $e^2 + 18e + 81$
 77. $4 - 28h + 49h^2$
 78. $64x^2 + 80xy + 25y^2$
 79. $4m^2 - 36mn + 81n^2$
 80. $16w^2 + 24wz + 9z^2$

Factor. Check by multiplying the factors. If the polynomial is not factorable, write *prime*.

75. $k^2 + 8k + 7$
 76. $v^2 - 9v + 20$
 77. $a^2 - 2a + 1$
 78. $35 + 12u + u^2$
 79. $n^2 - 16n + 48$
 80. $w^2 + 18w + 80$
 81. $x^2 + 13xy + 42y^2$
 82. $m^2 - 10mn + 21n^2$
 83. $e^2 - 15ef + 44f^2$
 84. $c^2 + 3c - 18$
 85. $x^2 - 2x - 35$
 86. $k^2 + 8k - 32$
 87. $h^2 - 7h - 18$
 88. $b^2 + 7b - 30$
 89. $y^2 - 4y - 45$
 90. $a^2 - 2ab - 3b^2$
 91. $u^2 + 3uv - 4v^2$
 92. $m^2 - mn - 20n^2$
 93. $2x^2 + 11x + 12$
 94. $10e^2 - 12e + 3$
 95. $10d^2 + d - 3$
 96. $-10 - 26y - 12y^2$
 97. $-7 - 39z - 18z^2$
 98. $-10 + 24z - 8z^2$
 99. $15x^2 + 13xy + 2y^2$
 100. $8a^2 - 22ab + 12b^2$
 101. $14m^2 - mn - 3n^2$

Factor. Check by multiplying.

102. $8(m - 3) - 5m(3 - m)$
 103. $2(a + 2)(3a + 2)$
 104. $u(u - 2v) - (2v - u)$
 105. $(b - 3)(b + 1)^2$
 106. $a^2 + 2a + ab + 2b$
 107. $6a(a + 2) + 4(a + 2)$
 108. $n^3 + n^2 - 6n - 6$
 109. $b(b - 2)(b + 1) - 3 - 3b$
 110. $a^2 + 2a + ab + 2b$
 111. $7cw + 3c - 7w^2 - 3w$
 112. $n^3 + n^2 - 6n - 6$
 113. $64 - 64m^2 + m^4 - m^6$
 114. $(a + 2)(a + b)$
 115. $(7w + 3)(c - w)$
 116. $n^3 + n^2 - 6n - 6$
 117. $(1 + m)(1 - m)(64 + m^4)$
 118. $(n + 1)(n^2 - 6)$
 119. $(1 + m)(1 - m)(64 + m^4)$

Factor completely. Check by multiplying.

110. $42x^3 + 68x^2 + 16x$
 111. $60y^3 - 18y^2 - 6y$
 112. $12x^5 - 20x^4 + 3x^3$
 113. $16a^4 - 144a^2$
 114. $4n^5 - 100n$
 115. $28w^7 - 102w^5$
 116. $36m^2 + 24mn + 4n^2$
 117. $24cd - 12c^2 - 12d^2$
 118. $-7x^3 + 14x^2y - 7xy^2$

119. $\{-13, -8\}$
 120. $\{16, 27\}$
 121. $\{2, \frac{5}{3}\}$
 122. $\{\frac{5}{6}, -\frac{5}{6}\}$
 123. $\{0, -\frac{3}{4}\}$
 124. $\{0, -\frac{7}{2}, \frac{4}{3}\}$
 119. $(a + 13)(a + 8) = 0$
 120. $(f - 16)(f - 27) = 0$
 121. $(2x - 4)(3x - 5) = 0$
 122. $(6h - 5)(6h + 5) = 0$
 123. $7w(4w + 3) = 0$
 124. $m(2m + 7)(3m - 4) = 0$
 125. $a^2 + 7a + 6 = 0$
 126. $q^2 - 21q = -20$
 127. $d^2 = 14d - 45$
 128. $y^2 - 7y - 18 = 0$
 129. $c^2 - 36 = -5c$
 130. $h^2 = -3h + 54$
 131. $6 - 23z - 4z^2 = 0$
 132. $3m^2 + 1 = 4m$
 133. $2n^2 = 10 + n$
 134. $e^2 - 49 = 0$
 135. $36g^2 = 16$
 136. $w^3 - 9w = 0$

84. $\frac{5a-4}{6} + \frac{a-2}{17a^9-16}$ 85. $\frac{2h+4}{8} - \frac{h}{4} + \frac{3h-2}{10}$ 86. $\frac{4(m-n)}{16} - \frac{3(m+n)}{12} - \frac{n}{2}$
 87. $\frac{3}{x+2} - \frac{18}{2x+7}$ 88. $\frac{3z}{z^2-16} + \frac{z}{z-4} - \frac{10}{z(z+7)}$ 89. $\frac{u}{u-4} + \frac{3}{4-u} - \frac{u-3}{u-4}$

Write each expression as a fraction in simplest form. (6-6)

90. $7\frac{1}{3} - \frac{22}{3}$ 91. $5 + \frac{1}{n} - \frac{5n+1}{n}$ 92. $4m - \frac{3}{m} - \frac{4m^2-3}{m}$ 93. $\frac{x}{y} + 3 - \frac{x+3y}{y}$
 94. $6 - \frac{5}{k+3} - \frac{6k+13}{k+3}$ 95. $\frac{n}{n-2} + 7 - \frac{8n-14}{n-2}$ 96. $\frac{x+3}{x} - 2 - \frac{3-x}{x}$ 97. $8h - \frac{h}{h+3}$
 98. $3y + \frac{y}{2y+7}$ 99. $5 - \frac{e+3}{e^2-1}$ 100. $a + \frac{5a+3}{a+3}$ 101. $2w - \frac{w+3}{w-3}$
 102. $n - \frac{7}{n+2} - \frac{3n-1}{n+2}$ 103. $\frac{v}{u+v} + \frac{u}{v-u} + 1$ 104. $\frac{x}{x-4} + \frac{x}{x+4} - 3$

Divide. Write the answer as a polynomial or mixed expression. (6-7)

105. $\frac{x^2+7x+10}{x+2}$ 106. $\frac{y^2-2y-35}{y-7}$ 107. $\frac{a^2-5a-3}{a+2}$ 108. $\frac{n^2-16}{n+4}$
 109. $\frac{7+k^2-4k}{k-5}$ 110. $\frac{8y^2+6}{2y-1}$ 111. $\frac{b^3-1}{b+1}$ 112. $\frac{x^3+5}{x+3}$
 113. $\frac{w^3+w^2+2w-4}{w-1}$ 114. $\frac{u^3+2u^2-16}{u-2} - \frac{u^2+4u+8}{u^2+4u+8}$ 115. $\frac{2n^2-13n+20}{2n-5} - n - 4$
 116. $\frac{2-9h+7h^2}{7h-2} - h - 1$ 117. $\frac{v^3+v^2+v+1}{v-2} - \frac{v^2+3v+7}{v-2} + \frac{15}{v-2}$ 118. $\frac{5n^2+6n^3+9}{3+2n} - \frac{3n^2-2n+3}{3+2n}$

Chapter 7

Write each ratio in simplest form.

1. 40 s : 2 min 1:3
 2. 4 m : 250 cm 8:5
 3. 3 kg : 45 g 200:3
 4. 6y : 15y 2:5
 5. $36d^2 : 10d$ 18d:5
 6. $(4a)^2 : 6a$ 8a:3
 7. The ratio of old cars to new cars if there are 180 cars and 55 are new. 25:11
 8. The ratio of wins to losses for a baseball team that played 84 games and won 48 of them. 4:3

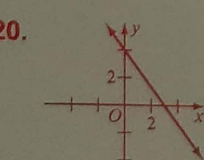
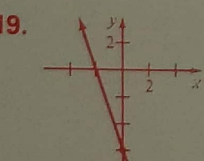
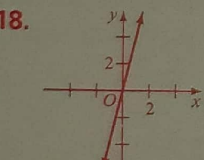
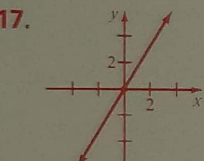
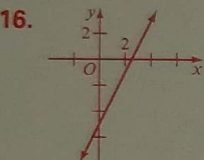
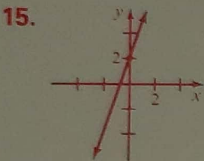
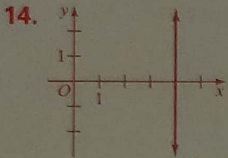
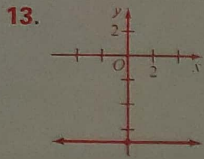
Solve each proportion. (7-2)

9. $\frac{3}{5} = \frac{x}{15}$ {9}
 10. $\frac{5}{7} = \frac{25}{a}$ {35}
 11. $\frac{24}{7} = \frac{4}{c} - \frac{7}{6}$
 12. $\frac{3x}{2} = \frac{2}{5} - \frac{4}{15}$
 13. $\frac{15a}{64} = \frac{45}{32}$ {6}
 14. $\frac{17d}{25} = \frac{51}{125} - \frac{3}{5}$
 15. $\frac{x-4}{x} = \frac{7}{9}$ {18}
 16. $\frac{3w}{10w+2} = \frac{2}{7}$ {4}
 17. $\frac{8a-5}{5a-4} = \frac{13}{8}$ {12}

Additional Answers

97. $\frac{h(8h+23)}{h+3}$
 98. $\frac{2y(3y+11)}{2y+7}$
 99. $\frac{5e^2-e-8}{(e+1)(e-1)}$
 100. $\frac{a^2+8a+3}{a+3}$
 101. $\frac{2w^2-7w-3}{w-3}$
 102. $n-3$
 103. $\frac{2v^2}{(v+u)(v-u)}$
 104. $\frac{-x^2+48}{(x+4)(x-4)}$
 105. $x+5$
 106. $y+5$
 107. $a-7 + \frac{11}{a+2}$
 108. $n-4$
 109. $k+1 + \frac{12}{k-5}$
 110. $4y+2 + \frac{8}{2y-1}$
 111. $b^2-b+1 - \frac{2}{b+1}$
 112. $x^2-3x+9 - \frac{22}{x+3}$

Additional Answers, page 653



(continued)

Solve and check. If the equation has no solution, write *No Solution*.

18. $\frac{a}{3} - \frac{a}{9} = 2$ {9} 19. $\frac{2x}{3} - \frac{x}{2} = 12$ {72} 20. $\frac{6}{7}x - \frac{1}{2}x = 5$ {14} ^(7-3, 7-4)
 21. $\frac{2}{3}x - \frac{5}{9}x = -1$ {-9} 22. $\frac{y+2}{2} = \frac{2y}{3}$ {6} 23. $\frac{x+1}{5} - \frac{3}{2} = \frac{3x-6}{10}$ {-7}
 24. $\frac{12}{z} = \frac{4+4z}{z}$ {2} 25. $\frac{1}{x} + \frac{1}{3} = \frac{1}{2}$ {6} 26. $\frac{4}{5y} + \frac{y-2}{y} = -\frac{1}{5}$ {1}
 27. $\frac{c}{c+3} = \frac{2}{5}$ {2} 28. $\frac{3m+5}{6} - \frac{10}{m} = \frac{m}{2}$ {12} 29. $\frac{h}{2h+4} - \frac{1}{h+2} = 1$ {-6}

Evaluate.

30. 80% of 700 **560** 31. 45% of 450 **202.5** 32. 3.25% of 48 **1.56** ⁽⁷⁻⁵⁾
 33. 18 is 60% of what number? **30** 34. 63 is 150% of what number? **42**
 35. What percent of 180 is 45? **25%** 36. What percent of 36 is 54? **150%**

Solve.

37. $1.2x = 48$ {40} 38. $0.6z = 180$ {300} 39. $0.08y = 64$ {800} ^(7-5, 7-6, 7-7, 7-8)
 40. $0.4a - 0.7 = 2.9$ {9} 41. $0.3b + 0.03b = 99$ {300} 42. $0.05c = 6.6 - 0.06c$ {60}
 43. How many kilograms of zinc are contained in 30 kg of an alloy containing 28% zinc? **8.4 kg**
 44. Ed Jefferson bought a new suit that cost \$140. If he also paid \$6.30 in sales tax, find the sales tax rate. **4.5%**
 45. A camera that originally cost \$150 is on sale at 15% off the original price. Find the sale price. **\$127.50**
 46. How many kilograms of water must be added to 12 kg of a 30% salt solution to produce a 20% solution? **6 kg**
 47. How many kilograms of water must be evaporated from 40 kg of a 10% salt solution to produce a 25% solution? **24 kg**
 48. A coin-sorting machine can sort a certain number of coins in 15 min. A second machine can sort the same number of coins in 30 min. How long would it take both machines working together to do the job? **10 min**
 49. An air conditioner takes 20 min to cool a room. If a second air conditioner is used together with the first, it takes only 12 min to cool the room. How long would it take the second air conditioner alone to cool the room? **30 min**

Evaluate.

50. $6^{-2} \frac{1}{36}$ 51. $5^{-3} \frac{1}{125}$ 52. $7^{-2} \frac{1}{49}$ 53. $9^{-3} \frac{1}{729}$ ⁽⁷⁻⁹⁾
 54. $2^{-4} \cdot 2^{-3} \frac{1}{128}$ 55. $(6^{-2})^{-1} 36$ 56. $\frac{3^{-4}}{3^{-3}} \frac{1}{3}$ 57. $\frac{8^{-2}}{8^{-4}} 64$

652 Extra Practice

- Aaron, Betsy, and Charita work part-time at the public library. Betsy works 4 h more each week than Aaron, and together they work half as many hours as Charita. How long does each person work if their total time is 45 h? **Aaron, 5.5 h; Betsy, 9.5 h; Charita, 30 h**
- Zach's last quiz score was 30 points less than twice his first score. What was his first quiz score if the sum of his two scores is 150? **60**
- The length of a rectangle is 18 cm more than the width. A second rectangle is 6 cm shorter and 3 cm wider than the first and has a perimeter of 126 cm. Find the dimensions of each rectangle. **24 cm by 42 cm; 27 cm by 36 cm**
- Becky has as many dimes as Ryan and Amy have together. Ryan has 2 more dimes than Amy, and Amy has one third as many dimes as Becky has. How many dimes does each have? **Becky, 6; Ryan, 4; Amy, 2 dimes**
- A cup of skim milk has 10 more than half the calories of a cup of whole milk. A cup of whole milk has 40 more calories than a glass of apple juice. If the total number of calories in one cup of each is 370, find the number of calories in each. **whole milk, 160 calories; skim milk, 90 calories; apple juice, 120 calories**

Solve.

- A collection of quarters and dimes is worth \$6.75. The number of dimes is 4 less than three times the number of quarters. How many of each are there? **13 quarters, 35 dimes** (3-7)
- A total of 720 people attended the school basketball game. Adult tickets cost \$2.50 each and student tickets cost \$1.50 each. If \$1220 worth of tickets were sold, how many students and how many adults attended? **580 students, 140 adults**
- A worker earns \$9 per hour for a regular workday and \$13.50 per hour for additional hours. If the worker was paid \$114.75 for an 11-hour workday, what is the length of a regular workday? **7.5 h**
- Carrots cost 75¢ per kilogram and potatoes cost 70¢ per kilogram. A shopper bought 9 kg of the vegetables for \$6.60. How many kilograms of each did the shopper buy? **6 kg of carrots, 3 kg of potatoes**
- A collection of 102 nickels, dimes, and quarters is worth \$13.60. There are 14 more nickels than dimes. How many quarters are there? **36 quarters**

Chapter 4

Solve.

- Two trains leave a station at the same time, heading in opposite directions. One train is traveling at 80 km/h, the other at 90 km/h. How long will it take for the trains to be 425 km apart? **2.5 h** (4-8)
- Grace leaves home at 8:00 A.M. Ten minutes later, Will notices Grace's lunch and begins bicycling after her. If Grace walks at 5 km/h and Will cycles at 15 km/h, how long will it take him to catch up with her? **5 min**

- A jet took one hour longer flying to Lincoln from Adams at 800 km/h than to return at 1200 km/h. Find the distance from Lincoln to Adams. **2400 km**
- Gene spent 10 min riding his bicycle to a friend's house. He left his bike there and, with his friend, walked for 15 min to the gym. Gene rides his bicycle 10 km/h faster than he walks. If the entire trip covered a distance of 2.75 km, how far is it from his friend's house to the gym? **0.65 km**
- At noon, Sheila left a boat landing and paddled her canoe 20 km downstream and 20 km back. If she traveled 10 km/h downstream and 4 km/h upstream, what time did she arrive back at the landing? **7:00 P.M.**

Solve.

(4-9)

- A rectangle is 4 m longer than it is wide. If the length and width are both increased by 5 m, the area is increased by 115 m². Find the original dimensions. **7 m by 11 m**
- A rectangle is 3 cm longer and 2 cm narrower than a square with the same area. Find the dimensions of each figure. **4 cm by 9 cm; 6 cm by 6 cm**
- A rectangular swimming pool is 4 m longer than it is wide. It is surrounded by a cement walk 1 m wide. The area of the walk is 32 m². Find the dimensions of the pool. **5 m by 9 m**
- When the length of a square is increased by 6 and the width is decreased by 4, the area remains unchanged. Find the dimensions of the square. **12 by 12**
- A print is 10 cm longer than it is wide. It is mounted in a frame 1.5 cm wide. The area of the frame is 399 cm². Find the dimensions of the print. **60 cm by 70 cm**

Solve.

(4-10)

- Find two consecutive integers whose sum is 104. **No solution**
- A plane averaged 1000 km/h on the first half of a round trip, but heavy winds slowed its speed on the return trip to 600 km/h. If the entire trip took 6 h, find the total distance. **4500 km**
- Jill earned 12 more points on her quiz than Jack. If they both get 8 bonus points, Jill will have three times as many points as Jack does. How many points does each have? **No solution**
- The side of a square is 2 cm longer than the side of a second square. The area of the first square exceeds that of the second by 220 cm². Find the side of each square. **56 cm and 54 cm**
- Find three consecutive integers whose sum is four times the greatest integer.
-5, -4, -3

Chapter 5

(5-13)

Solve.

- The sum of a number and its square is 132. Find the number. **11 or -12**
- The sum of the squares of two consecutive positive odd integers is 202. Find the numbers. **9, 11**

- A rectangle is 8 cm longer than it is wide. The area is 240 cm^2 . Find the dimensions. **12 cm by 20 cm**
- The sum of two numbers is 12 and the sum of their squares is 74. Find the numbers. **5 and 7**
- A rectangular flower garden is planted in a rectangular yard that is 16 m by 12 m. The garden occupies $\frac{1}{8}$ of the area of the yard and leaves a uniform strip of grass around the edges. Find the dimensions of the garden. **4 m by 8 m**
- The edge of one cube is 4 cm longer than the edge of a second cube. The volumes of the cubes differ by 316 cm^3 . Find the length of the edge of each cube. **3 cm; 7 cm**

Chapter 7

Solve.

- Two numbers are in the ratio 2:3 and their sum is 125. Find the numbers. **50, 75**
- The measures of the angles of a triangle are in the ratio 2:3:5. Recall that the sum of the measures of the angles of a triangle is 180° . Find the measure of each angle. **36° , 54° , 90°**
- Three numbers are in the ratio 2:3:5 and their sum is 200. Find the numbers. **40, 60, 100**
- The ratio of teachers to assistants to children at a day care center is 2:1:9. Of the 96 people at the center, how many are children? **72 children**
- A collection of quarters, dimes, and nickels is worth \$22.80. If the ratio of quarters to dimes to nickels is 5:3:7, how many coins are there? **180 coins**
- Two trains leave a station at the same time heading in opposite directions. After 2 h, the trains are 376 km apart. If the ratio of their speeds is 22:25, find the speed of each train. **88 km/h, 100 km/h**

Solve.

- A 1.5-lb steak costs \$5.80. Find the cost of a 2-lb steak. **\$7.73**
- A poll showed that 400 voters out of 625 favor Question 1 in the town election. If there are 7500 voters altogether, how many can be expected to vote in favor of the question? **4800**
- Group-rate admissions to a museum cost \$140.70 for a group of 42. How much would it cost for a group of 50? **\$167.50**
- The tax on a restaurant meal that costs \$24 is \$1.44. Find the tax on a meal that costs \$35. **\$2.10**
- The Sommers' scale is inaccurate. If it registers 120 lb for Karen, who actually weighs 116 lb, how much will it register for Neil, who actually weighs 174 lb? **180 lb**

6. On a wall map, 1 cm represents 25 km. Colorado is represented by a rectangle 25.8 cm long and 18.4 cm wide. Find the approximate area of Colorado in square kilometers. **296,700 km²**

(7-3)

Solve.

1. Juan spent \$2 more on books than Sylvia did. If they each spent \$4 less, Sylvia would have spent exactly $\frac{5}{6}$ of what Juan spent. How much did each spend? **Juan, \$16; Sylvia, \$14**
2. Three fifths of a number added to one fourth of the number is 51. Find the number. **60**
3. Bart's age is one third of his mother's age. Seven years ago, his age was one fifth of hers. How old are both now? **Bart, 14 years old; mother, 42 years old**
4. A rectangle is 11 cm narrower than it is long. The length is two sevenths of the perimeter. Find the length and the width. **length, 44 cm; width, 33 cm**
5. Two thirds of the coins in a collection of quarters and dimes are quarters. The collection is worth \$12. How many dimes are there? **20 dimes**
6. A bus, traveling at 90 km/h, takes 15.2 h longer to get from Ardmore to Zepher than a plane flying at 850 km/h. How far is it from Ardmore to Zepher? **1530 km**

(7-4)

Solve.

1. The sum of a number and its reciprocal is $\frac{25}{12}$. Find the number. **$\frac{3}{4}$ or $\frac{4}{3}$**
2. The sum of a number and its reciprocal is $\frac{29}{10}$. Find the number. **$\frac{5}{2}$ or $\frac{2}{5}$**
3. The denominator of a fraction is 2 more than the numerator. If the numerator and denominator are increased by 2, the new fraction is $\frac{4}{15}$ greater than the original fraction. Find the original fraction. **$\frac{1}{3}$**
4. The denominator of a fraction is 2 more than the numerator. The sum of the fraction and its reciprocal is $\frac{34}{15}$. Find the fraction. **$\frac{3}{5}$**
5. If the speed limit is decreased by 10 km/h on a 100 km stretch of a highway, the trip will take a half hour longer than usual. What is the usual speed limit? **50 km/h**
6. Sue can ride her bike 14 km/h faster than she can walk. It takes 17.5 min longer to walk 2.5 km than to ride. Find Sue's walking speed. **6 km/h**

(7-5)

Solve.

1. If there is a 6% tax on clothing, find the tax on a suit that costs \$175. **\$10.50**
2. A real estate agent makes a 7% commission on all sales. How much does the agent make on a sale of \$182,500? **\$12,775**
3. A discount store sold a sweater for \$32. If the discount was 20%, find the original price. **\$40**
4. If the Gannons' \$84 monthly gas bill goes up 8%, what will be their new monthly payment? **\$90.72**

DISCOVER

ACTIVITY

Where Are Volcanoes Found on Earth's Surface?

1. Look at the map of Earth's active volcanoes on page 351. What symbols are used to represent volcanoes? What other symbols are shown on the map?
2. Do the locations of the volcanoes form a pattern? Do the volcanoes seem related to any other features on Earth's surface?

Think About It

Developing Hypotheses Develop a hypothesis to explain where Earth's volcanoes are located. Are there any volcanoes on the map whose location cannot be explained by your hypothesis?

GUIDE FOR READING

- ◆ How does plate movement change Earth's surface?
- ◆ How do mountains form?
- ◆ What is land subsidence?

Reading Tip Before you read, write the headings in this section. As you read, write down the main point of each heading.

Key Terms

- stress
- deformation
- earthquake
- fault
- strike-slip fault
- normal fault
- hanging wall
- footwall
- reverse fault
- fault-block mountain
- land subsidence
- volcano
- hot spot

In 1983, a fault near Borah Peak in Idaho slipped, causing a powerful earthquake. The earthquake pushed the land along one side of the fault up by nearly 3 meters. The result was a long, clifflike ridge marking where the fault movement occurred. In only a few seconds, the Borah Peak earthquake produced a dramatic change in Earth's surface. More often, changes in the surface take place gradually. But over time, even gradual change can produce new features.

Forces in the Lithosphere

The Borah Peak earthquake is an example of how the forces of plate movement affect the lithosphere. **Plate movement can alter Earth systems and produce changes in Earth's surface. These changes include deformation of the crust, faults, mountain building, land subsidence, and volcanoes.** Scientists try to predict

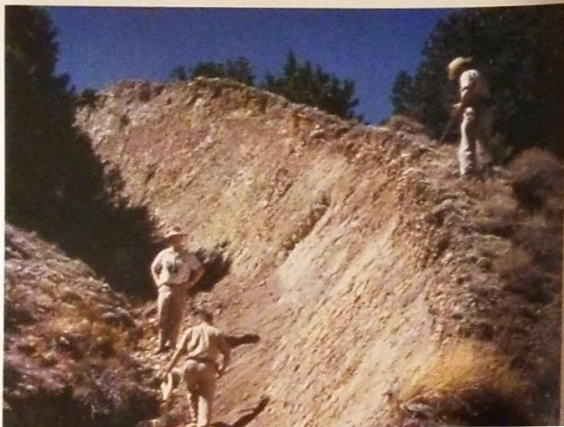


Figure 29 An earthquake pushed up the land along this fault, forming a long ridge.

the Earth features, or landforms, that will develop in an area by studying the plates around the area and how they move.

Plate movements produce powerful forces that push, pull, bend, and twist the lithosphere. They produce stress in rock. **Stress** is a force that adds potential energy to rock until the rock changes shape or breaks and moves. Stress leads to **deformation**, a change in the rock's shape or volume.

Deformation takes place so slowly that you cannot observe it directly. But over a very long time, deformation changes Earth's surface. Stress produces three types of deformation: shearing, tension, and compression. Shearing pushes a mass of rock in two opposite directions. Tension pulls on rock, making it thinner in the middle. Compression squeezes rock, making it thicker in the middle.

Deformation caused by plate movement can put so much stress on the lithosphere that it breaks. Where the lithosphere breaks, a fault forms. During plate movement, stress builds up along the fault, storing potential energy in the rock. Eventually, the rock along the fault suddenly breaks and slides, causing an **earthquake**. Each time an earthquake occurs, potential energy changes to kinetic energy as the rock along the fault moves. In this way, every earthquake changes Earth's surface.

Figure 30 Deformation pushes, pulls, or twists the rocks in Earth's crust. **Relating Cause and Effect** Which type of deformation tends to shorten part of the crust?

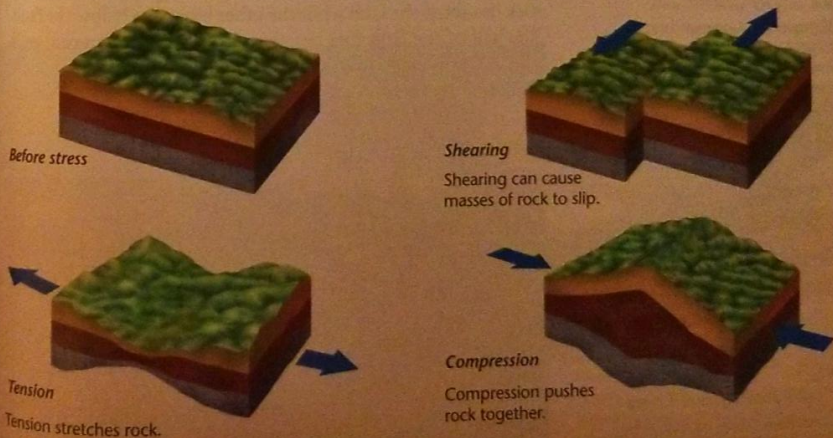
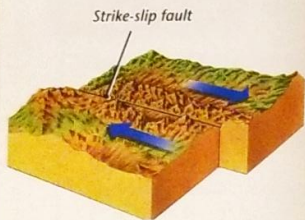


Figure 31 The San Andreas fault is a strike-slip fault that slices through California.



Faults and Fault Movements

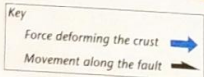
If you try to break a caramel candy bar in two, it may only bend and stretch at first. Like a candy bar, many types of rock can bend or fold. But beyond a certain limit, even these rocks will break. Rocks that easily bend take more stress to break than brittle ones.

When enough stress builds up in rock, the rock breaks, creating a fault. A **fault** is a break in the crust where slabs of crust slip past each other. The rocks on both sides of a fault can move up or down or sideways. **Faults usually occur along plate boundaries, where the forces of plate motion compress, pull, or shear the crust so much that the crust breaks.** There are three main types of faults: strike-slip faults, normal faults, and reverse faults.

Strike-Slip Faults Shearing creates strike-slip faults. In a **strike-slip fault**, the rocks on either side of the fault slip past each other sideways with little up or down motion. Figure 31 shows the type of movement that occurs along a strike-slip fault. As you learned in the previous section, this type of motion results in a transform boundary between plates. The San Andreas fault in California is an example of a transform boundary.

Normal Faults Tension forces in Earth's crust cause normal faults. In a **normal fault**, the fault is at an angle, so one block of rock lies above the fault while the other block lies below the fault. The half of the fault that lies above is called the **hanging wall**. The half of the fault that lies below is called the **footwall**. Look at Figure 32 to see how the hanging wall lies above the footwall.

Figure 32 A normal fault is exposed in this road cut. The rock layers no longer line up because the hanging wall has dropped down relative to the footwall.



When movement occurs along a normal fault, the hanging wall slips downward. Tension forces create normal faults where plates diverge, or pull apart. For example, normal faults occur along the Rio Grande rift valley in New Mexico, where two pieces of Earth's crust are diverging.

Reverse Faults Compression forces produce reverse faults. A **reverse fault** has the same structure as a normal fault, but the blocks move in the opposite direction. Look at Figure 33 to see how the rocks along a reverse fault move. As in a normal fault, one side of a reverse fault lies at an angle above the other side. The rock forming the hanging wall of a reverse fault slides up and over the footwall. Reverse faults produced mountains in the Canadian Rockies.

Mountain Building

Over millions of years, plate movement can cause folding and faulting. **Folding and faulting driven by plate movement result in mountain building.** A mountain is a landform that rises high above the surrounding land. A mountain range is a group of mountains that are closely related in shape, structure, and age.

Folding When continental plates collide, the collision squeezes the two plates together. Slowly, layers of rock in the plate fold, like a rug when its ends are pushed toward each other. For example, when Pangaea began to form, the North American plate collided with the Eurasian plate. As these huge plates collided, thick layers of rock near the edges of the plates were compressed and folded. This folding formed the Appalachian Mountains.

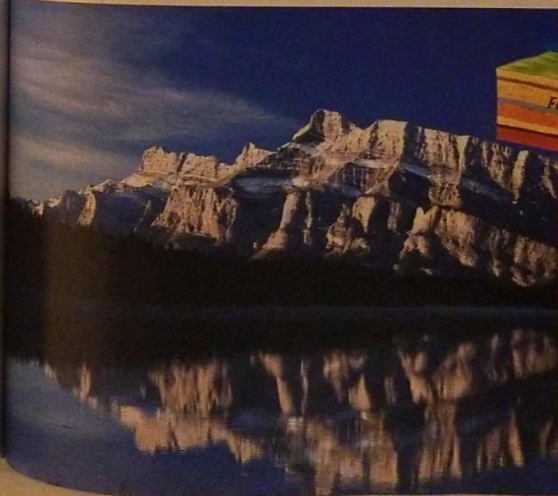
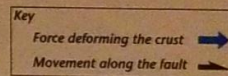
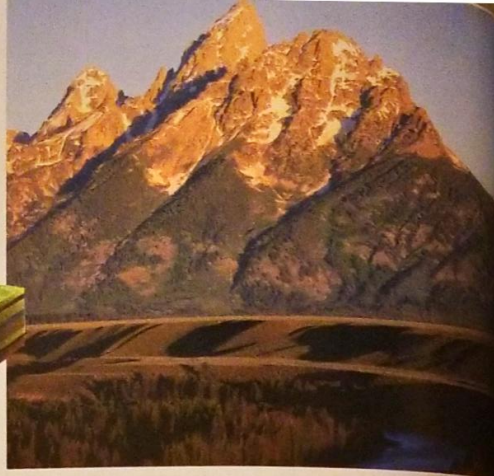
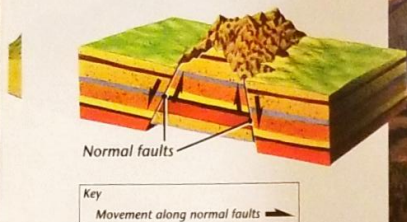


Figure 33 A reverse fault formed this mountain in Alberta, Canada, as compression forces pushed one mass of rock up and over another.

Figure 34 Two normal faults can form fault-block mountains, such as the Teton range in Wyoming.



Faulting Sometimes, plate movements cause tension in the crust. If the tension is great enough the crust breaks, forming a normal fault. Faulting can cause mountains to form. For example, geologists think that plate movements have placed tension on Earth's crust in Nevada and Utah and parts of nearby states. The tension caused many normal faults to form in this region. Blocks of crust then slid along these normal faults, forming mountains called **fault-block mountains**. One example of a fault-block mountain range is shown in Figure 34.

Land Subsidence

When plate movement and deformation of the crust push up a wide area of crust, uplift occurs. These forces also can lead to land subsidence. **Land subsidence occurs when the land surface sinks, or subsides, as a result of geologic processes or human activities.** In Chapter 13, you will learn how certain human activities can cause a different kind of land subsidence.

Plate movements along diverging plate boundaries are one cause of land subsidence. This type of subsidence leads to the formation of rift valleys and ocean basins.

Sometimes, as uplift raises one part of the crust, land subsidence occurs in an adjoining area. In the area of subsidence, the force of plate movement warps the crust downward. The crust may sink until it is below sea level. About 65–70 million years ago, this process resulted in shallow seas covering the central part of North America. The seas extended all the way from Texas to northern Canada!

Volcanic Mountains

Some of Earth's most spectacular mountains are volcanoes. A **volcano** is a weak spot in the crust where molten, rock-forming material called magma comes to the surface. Magma that reaches the surface is called lava. Lava cools to form solid rock. **Volcanic activity builds mountains made of lava rock and other volcanic materials.** Plate movements determine where volcanoes develop on Earth's surface.

Location of Volcanoes

There are about 600 active volcanoes on land. Many more lie beneath the sea. Volcanoes occur in belts that extend across continents and oceans. One major volcanic belt is the Ring of Fire, formed by the many volcanoes that rim the Pacific Ocean.

Volcanic belts form along the boundaries of Earth's plates. Here, the lithosphere is weak and fractured, allowing magma to reach the surface. Most volcanoes occur along diverging plate boundaries, such as the mid-ocean ridge, or in subduction zones around the edges of oceans. But there are exceptions to this pattern. Some volcanoes form far from the boundaries of continental or oceanic plates.

Language Arts CONNECTION

The word *volcano* comes from the name of the Roman god of fire, Vulcan. According to Roman mythology, Vulcan lived beneath Mount Etna, a huge volcano on the island of Sicily in the Mediterranean Sea. Vulcan used the heat of Mount Etna to make metal armor and weapons for the ancient gods and heroes.

In Your Journal

Use the dictionary to find the definition of *plutonic* rock. Explain why the name of another Roman god was used for this term.

Earth's Active Volcanoes

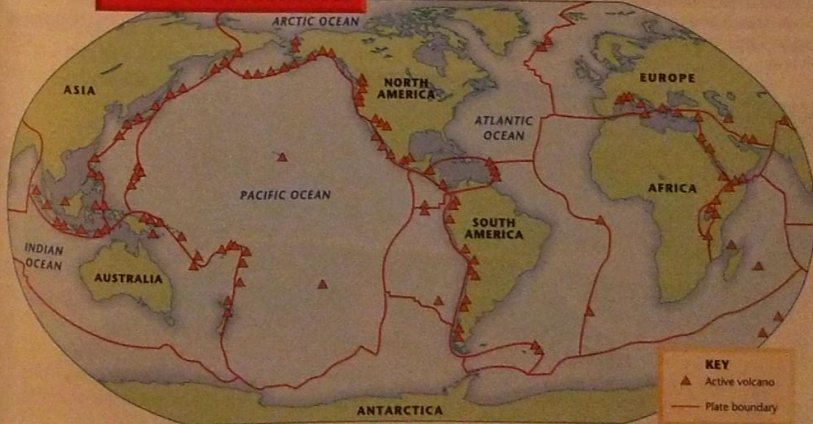


Figure 35 The Ring of Fire is a belt of volcanoes that circles the Pacific Ocean. **Observing** What other patterns can you see in the locations of Earth's volcanoes?

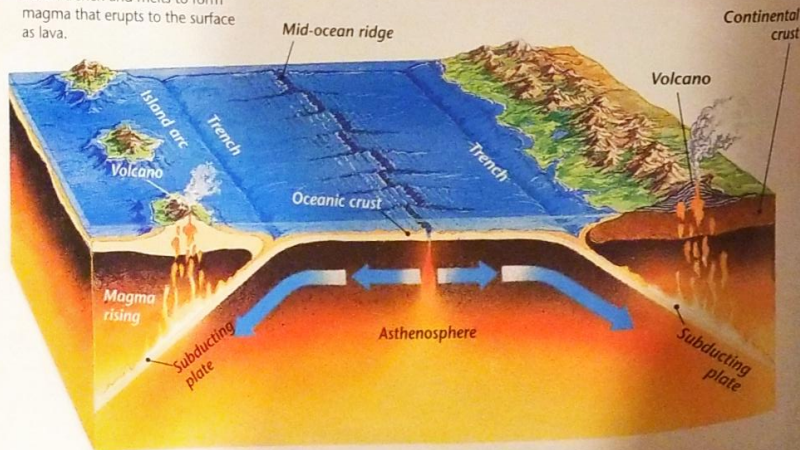
Volcanoes at Diverging Plate Boundaries Volcanoes form along the mid-ocean ridge, which marks a diverging plate boundary. Along the ridge, lava pours out of cracks in the ocean floor. Volcanoes also form along rift valleys, such as the Great Rift Valley in Africa.

Volcanoes at Converging Boundaries Many volcanoes form near the plate boundaries where some oceanic crust returns to the mantle. There, the crust melts and forms magma, which then rises back toward the surface. When the magma from the melted crust erupts as lava, volcanoes are formed.

Many volcanoes occur on islands, near boundaries where two oceanic plates collide. Recall that at such places, the older, denser plate dives under the other plate, creating a deep-ocean trench. The lower plate sinks beneath the deep-ocean trench into the asthenosphere. There it begins to melt, forming magma. Because the magma is less dense than the surrounding rock, it seeps upward through cracks in the crust. Eventually, the magma breaks through the ocean floor, creating volcanoes. The resulting volcanoes create a string of islands called an island arc. Major island arcs include Japan, New Zealand, Indonesia, the Caribbean islands, the Philippines, and the Aleutians.

Subduction also occurs where the edge of a continental plate collides with an oceanic plate. Collisions between oceanic and continental plates produced both the volcanoes of the Andes mountains on the west coast of South America and the volcanoes of the Pacific Northwest in the United States.

Figure 36 Volcanoes form when two oceanic plates collide or when an oceanic plate collides with a continental plate. In both cases, oceanic crust sinks beneath a deep-ocean trench and melts to form magma that erupts to the surface as lava.



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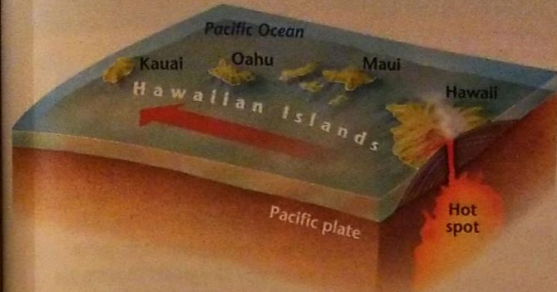


Figure 37 Hawaii sits on the moving Pacific plate. Beneath it is a powerful hot spot. Eventually, the plate's movement will carry the island of Hawaii away from the hot spot. **Inferring** Which island on the map formed first?

Hot Spot Volcanoes Some volcanoes result from “hot spots” in Earth’s mantle. A **hot spot** is an area where magma from deep within the mantle melts through the crust like a blowtorch through steel. Hot spots often lie in the middle of continental or oceanic plates far from any plate boundaries.

A hot spot volcano in the ocean floor can gradually form a series of volcanic mountains. For example, the Hawaiian Islands formed one by one over millions of years as the Pacific plate drifted over a hot spot.

Hot spots can also form under the continents. Yellowstone National Park in Wyoming marks a major hot spot under the North American plate. The last volcanic eruption in Yellowstone occurred about 75,000 years ago.

TRY THIS

Hot Spot in a Box

1. Fill a plastic box half-full of cold water. This represents the ocean.
2. Mix red food coloring with hot water in a small, narrow-necked bottle to represent magma.
3. Hold your finger over the mouth of the bottle as you place the bottle in the center of the box with the bottle's mouth under water.
4. Float a flat piece of plastic foam on the water to model a tectonic plate. Make sure the “plate” is floating above the bottle.
5. Take your finger off the bottle and observe what happens to the “magma.”

Making Models Move the plastic foam slowly along. Where does the magma touch the “plate”? How does this model a hot spot volcano?



Section 6 Review

1. Explain how the three types of deformation affect Earth’s crust.
2. Describe two ways that mountains form.
3. What is land subsidence and why does it occur?
4. Where do most volcanoes occur?
5. **Thinking Critically Predicting** If oceanic crust is subducted beneath continental crust, what Earth features will form on the continental crust?

Check Your Progress

Complete the construction of your model by adding the surface features. Be sure to label the features on your model. Include arrows that indicate the direction of plate movement. Predict how Earth’s surface features might change along the plate boundaries in your model. Construct a map showing what your plate might look like 20 million years in the future.

CHAPTER PROJECT