MATH 191

1 The Real Number System

Natural number, factor, divisor, prime number, composite number, prime factorization, greatest common factor, least common multiple. Integers, positive, negative, opposite, absolute value. Rules for addition, subtraction, multiplication, division of integers. Order of operations. Rational numbers, proper fraction, improper fraction, mixed number, reducing fractions to lower terms and higher terms. Operations with fractions, radicals. Irrational numbers. Rules for operations with radicals. Real numbers, exponents. Scientific notation of a real number.

After completing this chapter, you should be able to:

- distinguish between a prime number and a composite number,
- find the factors of a number,
- find a prime factorization of a number,
- find the greatest common factor of two or more numbers,
- find the multiples of a number,
- find the least common multiple of two or more numbers,
- use the rules for operations and order of operations to simplify expressions,
- simplify expressions using the properties of exponents,
- convert decimal numbers into numbers in scientific notation and vice versa,
- perform operations with numbers written in scientific notation.

2 Set of problems for Chapter 1

1. Find a prime factorization of the following numbers:

   (a) 360
   (b) 475
   (c) 625
   (d) 448
   (e) 825

2. Find the GCF of each.

   (a) 12, 24, 48
(b) 125, 175
(c) 100, 225, 350
(d) 42, 56, 63.

3. Find LCM of each.
   (a) 195, 390
   (b) 5, 6, 13
   (c) 12, 18, 36
   (d) 42, 48, 56.

4. An amusement park has two shuttle buses. Shuttle bus A makes six stops and shuttle bus B makes eight stops. The buses take 5 minutes to go from one stop to the next. Each bus takes a different route. If they start at 10.00 A.M. from station one, at what time will they both return to station one? Station one is at the beginning and at the end of the loop and is not counted twice.

5. There are 30 women and 36 men in a bowling league. The president want to divide the members into all male and all female teams, each of the same size, regardless of gender. Find the number of members and the number of teams for each gender.

6. Perform the indicated operations.
   (a) \(3^3 + 5^2 - 2^4\),
   (b) \(14^2 - 5^3 + 8^2\),
   (c) \(-3[6 + (-10) - (-2)]\),
   (d) \(-5 \cdot 4 - [-3 + 8 - (-5)]\),
   (e) \(376 - 14 \cdot 3^4\),
   (f) \(82 - 9 \cdot 6 - (-2)^2\),
   (g) \(256 - 4^3 \cdot 5 + (8 \cdot 4 - 6 \cdot 4)\),
   (h) \(6^2 + 5 \cdot 9 - (-27 + 3 \cdot 2)\),
   (i) \(-56 \div 8 - \{3 \times [-10 - (4 \times 3)]\}\),
   (j) \((96 - 70) + [(-4 \times 9) - 32 \div 8]\),
   (k) \(32 - \{-16 + 5[25 + 9^2 + (8 - 6)]\}\),
   (l) \(2\{-5 - 6[3^2 - 7 \cdot (4 + 1)]\}\).

7. Find each.
   (a) \(|-8|\),
   (b) \(|-12|\),
(c) $|+10|$, 
(d) $|+14|$, 
(e) the opposite of $-8$, 
(f) the opposite of $+10$, 
(g) the opposite of $0$.

8. A student’s bank balance at the beginning of the month was $867. During the month, the student made deposits of $83, $562, $37, and $43. Also, the student made withdrawals of $74, $86, and $252. What was the student’s bank balance at the end of the month?

9. Reduce each fraction to lowest term.
   (a) $\frac{30}{36}$,
   (b) $\frac{25}{35}$,
   (c) $\frac{91}{104}$,
   (d) $\frac{68}{119}$,
   (e) $\frac{420}{756}$,
   (f) $\frac{950}{2400}$.

10. Change each fraction to higher term.
    (a) $\frac{5}{16} = \frac{2}{32}$,
    (b) $\frac{15}{32} = \frac{7}{64}$,
    (c) $\frac{7}{9} = \frac{7}{45}$,
    (d) $\frac{11}{15} = \frac{7}{50}$.

11. Perform the operations and reduce the answer to lowest terms.
    (a) $\left( -\frac{3}{4} \right) \div \left( -\frac{2}{3} \right)$,
    (b) $\left( -\frac{7}{8} \right) \div \left( \frac{4}{3} \right)$,
    (c) $\left( \frac{9}{14} \div \frac{3}{2} \right) \times \frac{1}{2}$,
    (d) $\left( \frac{4}{5} + \frac{7}{8} \right) \div \frac{3}{4}$,
    (e) $\left( \frac{9}{10} - \frac{3}{4} \right) \times \frac{5}{6}$,
    (f) $\frac{3}{4} \div \left( \frac{5}{8} + \frac{1}{2} \right)$.

12. A company uses $\frac{2}{5}$ of its budget for advertising. Of that, $\frac{1}{2}$ is spent on television advertisement. What part of its budget is spent on television advertisement?

13. According to the Census Bureau, 4 out of 25 men do not have health insurance. In a group of 25 men, about how many men would not have health insurance?
14. An estate was divided among five people. The first person received $\frac{1}{5}$ of the estate. The next two people each received $\frac{1}{5}$ of the estate. The fourth person received $\frac{1}{10}$ of the estate. What fractional part of the estate did the last person receive?

15. A recipe calls for $2\frac{1}{2}$ cups of flour and $\frac{2}{7}$ cup of sugar. If a person wanted to cut the recipe in half, how many cups of flour and sugar are needed?

16. Fractions can be represented as the sum of two or more fractions whose numerators are one. For example, $\frac{11}{28}$ can be written as $\frac{1}{4} + \frac{1}{7}$. Write each fraction as a sum of two fractions whose numerators are one:

   (a) $\frac{13}{40}$
   (b) $\frac{4}{9}$
   (c) $\frac{13}{42}$

17. State whether each number is rational or irrational.

   (a) $\sqrt{49}$
   (b) $\sqrt{37}$
   (c) $\frac{5}{6}$
   (d) $\pi$
   (e) 0

18. Simplify each.

   (a) $\sqrt{24}$
   (b) $\sqrt{448}$
   (c) $\frac{2}{\sqrt{72}}$
   (d) $3\sqrt{800}$
   (e) $\sqrt{250}$
   (f) $\sqrt{162}$
   (g) $\frac{1}{\sqrt{5}}$
   (h) $\frac{3}{\sqrt{8}}$
   (i) $\frac{3}{\sqrt{6}}$
   (j) $\frac{10}{\sqrt{20}}$
   (k) $\sqrt{\frac{3}{28}}$
   (l) $\sqrt{\frac{1}{5}}$
   (m) $\sqrt{\frac{1}{3}}$
19. Perform the indicated operations and simplify the answer.

(a) $2\sqrt{3} + 5\sqrt{3} - 9\sqrt{3}$,
(b) $8\sqrt{5} - 6\sqrt{5} - 9\sqrt{5}$,
(c) $\sqrt{320} - \sqrt{80}$,
(d) $\sqrt{125} + \sqrt{20}$,
(e) $\sqrt{5} - 3\sqrt{80}$,
(f) $13\sqrt{90} + 5\sqrt{40}$,
(g) $6\sqrt{72} - 9\sqrt{8}$,
(h) $5\sqrt{10} + 2\sqrt{40}$,
(i) $\sqrt{2} \cdot \sqrt{10}$,
(j) $2\sqrt{6} \cdot 3\sqrt{8}$,
(k) $6\sqrt{15} \cdot 2\sqrt{5}$,
(l) $\frac{\sqrt{60}}{\sqrt{2}}$,
(m) $\frac{\sqrt{72}}{\sqrt{8}}$,
(n) $\frac{\sqrt{42}}{\sqrt{6}}$,
(o) $\frac{\sqrt{15}}{\sqrt{3}}$,
(p) $\sqrt{5}(\sqrt{75} + \sqrt{12})$,
(q) $\sqrt{3}(\sqrt{48} - \sqrt{27})$.

20. The voltage of an electric circuit can be found by the formula

$$V = \sqrt{P \cdot r},$$

where $V$ = volts, $P$ = power in watts, and $r$ = resistance in ohms. Find the voltage when $P = 360$ watts and $r = 10$ ohms.

21. Can the product of any two irrational numbers be a rational number? Explain your answer.

22. Simplify each and write the answer in exponential notation using positive exponents. Then evaluate each.

(a) $3^4 \cdot 3^5$,
(b) $5^3 \cdot 5^3$,
(c) $4^4 \cdot 4^3$,
(d) $2^6 \cdot 2^4$,
23. Write each number in scientific notation.

(a) 625 000 000,
(b) 9 910 000,
(c) 0.0073,
(d) 0.261,
(e) 528 000 000 000,
(f) 2 220 000,
(g) 0.00000618,
(h) 0.00000000000077,
(i) 43 200,
(j) 56 000,
(k) 0.0814,
(l) 0.0011,
(m) 32 000 000 000 000,
(n) 0.00000435.

24. Write each number in decimal notation.
(a) $5.9 \times 10^4$,
(b) $6.28 \times 10^6$,
(c) $3.75 \times 10^{-5}$,
(d) $9 \times 10^{-10}$,
(e) $2.4 \times 10^3$,
(f) $7.72 \times 10^5$,
(g) $3 \times 10^{-6}$,
(h) $4 \times 10^{-9}$,
(i) $1 \times 10^3$,
(j) $2.26 \times 10^4$,
(k) $8.02 \times 10^9$,
(l) $1 \times 10^{-4}$,
(m) $7 \times 10^{12}$,
(n) $1.33 \times 10^2$.

25. Write each number in scientific notation and perform the indicated operation

(a) $(63\,000\,000)(41\,000\,000)$,
(b) $(52\,000)(3\,000\,000)$,
(c) $\frac{600\,000\,000}{25\,000\,000}$,
(d) $\frac{32\,000\,000}{64\,000\,000}$,
(e) $(0.00000025)(0.000004)$,
(f) $\frac{0.0000036}{0.00009}$.

26. The planet Venus is about 67 000 000 miles from the sun. How far does it travel in one revolution around the sun? Assume the orbit is circular.

27. Each red blood cell contains 250 000 000 molecules of hemoglobin. How many molecules will there be in $5 \times 10^4$ red blood cells?

28. If light travels at $1.86 \times 10^5$ miles per second, how many minutes will it take the light from the sun to reach Jupiter? Jupiter is about 480 million miles from the sun.

29. If the mass of a proton is 0.00000000000000000000000167 grams, how many protons would it take to make one ounce? One ounce is equal to 28.4 grams.
3 **Topics in Algebra**


After completing this chapter you should be able to

- Simplify algebraic expressions by combining like terms and using the distributive property
- Evaluate algebraic expressions and formulas
- Solve linear equations in one variable
- Identify equations that have no solution or infinitely many solutions
- Translate verbal expressions into mathematical symbols
- Solve real-word problems using linear equations
- Solve linear inequalities and graph the solutions on the number line
- Solve real-word problems using linear inequalities
- Write ratios as fractions
- Simplify fractions
- Solve real-word problems using proportions and variation
- Solve quadratic equations using factoring or the quadratic formula
- Solve real-word problems using quadratic equations
- Graph points on the Cartesian plane
- Graph lines on the Cartesian plane
- Find the slope of a line given two points
- Write an equation of a line in slope-intercept form and identify the slope and intercepts
- Determine the domain and range of a relation
- Determine whether or not a relation is a function
- Determine the vertex, axis, and intercepts of a parabola
- Graph a parabola
- Graph an exponential function
- Solve real-world problems using quadratic or exponential function
4 Set of problems for Chapter 2

5 Fundamental Concepts of Algebra

1. Use the distributive property to multiply each.
   (a) \(7(4x - 20)\)
   (b) \(5(3x - 7y + 18)\)

2. Simplify each.
   (a) \(5(7x + 10) - 4x + 8\)
   (b) \(-(2a + 6b) + 5c - 12a\)

3. Evaluate each expression.
   (a) \(9x - 17\) when \(x = 3\)
   (b) \(2x^2 - 3x + 5\) when \(x = -10\)
   (c) \(6x + 8y - 15\) when \(x = -5\) and \(y = 7\)

4. For a certain occupation, it was found that the relationship between the number of hours, \(x\), a person works per week and the number of accidents, \(n\), the person has per year is given by the expression

\[
n = 0.5x - 17
\]

Find the number of yearly accidents for a person who works 40 hours per week.

5. Simplify each expression.
   (a) \(-4(12x - 10)\)
   (b) \(3x^2 + 8x^2 - 15x^2\)
   (c) \(8A - 15A + 2A\)
   (d) \(5x - 8y + 9 + 4y - 27 + 2x\)
   (e) \(-9x^2 - 2x - 7 + 3 - 5x + 21x\)
   (f) \(9(3x + 8)\)
   (g) \(4(6x - 3) - 7 - 10x\)
   (h) \(-10(4x + 11) - 15x + 9\)
   (i) \(9b + 12 + 8(2b + 3)\)
   (j) \(14x + 9 - 6(3x - 2)\)

6. Evaluate each.
(a) \(-3x + 8\) when \(x = 5\)
(b) \(4w + 9\) when \(w = -12\)
(c) \(8x^2 - 7x + 4\) when \(x = 16\)
(d) \(14x^2 - 6x + 30\) when \(x = -7\)
(e) \(9a + 18b - 5\) when \(a = 7\) and \(b = 2\)
(f) \(5x^2 - 7x + 2y^2\) when \(x = -1\) and \(y = 5\)
(g) \(9x^2 + 7y^2 + 6x + 2y + 5\) when \(x = 1\) and \(y = 5\)
(h) \(10y^3 + 10y^2 + 7x - 6\) when \(x = -3\) and \(y = 10\)
(i) \(3x - \frac{7y}{15}\) when \(x = 7\) and \(y = 3\)
(j) \(6x^2 - \frac{10}{39}\) when \(x = -5\) and \(y = 15\)

7. Evaluate each formula

(a) \(P = 2l + 2w\) when \(l = 10\) cm and \(w = 5\) cm
(b) \(S = \frac{1}{2}gt^2\) when \(g = 10\) m/sec\(^2\) and \(t = 20\) seconds
(c) \(S = 4\pi r^2\) when \(r = 7\) and \(\pi = 3.14\)
(d) \(v = V + gt\) when \(V = 50\), \(g = 32\), and \(t = 8\)
(e) \(T = 2\pi \sqrt{\frac{L}{g}}\) when \(\pi = 3.14\), \(L = 10\), and \(g = 32\).

8. For a particular occupation, a person’s hourly income can be estimated by using the expression

\[11.2 + 1.88x + 0.547y\]

where \(x\) is the number of years of experience on the job and \(y\) is the number of years of higher education completed. Find the income of the person who has completed 4 years of college and has worked for the company for 5 years.

9. A real estate agent found that the value of a farm in thousands of dollars can be estimated by

\[7.56x - 0.266y + 44.9\]

where \(x\) is the number of acres on the farm and \(y\) is the number of rooms in the farmhouse. Predict the value of a farm that has 371 acres and a farmhouse with 6 rooms.

10. Find the Celsius temperature that corresponds to a Fahrenheit temperature of 50\(^\circ\).

\[C = \frac{5}{9}(F - 32)\]

11. The future value \(FV\) of a compound interest investment \((P)\) at a specific interest rate \((R)\) for a specific number of periods, \(N\), is found by the formula

\[FV = P(1 + R)^N\]

Find the future value of 9000\$ invested at 8\% compounded annually for 6 years.
5.1 Solving Linear Equations

1. Solve each equation.
   
   (a) $7 + x = 43$
   (b) $36 = x - 9$
   (c) $12 = x + 8$
   (d) $6x = 42$
   (e) $-42 = -7x$
   (f) $10x - 30 = -5$
   (g) $-3x + 18 = 42$
   (h) $5x - 6 = 2x - 24$
   (i) $9x - 18 = 7x + 4$
   (j) $5x + 8 = 10x - 32$
   (k) $9 - 2x = 7 - x$
   (l) $2(x - 6) = 2$
   (m) $7(x - 3) = 42$
   (n) $-2(4x - 7) = 3x - 8$
   (o) $5(9 - x) = 4(x + 6)$
   (p) $-2x + 3 + 4(x - 6) = 18$
   (q) $-\frac{3}{4}x = 21$
   (r) $-\frac{1}{2}x = 25$
   (s) $\frac{1}{8}x - 10 = -16$
   (t) $\frac{3x}{4} + \frac{7x}{2} = 18$
   (u) $\frac{4x}{6} + \frac{x}{5} = \frac{2}{3} - \frac{x}{9}$
   (v) $\frac{3x}{2} + \frac{1}{2} = \frac{4x}{5} + \frac{3}{5}$
   (w) $\frac{5}{12} - \frac{1}{3}x = \frac{2}{3}x - \frac{7}{6}$
   (x) $\frac{6x}{8} + \frac{-x}{2} - 5 = \frac{3x}{4}$

2. Solve each equation for the specified variable.

   (a) $5y = 3x + 2$ for $x$
   (b) $5y - 3x + 2 = 10$ for $y$
   (c) $3y + 6 = 2x + 8$ for $x$

3. Determine whether each equation has a solution set $\{x \mid x \text{ is a real number}\}$ or $\emptyset$.

   (a) $8x - 5 + 2x = 10x - 10 + 5$
(b) $3x + 7 - x = 2x + 21$
(c) $5(x - 3) + 2 = 5x - 8$
(d) $4(x + 2) + 6 = 2x + 2x + 14$

4. The illumination of a light can be found by the formula

$$I = \frac{C}{D^2}$$

Solve the formula for $C$.

5. The formula for the perimeter of a rectangle is

$$P = 2l + 2w$$

Solve the formula for $w$.

6. The formula for the volume of a rectangular solid is

$$V = lwh$$

Solve the formula for $h$.

7. The formula for converting mass to energy is

$$E = mc^2$$

Solve the formula for $m$.

8. The formula for the average $a$ of two numbers $b$ and $c$ is

$$a = \frac{b + c}{2}$$

Solve for $b$.

### 5.2 Applications of Linear Equations

1. Write each phrase in symbols.

   (a) A number decreased by 17
   (b) 6 increased by a number
   (c) 8 more than a number
   (d) 6 subtracted from a number
   (e) Seven times a number
   (f) One-half a number
   (g) The quotient of three times a number and 6
   (h) Four times a number
(i) Four less than six times a number
(j) A number divided by 8

2. Solve each.

(a) The sum of a number and the number plus two is equal to 20. Find the number.
(b) The larger of two numbers is 10 more than the smaller number. The sum of the numbers is 42. Find the numbers.
(c) Five times a number is equal to the number increased by 12. Find the number.
(d) The difference between one-half a number and the number is 8. Find the number.

3. A mathematics class containing 57 students was divided into two sections. One section has three more students than the other. How many students were in each section?

4. For a certain year, the combined revenues for PepsiCo and Coca-Cola were 47 billions dollars. If the revenue for PepsiCo was 11 billion dollars more than Coca-Cola, how much was the revenue of each company?

5. The cost, including the sales tax, of a Ford Focus is 13 884.94$. If the sales tax is 6%, find the cost of the automobile before the tax was added.

6. Pete is three times as old as Bill. The sum of their ages is 48. How old is each?

7. An electric bill for September is 2.32$ less than the electric bill for October. If the total bill for two months is 119.56$, find the bill for each month.

8. If a person invested half of her money at 8% and half at 6% and received 210$ interest, find the total amount of money invested.

9. A basketball team played 32 games and won 4 more games than it lost. Find the number of games the team won.

10. The population of a city decreased by 6% between the years of 1990 and 1998. If the total population for the two years was 16 984, find the population in 1990 and 1998.

11. If a television set is marked 1/3 off and sells for 180$, what was the original price?
5.3 Solving Linear Inequalities

1. Show the solutions of the linear inequalities, using a graph.
   
   (a) \( x \geq 3 \)
   
   (b) \( x < -4 \)
   
   (c) \( x \leq -9 \)
   
   (d) \( x > 0 \)
   
   (e) \(-3 < x \leq 7\)
   
   (f) \(-3 \leq x < 0\)
   
   (g) \(4 \leq x \leq 10\)
   
   (h) \(2 < x < 8\)

2. Solve each inequality and graph the solution set on the number line.
   
   (a) \( x - 2 \leq 15 \)
   
   (b) \( x + 9 > 20 \)
   
   (c) \( 5x < 30 \)
   
   (d) \( 9 - x \leq 20 \)
   
   (e) \( \frac{3}{4}x \geq 36 \)
   
   (f) \( -25x \geq 100 \)
   
   (g) \( 5x - 6 < 39 \)
   
   (h) \( 5 - 2x > 20 \)
   
   (i) \( -3(2x + 7) < -16 \)
   
   (j) \( 9(4x - 1) > 71 \)
   
   (k) \( 3(x + 1) - 10 < 2x + 7 \)
   
   (l) \( 4(x - 8) - 2x < -22 \)
   
   (m) \( 9 - 5(x + 6) \geq 32 \)
   
   (n) \( 6(2x + 3) \geq 5(2x - 15) \)
   
   (o) \( -x \geq -15 \)
   
   (p) \( 6x - 7 \geq 5(x - 2) - 17 \)
   
   (q) \( 3x + 6 < -8x + 7 \)

3. Mary wishes to purchase a used car. She wishes to spend at most 8000$. The sales tax rate is 7%. Title and license plate fee is 120$. What is the maximum amount she can spend for an automobile?

4. Bill has three test grades of 95, 84, and 85 so far. If the final examination, still to come, counts for two test scores, what is the lowest he can score on the final exam and still get an A for the course? He needs at least 450 points for an A.
5. In order to get a C for her sociology course, Betsy needs at least a 70% average. On exam 1 she scored 78% and on exam 2 she scored 68%. What is the lowest score she can get on the last exam?

6. A husband and wife wish to sell their house and make at least a 10% profit. The real estate agent’s commission is 7% and closing costs are 1000$. If they paid 150 000$ for their home, what is the minimum price they should ask for their house?

5.3.1 Ratio, Proportion and Variation

1. Write each ratio statement as a fraction and reduce to lowest terms if possible.
   (a) 18 to 28
   (b) 14:32
   (c) 12 cents to 15 cents
   (d) 3 weeks to 140 days
   (e) 12 years to 18 months
   (f) 5 kilograms to 500 grams

2. Solve each proportion.
   (a) \( \frac{3}{x} = \frac{14}{15} \)
   (b) \( \frac{5}{6} = \frac{x}{42} \)
   (c) \( \frac{x-6}{12} = \frac{1}{3} \)
   (d) \( \frac{2}{x-3} = \frac{5}{x+8} \)
   (e) \( \frac{x-3}{4} = \frac{x+6}{20} \)

3. One out of every five people who buys ice cream buys vanilla ice cream. If a store sells 75 ice cream cones in one day, about how many of them will be vanilla?

4. If a person drives 4000 km in 8 months, how many kilometers will that person drive in 2 years?

5. A quality control inspector found that out of every 50 calculators manufactured, 2 were defective. In a lot of 1000 calculators, about how many will be defective?

6. A small college has 1200 students and 80 professors. The college is planning to increase enrollment to 1500 students next year. How many new professors should be hired, assuming they want to maintain the same ratio?
7. If you need a minimum of 27 correct out of 30 to get an A on a test, how many correct answers would you need to get an A on a 80-point test assuming that the same ratio is used for scoring purposes?

8. The number of tickets purchased for a prize varies directly with the amount of the prize. For a prize of 1000$, 250 tickets are purchased. Find the approximate number of tickets that will be purchased on a prize worth 5000$.

5.4 Solving Quadratic Equations.

1. Use the FOIL method to multiply the two binomials.
   (a) \((x - 8)(x - 12)\)
   (b) \((x + 4)(x + 2)\)
   (c) \((x + 10)(x - 3)\)
   (d) \((2x - 7)(7x - 9)\)
   (e) \((4x - 2)(4x - 3)\)
   (f) \((5x + 7)(3x - 8)\)
   (g) \((2x - 5)(3x + 8)\)

2. Solve each quadratic equation by factoring.
   (a) \(x^2 + 9x + 20 = 0\)
   (b) \(x^2 - 3x - 10 = 0\)
   (c) \(x^2 - x = 20\)
   (d) \(x^2 - 12x = 64\)
   (e) \(x^2 + 20 - 12x = 0\)
   (f) \(5x^2 + 27x - 18 = 0\)
   (g) \(4x^2 + 13x - 12 = 0\)
   (h) \(10x^2 + 21x = 10\)
   (i) \(5x^2 - 18 = 27x\)
   (j) \(6x^2 + 6 = 13x\)

3. Solve each quadratic equation using the quadratic formula.
   (a) \(4x^2 - 7x = 2\)
   (b) \(x^2 + 5x - 12 = 0\)
   (c) \(5x^2 + 2x = 3\)
   (d) \(6x^2 + x = 35\)
(e) \(6x - 1 = 4x^2\)

4. The product of two consecutive even integers is 288. Find the numbers.

5. The product of two consecutive integers is 156. Find the numbers.

6. Mary is 5 years older than Bill. The product of their present ages is three times what the product of their age was 5 years ago. Find their present ages.

6 The Rectangular Coordinate System and the Line

1. Plot each point on the real line
   
   (a) \((-4, -6)\)
   (b) \((-5, 3)\)
   (c) \((7, 0)\)
   (d) \((6, 6)\)
   (e) \((2, -8)\)
   (f) \((-1, 0)\)
   (g) \((0, -2)\)
   (h) \((3, -2)\)
   (i) \((0, 1)\)
   (j) \((12, -3)\)

2. Draw the graph for each equation by finding at least two points on the line
   
   (a) \(5x + y = 20\)
   (b) \(x + 4y = 24\)
   (c) \(3x - y = 15\)
   (d) \(2x - y = 10\)
   (e) \(4x + 7y = 28\)
   (f) \(3x - 5y = 15\)
   (g) \(8x - 3y = 12\)
   (h) \(5x - 3y = -18\)
   (i) \(2x + 7y = -14\)
   (j) \(-9x + 2y = 18\)
   (k) \(-2x - 3y = 9\)
3. Find the slope of the line passing through the two points
   (a) \((-3,-2),(6,7)\)
   (b) \((4,0),(3,-5)\)
   (c) \((2,10),(4,9)\)
   (d) \((6,3.5),(4.2,6)\)
   (e) \((-4,-5),(-9,-2)\)
   (f) \((2,-6),(3,-3)\)
   (g) \((4,0),(0,7)\)

4. Find the coordinates for the x intercept and the y intercept for each line
   (a) \(3x + 4y = 24\)
   (b) \(-2x + 7y = -28\)
   (c) \(-5x - 6y = 30\)
   (d) \(2x - y = 18\)
   (e) \(5x - 2y = 15\)
   (f) \(x + 6y = 10\)
   (g) \(9x + 4y = -36\)
   (h) \(9x - 7y = 18\)

5. Write the equation in the slope-intercept form, then find the slope and the y intercept. Finally, draw the graph of the line
   (a) \(7x + 5y = 35\)
   (b) \(-2x + 7y = 14\)
   (c) \(x - 4y = 16\)
   (d) \(4x - 8y = 15\)
   (e) \(8x - 3y = 24\)
   (f) \(3x - 7y = 14\)
   (g) \(2x - y = 19\)
   (h) \(3x - 9y = 20\)

6. Draw the graph for each
   (a) \(x = -1\)
   (b) \(y = -5\)
   (c) \(x = 3\)
   (d) \(y = 6\)
   (e) \(x = 0\)
7. A newspaper advertisement costs $6.50 per week to run the ad plus a setup charge of $50. Find the cost of running the ad for
   (a) 3 weeks
   (b) 10 weeks

8. A painter’s labor charges are $50 plus $40 per room to paint the interior of a house. Find the cost of painting
   (a) a five-room house
   (b) a seven-room house
   (c) a nine-room house.

9. The cost of renting an automobile is $40 per day plus $1.10 per kilometer. Find the cost of renting the automobile for one day if it is driven
   (a) 63 kilometers
   (b) 42 kilometers
   (c) 127 kilometers

10. The number in billions of pieces of mail delivered in the country is approximately determined by the equation
    \[ y = 10x + 190 \]
    where \( x \) is equal to the number of years from now. Find the number of pieces of mail that will be delivered 5 years from now.

11. The number in thousands of civilian staff in the military can be approximated by the equality
    \[ y = 10.5x \]
    where \( x \) is the number of years from now. Find the number of civilians in the military during the year that is 3 years from now.

12. The percentage of alcohol-related traffic deaths can be approximated by
    \[ y = 1.2x \]
    where \( x \) is the number of years from now. What will be the percentage of alcohol-related traffic deaths during the year that is 2 years from now?

13. The number in millions of people over age 65 can be approximated by the equation
    \[ y = 0.5x + 35.3 \]
    where \( x \) is the number of years from now. Find the number of people over 65 living 5 years from now.
14. The percentage of the population with less than 12 years of school can be approximated by the equation

\[ y = 18 - 1.1x \]

where \( x \) represents a specific year from now. Find the percentage of the population with less than 12 years of school in the years that is 4 years from now.

7 Functions

1. Find the domain and the range for each relation and state whether or not the relation is a function

(a) \( \{(5, 8), (6, 9), (7, 10), (8, 11)\} \)
(b) \( \{(0, 1), (0, 2), (0, 3), (0, 4), (0, 5)\} \)
(c) \( \{(6, 11), (7, 11), (8, 11), (9, 11)\} \)
(d) \( \{(-2, -3)\} \)
(e) \( \{(0, 0)\} \)
(f) \( \{(-2, 2), (-3, 4), (-4, 5), (-5, 6)\} \)
(g) \( \{(-10, 20), (-10, 40), (-40, 60), (-60, 60)\} \)
(h) \( \{(5, 8), (5, 10), (5, 12)\} \)

2. Evaluate each function for the specific value

(a) \( f(x) = 3x + 8 \) for \( x = 3 \)
(b) \( f(x) = -2x + 5 \) for \( x = -5 \)
(c) \( f(x) = 4x - 8 \) for \( x = -10 \)
(d) \( f(x) = 6x^2 - 2x + 5 \) for \( x = 2 \)
(e) \( f(x) = 8x^2 + 3x \) for \( x = 0 \)
(f) \( f(x) = -3x^2 + 5 \) for \( x = 1.5 \)
(g) \( f(x) = x^2 + 4x + 7 \) for \( x = -3.6 \)
(h) \( f(x) = -x^2 + 6x - 3 \) for \( x = 0 \)

3. Graph each function

(a) \( f(x) = 7x - 8 \)
(b) \( f(x) = 6x \)
(c) \( f(x) = -3x + 2 \)
(d) \( f(x) = -5x + 1 \)
(e) \( f(x) = -x + 5 \)
4. Graph each parabola
   (a) \( y = x^2 \)
   (b) \( y = x^2 + 6x + 9 \)
   (c) \( y = -x^2 + 12x - 36 \)
   (d) \( y = -10x^2 + 20x \)
   (e) \( y = x^2 - 6x \)
   (f) \( y = 4x^2 - 4x + 1 \)
   (g) \( y = 4x^2 - 4x + 1 \)
   (h) \( y = -2x^2 + 3x + 4 \)
   (i) \( y = -3x^2 + 5x + 2 \)

5. Graph each exponential function
   (a) \( y = 5^x \)
   (b) \( y = \left(\frac{1}{2}\right)^{x-2} \)
   (c) \( y = 3^{x+1} \)
   (d) \( y = \left(\frac{1}{4}\right)^{x+1} \)

6. If a ball is thrown vertically up from a height of 6 m with an initial velocity of 60 m per second, then the height of the ball \( t \) seconds after it is thrown is given by
   \[
   f(t) = -16t^2 + 60t + 6
   \]
   Find the maximum height that the ball will attain and find the number of seconds that will elapse from the moment the ball is thrown to the moment it hits the ground.

7. A vendor sells boxes of computer paper. The amount of revenue made per week is given by the function
   \[
   f(x) = 12x - 0.1x^2
   \]
   where \( x \) is the number of boxes sold. How many boxes should be sold if the vendor is to make a maximum profit?

8. Find the length of the sides of a gutter consisting of three sides that can be made from a piece of aluminium that is 36 cm wide in order for it to carry the maximum capacity of water. (The shape of the gutter is \( \square \).)

9. A stone is dropped from a bridge, and 3 seconds later a splash is heard. How high is the bridge? Use \( f(x) = -16x^2 \), where \( f(x) \) is the height of the bridge.
10. The population growth of a certain geographic region is defined by the function \( f(t) = A_0(1.4)^t \), where \( A_0 \) is the present population and \( t \) is the time in decades. If the present population is 4 000 000, find the population in 5 years.

11. Using the formula \( A = P(1 + \frac{r}{n})^{nt} \) find the worth of a 500$ bond that collects interest at a rate of 6% calculated quarterly and is held for 3 years.

12. Interest can be compounded daily. The formula for interest which is compounded daily is

\[
I = P(1 + \frac{R}{365})^N - P
\]

where \( P \) is the principal, \( R \) is the rate, and \( N \) is the number of days. Using this formula, find the interest on 1200$ at 7% for 30 days.