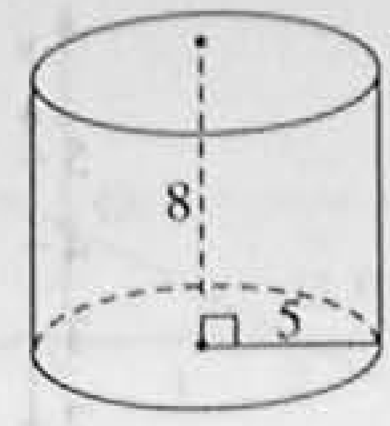


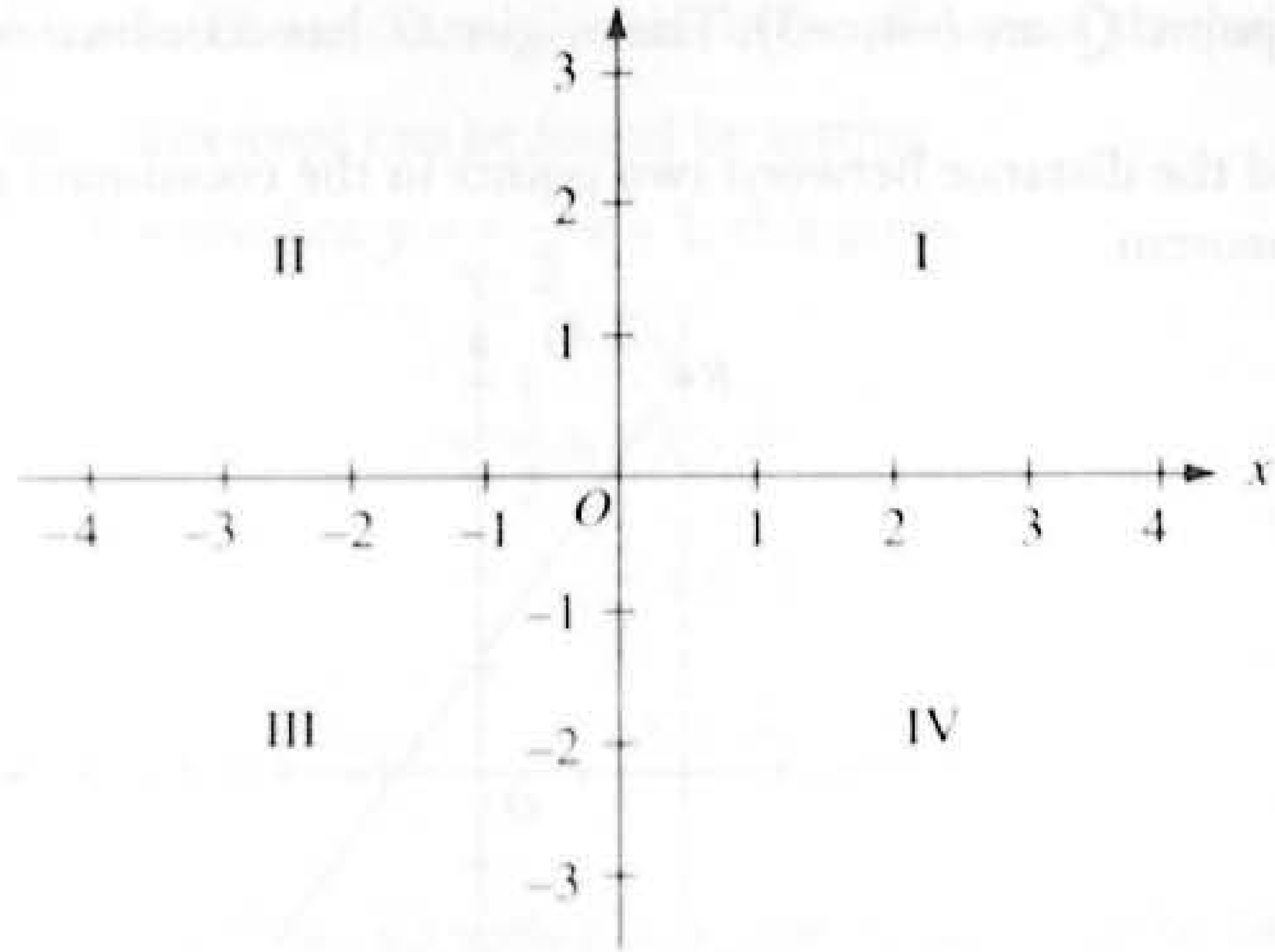
In the cylinder above, the surface area is equal to

$$2(25\pi) + 2\pi(5)(8) = 130\pi,$$

and the volume is equal to

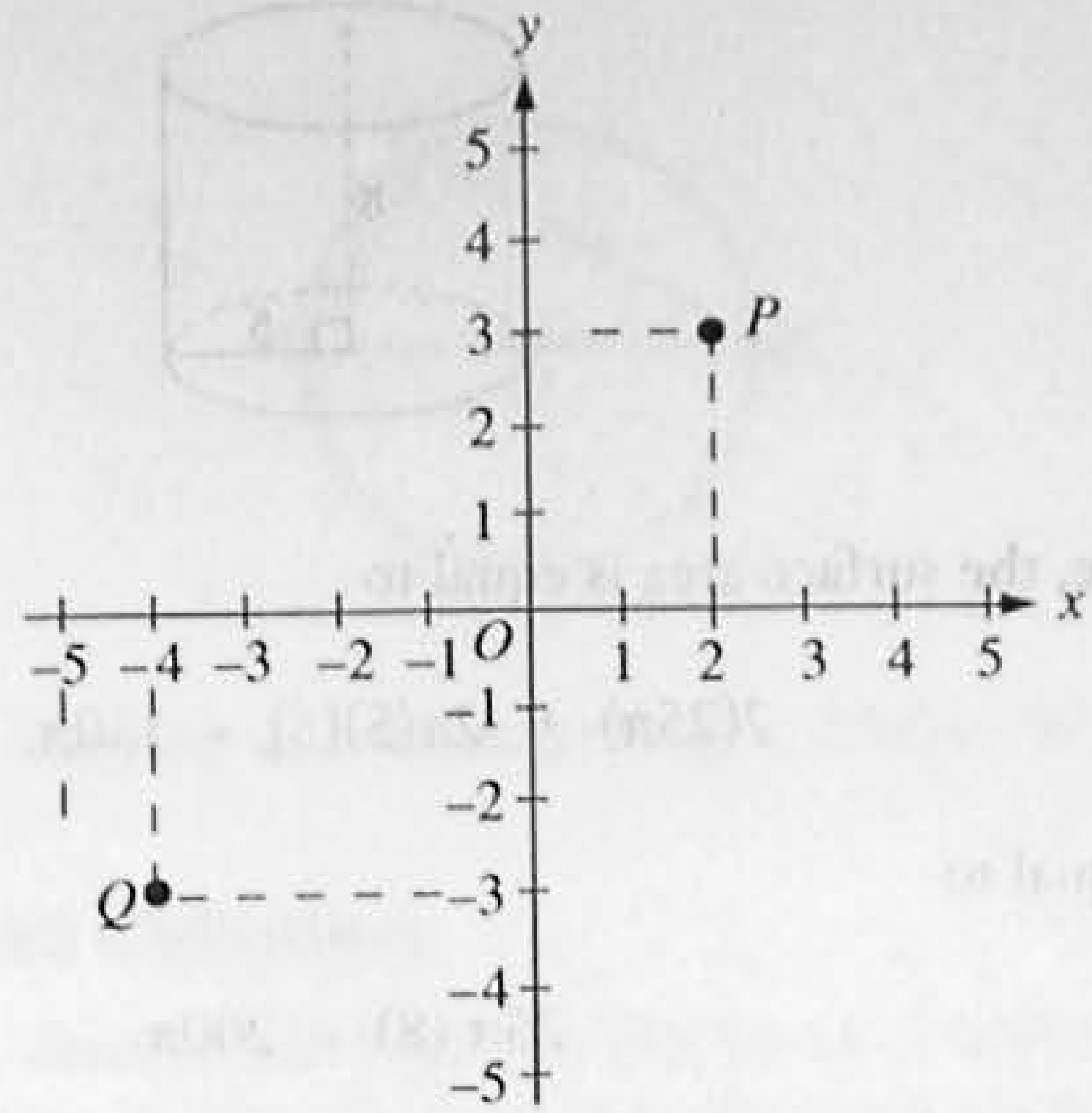
$$25\pi\,(8) = 200\pi.$$

10. Coordinate Geometry



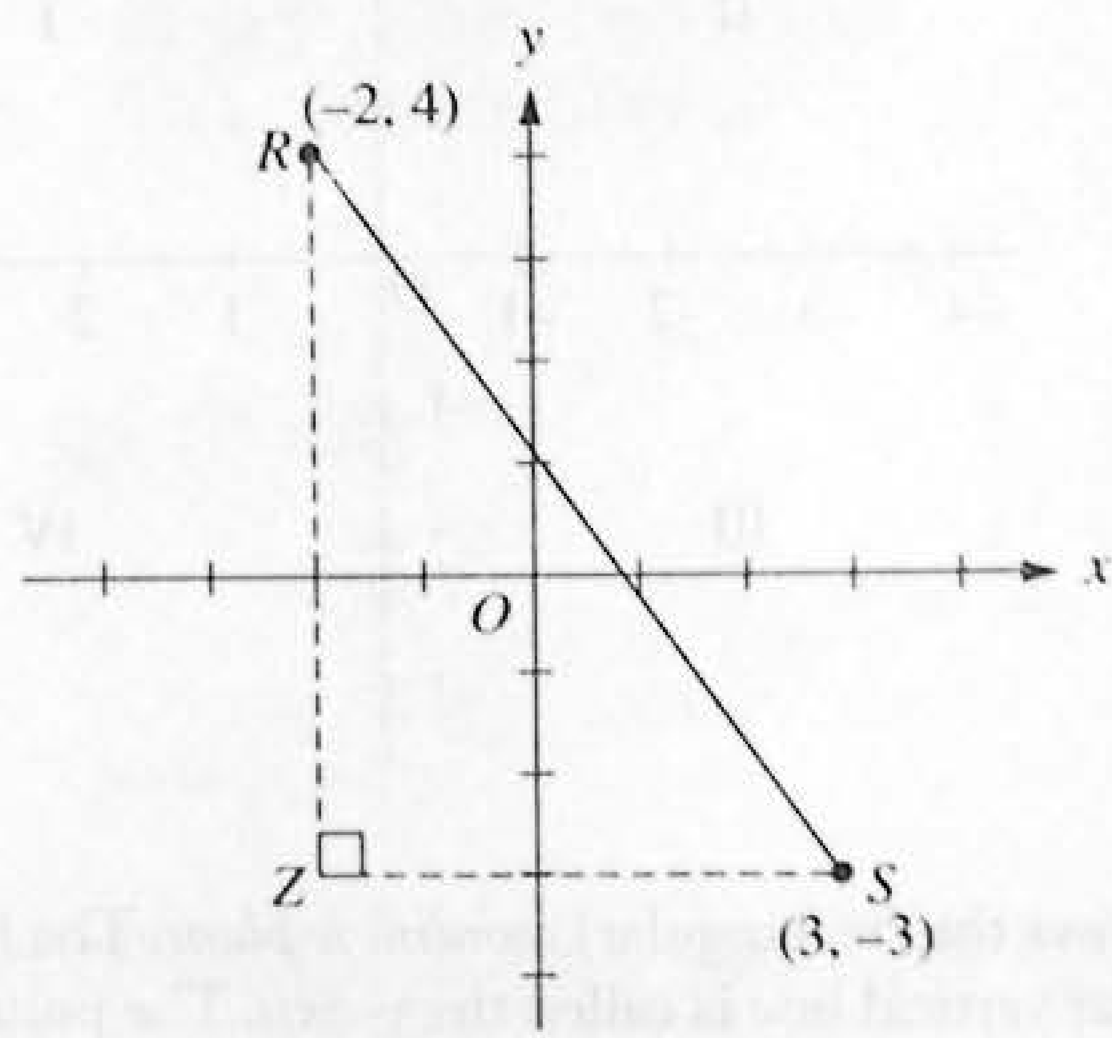
The figure above shows the (rectangular) *coordinate plane*. The horizontal line is called the *x-axis* and the perpendicular vertical line is called the *y-axis*. The point at which these two axes intersect, designated O, is called the *origin*. The axes divide the plane into four quadrants, I, II, III, and IV, as shown.

Each point in the plane has an *x-coordinate* and a *y-coordinate*. A point is identified by an ordered pair (x, y) of numbers in which the x-coordinate is the first number and the y-coordinate is the second number.



In the graph above, the (x, y) coordinates of point P are $(2, 3)$ since P is 2 units to the right of the y-axis (that is, $x = 2$) and 3 units above the x-axis (that is, $y = 3$). Similarly, the (x, y) coordinates of point Q are $(-4, -3)$. The origin O has coordinates $(0, 0)$.

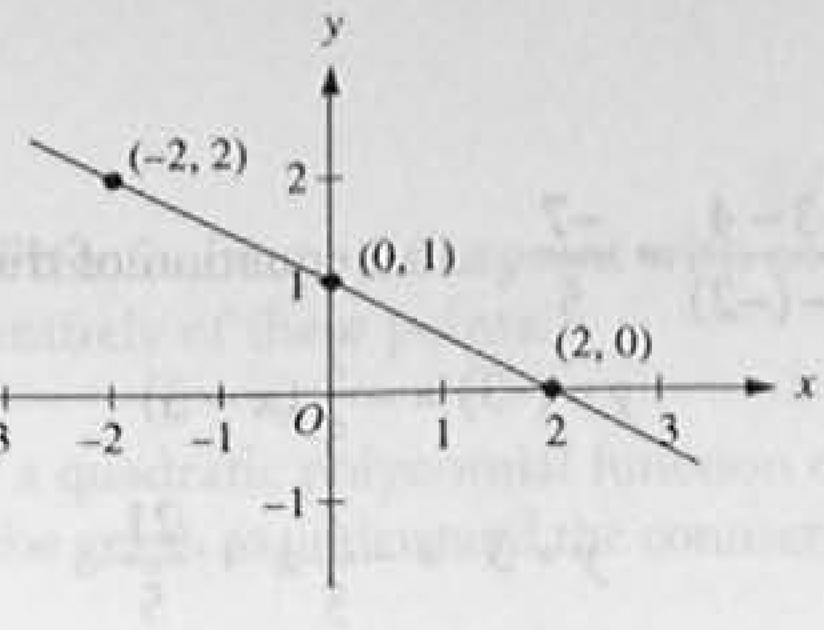
One way to find the distance between two points in the coordinate plane is to use the Pythagorean theorem.



To find the distance between points R and S using the Pythagorean theorem, draw the triangle as shown. Note that Z has (x, y) coordinates $(-2, -3)$, $RZ = 7$, and $ZS = 5$. Therefore, the distance between R and S is equal to

$$\sqrt{7^2 + 5^2} = \sqrt{74}$$

For a line in the coordinate plane, the coordinates of each point on the line satisfy a linear equation of the form $y = mx + b$ (or the form $x = a$ if the line is vertical). For example, each point on the line on the next page satisfies the equation $y = -\frac{1}{2}x + 1$. One can verify this for the points $(-2,2)$, $(2,0)$, and $(0,1)$ by substituting the respective coordinates for x and y in the equation.



In the equation $y = mx + b$ of a line, the coefficient m is the *slope* of the line and the constant term b is the *y-intercept* of the line. For any two points on the line, the slope is defined to be the ratio of the difference in the y-coordinates to the difference in the x-coordinates. Using (−2,2) and (2,0) above, the slope is

$$\frac{\text{The difference in the } y\text{-coordinates}}{\text{The difference in the } x\text{-coordinates}} = \frac{0-2}{2-(-2)} = \frac{-2}{4} = -\frac{1}{2}.$$

The y-intercept is the y-coordinate of the point at which the line intersects the y-axis. For the line above, the y-intercept is 1, and this is the resulting value of y when x is set equal to 0 in the equation m $y = -\frac{1}{2}x = 1$. The *x-intercept* is the x-coordinate of the point at which the line intersects the x-axis. The x-intercept can be found by setting $y = 0$ and solving for x. For the line $y = -\frac{1}{2}x + 1$, this gives

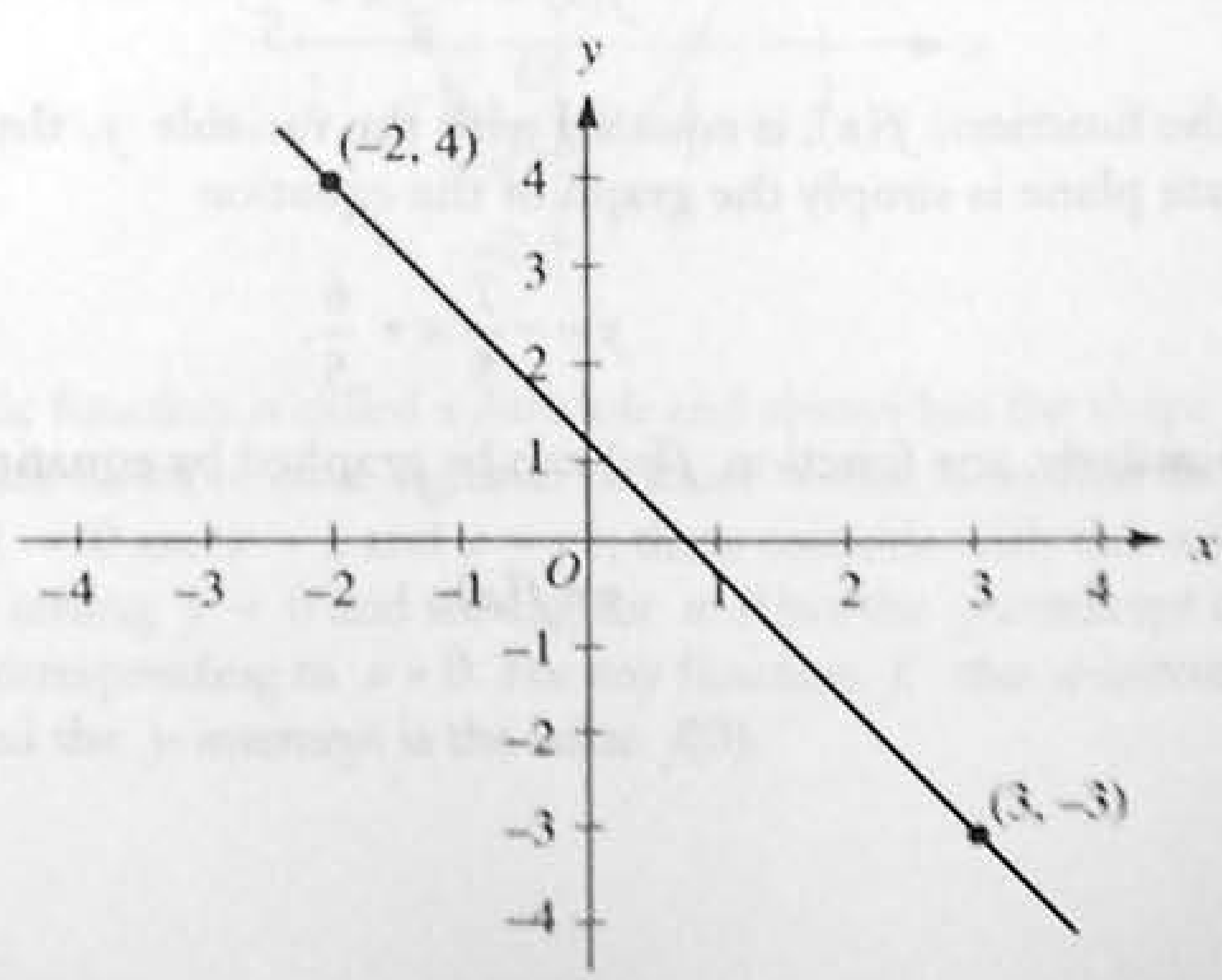
$$-\frac{1}{2}x + 1 = 0$$

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

$$x = 2.$$

Thus, the x-intercept is 2.

Given any two points (x_1, y_1) and (x_2, y_2) with $x_1 \neq x_2$, the equation of the line passing through these points can be found by applying the definition of slope. Since the slope is $m = \frac{y_2 - y_1}{x_2 - x_1}$, then using a point known to be on the line, say (x_1, y_1), any point (x, y) on the line must satisfy $\frac{y - y_1}{x - x_1} = m$, or $y - y_1 = m(x - x_1)$. (Using (x_2, y_2) as the known point would yield an equivalent equation.) For example, consider the points (−2, 4) and (3, −3) on the line below.



The slope of this line is $\frac{-3-4}{3-(-2)} = \frac{-7}{5}$, so an equation of this line can be found using the point (3, −3) as follows:

$$y-(-3) = -\frac{7}{5}(x-3)$$

$$y+3 = -\frac{7}{5}x + \frac{21}{5}$$

$$y = -\frac{7}{5}x + \frac{6}{5}.$$

The y-intercept is $\frac{6}{5}$. The x-*intercept* can be found as follows:

$$0 = -\frac{7}{5}x + \frac{6}{5}$$

$$\frac{7}{5}x = \frac{6}{5}$$

$$x = \frac{6}{7}$$

Both of these intercepts can be seen on the graph.

If the slope of a line is negative, the line slants downward from left to right; if the slope is positive, the line slants upward. If the slope is 0, the line is horizontal; the equation of such a line is of the form $y = b$ since $m = 0$. For a vertical line, slope is not defined, and the equation is of the form $x = a$, where a is the x-intercept.

There is a connection between graphs of lines in the coordinate plane and solutions of two linear equations with two unknowns. If two linear equations with unknowns x and y have a unique solution, then the graphs of the equations are two lines that intersect in one point, which is the solution. If the equations are equivalent, then they represent the same line with infinitely many points or solutions. If the equations have no solution, then they represent parallel lines, which do not intersect.

There is also a connection between functions (see section 4.2.10) and the coordinate plane. If a function is graphed in the coordinate plane, the function can be understood in different and useful ways. Consider the function defined by

$$f(x) = -\frac{7}{5}x + \frac{6}{5}.$$

If the value of the function, $f(x)$, is equated with the variable y, then the graph of the function in the xy-coordinate plane is simply the graph of the equation

$$y = -\frac{7}{5}x + \frac{6}{5}.$$

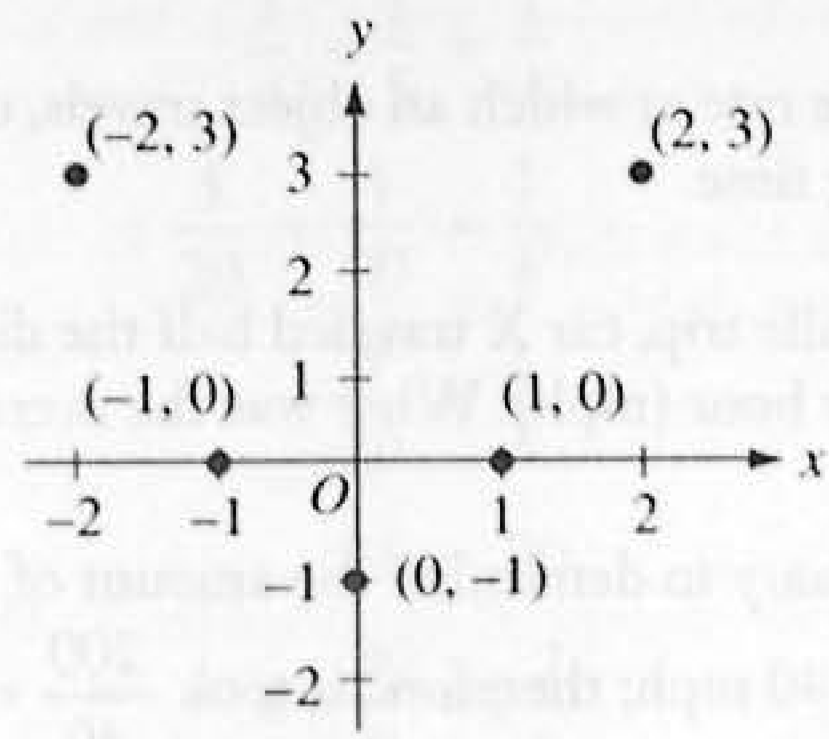
shown above. Similarly, any function $f(x)$ can be graphed by equating y with the value of the function:

$$y = f(x).$$

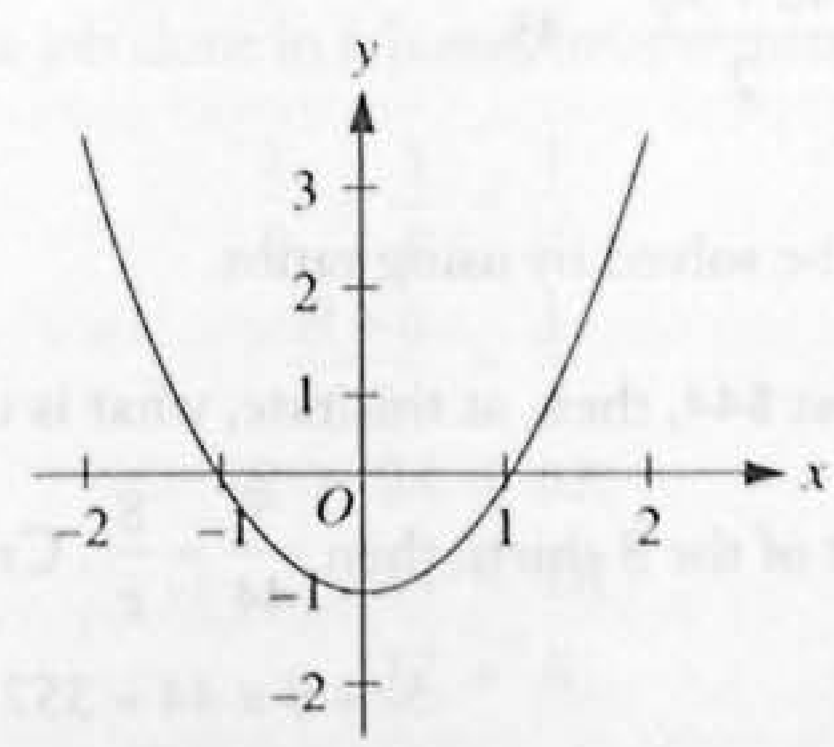
So for any x in the domain of the function f, the point with coordinates $(x, f(x))$ is on the graph of f, and the graph consists entirely of these points.

As another example, consider a quadratic polynomial function defined by $f(x) = x^2 - 1$. One can plot several points $(x, f(x))$ on the graph to understand the connection between a function and its graph:

x	$f(x)$
−2	3
−1	0
0	−1
1	0
2	3



If all the points were graphed for $-2 \le x \le 2$, then the graph would appear as follows.



The graph of a quadratic function is called a *parabola* and always has the shape of the curve above, although it may be upside down or have a greater or lesser width. Note that the roots of the equation $f(x) = x^2 - 1 = 0$ are $x = 1$ and $x = -1$; these coincide with the x-intercepts since x-intercepts are found by setting $y = 0$ and solving for x. Also, the y-intercept is $f(0) = -1$ because this is the value of y corresponding to $x = 0$. For any function f, the x-intercepts are the solutions of the equation $f(x) = 0$ and the y-intercept is the value $f(0)$.

4.4 Word Problems

Many of the principles discussed in this chapter are used to solve word problems. The following discussion of word problems illustrates some of the techniques and concepts used in solving such problems.

1. Rate Problems

The distance that an object travels is equal to the product of the average speed at which it travels and the amount of time it takes to travel that distance, that is,

$$\text{Rate} \times \text{Time} = \text{Distance}.$$

Example 1: If a car travels at an average speed of 70 kilometers per hour for 4 hours, how many kilometers does it travel?

Solution: Since rate × time = distance, simply multiply 70 km/hour × 4 hours. Thus, the car travels 280 kilometers in 4 hours.

To determine the average rate at which an object travels, divide the total distance traveled by the total amount of traveling time.

Example 2: On a 400-mile trip, car X traveled half the distance at 40 miles per hour and the other half at 50 miles per hour (mph). What was the average speed of car X?

Solution: First it is necessary to determine the amount of traveling time. During the first 200 miles, the car traveled at 40 mph; therefore, it took $\frac{200}{40} = 5$ hours to travel the first 200 miles. During the second 200 miles, the car traveled at 50 mph; therefore, it took $\frac{200}{50} = 4$ hours to travel the second 200 miles. Thus, the average speed of car X was $\frac{400}{9} = 44\frac{4}{9}$ mph. Note that the average speed is *not* $\frac{40+50}{2} = 45$.

Some rate problems can be solved by using ratios.

Example 3: If 5 shirts cost $44, then, at this rate, what is the cost of 8 shirts?

Solution: If c is the cost of the 8 shirts, then $\frac{5}{44} = \frac{8}{c}$. Cross multiplication results in the equation

$$5c = 8 \times 44 = 352$$

$$c = \frac{352}{5} = 70.40$$

The 8 shirts cost $70.40.

2. Work Problems

In a work problem, the rates at which certain persons or machines work alone are usually given, and it is necessary to compute the rate at which they work together (or vice versa).

The basic formula for solving work problems is $\frac{1}{r} + \frac{1}{s} = \frac{1}{h}$, where r and s are, for example, the number of hours it takes Rae and Sam, respectively, to complete a job when working alone, and h is the number of hours it takes Rae and Sam to do the job when working together. The reasoning is that in 1 hour Rae does $\frac{1}{r}$ of the job, Sam does $\frac{1}{s}$ of the job, and Rae and Sam together do $\frac{1}{h}$ of the job.

Example 1: If machine X can produce 1,000 bolts in 4 hours and machine Y can produce 1,000 bolts in 5 hours, in how many hours can machines X and Y, working together at these constant rates, produce 1,000 bolts?

Solution:

$$\frac{1}{4} + \frac{1}{5} = \frac{1}{h}$$

$$\frac{5}{20} + \frac{4}{20} = \frac{1}{h}$$

$$\frac{9}{20} = \frac{1}{h}$$

$$9h = 20$$

$$h = \frac{20}{9} = 2\frac{2}{9}$$

Working together, machines X and Y can produce 1,000 bolts in $2\frac{2}{9}$ hours.

Example 2: If Art and Rita can do a job in 4 hours when working together at their respective constant rates and Art can do the job alone in 6 hours, in how many hours can Rita do the job alone?

Solution:

$$\frac{1}{6} + \frac{1}{R} = \frac{1}{4}$$

$$\frac{R+6}{6R} = \frac{1}{4}$$

$$4R + 24 = 6R$$

$$24 = 2R$$

$$12 = R$$

Working alone, Rita can do the job in 12 hours.

3. Mixture Problems

In mixture problems, substances with different characteristics are combined, and it is necessary to determine the characteristics of the resulting mixture.

Example 1: If 6 pounds of nuts that cost \$1.20 per pound are mixed with 2 pounds of nuts that cost \$1.60 per pound, what is the cost per pound of the mixture?

Solution: The total cost of the 8 pounds of nuts is

$$6(\$1.20) + 2(\$1.60) = \$10.40.$$

The cost per pound is $\dfrac{\$10.40}{8} = \$1.30.$

Example 2: How many liters of a solution that is 15 percent salt must be added to 5 liters of a solution that is 8 percent salt so that the resulting solution is 10 percent salt?

Solution: Let n represent the number of liters of the 15% solution. The amount of salt in the 15% solution $[0.15n]$ plus the amount of salt in the 8% solution $[(0.08)(5)]$ must be equal to the amount of salt in the 10% mixture $[0.10\ (n + 5)]$. Therefore,

$$\begin{aligned} 0.15n + 0.08(5) &= 0.10(n + 5) \\ 15n + 40 &= 10n + 50 \\ 5n &= 10 \\ n &= 2 \text{ liters} \end{aligned}$$

Two liters of the 15% salt solution must be added to the 8% solution to obtain the 10% solution.

4. Interest Problems

Interest can be computed in two basic ways. With simple annual interest, the interest is computed on the principal only and is equal to (principal) × (interest rate) × (time). If interest is compounded, then interest is computed on the principal as well as on any interest already earned.

Example 1: If \$8,000 is invested at 6 percent simple annual interest, how much interest is earned after 3 months?

Solution: Since the annual interest rate is 6%, the interest for 1 year is

$$(0.06)(\$8{,}000) = \$480.$$

The interest earned in 3 months is $\dfrac{3}{12}(\$480) = \$120.$

Example 2: If \$10,000 is invested at 10 percent annual interest, compounded semiannually, what is the balance after 1 year?

Solution: The balance after the first 6 months would be

$$10{,}000 \times (10{,}000)(0.05) = 10{,}500 \text{ dollars.}$$

The balance after one year would be $10{,}500 \times (10{,}500)(0.05) = 11{,}025 \text{ dollars.}$

Note that the interest rate for each 6-month period is 5%, which is half of the 10% annual rate. The balance after one year can also be expressed as

$$10{,}000\left(1+\frac{0.10}{2}\right)^2 \text{ dollars.}$$

5. Discount

If a price is discounted by n percent, then the price becomes $(100 - n)$ percent of the original price.

Example 1: A certain customer paid \$24 for a dress. If that price represented a 25 percent discount on the original price of the dress, what was the original price of the dress?

Solution: If p is the original price of the dress, then $0.75p$ is the discounted price and $0.75p = \$24$, or $p = \$32$. The original price of the dress was \$32.

Example 2: The price of an item is discounted by 20 percent and then this reduced price is discounted by an additional 30 percent. These two discounts are equal to an overall discount of what percent?

Solution: If p is the original price of the item, then $0.8p$ is the price after the first discount. The price after the second discount is $(0.7)(0.8)p = 0.56p$. This represents an overall discount of 44 percent (100% − 56%).

6. Profit

Gross profit is equal to revenues minus expenses, or selling price minus cost.

Example: A certain appliance costs a merchant \$30. At what price should the merchant sell the appliance in order to make a gross profit of 50 percent of the cost of the appliance?

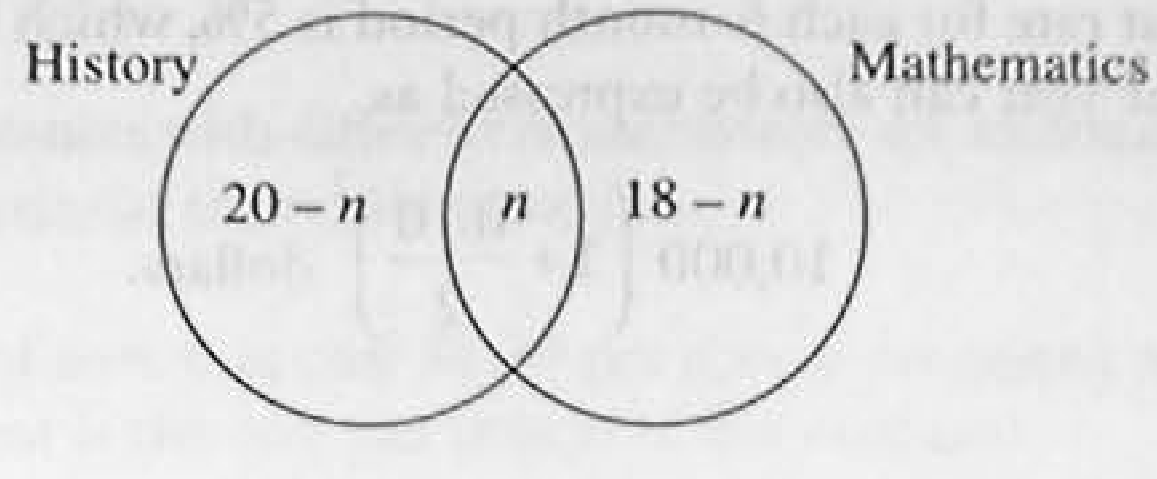
Solution: If s is the selling price of the appliance, then $s - 30 = (0.5)(30)$, or $s = \$45$. The merchant should sell the appliance for \$45.

7. Sets

If S is the set of numbers 1, 2, 3, and 4, you can write $S = \{1, 2, 3, 4\}$. Sets can also be represented by Venn diagrams. That is, the relationship among the members of sets can be represented by circles.

Example 1: Each of 25 people is enrolled in history, mathematics, or both. If 20 are enrolled in history and 18 are enrolled in mathematics, how many are enrolled in both history and mathematics?

Solution: The 25 people can be divided into three sets: those who study history only, those who study mathematics only, and those who study history and mathematics. Thus a Venn diagram may be drawn as follows, where n is the number of people enrolled in both courses, $20 - n$ is the number enrolled in history only, and $18 - n$ is the number enrolled in mathematics only.



Since there is a total of 25 people, $(20 - n) + n + (18 - n) = 25$, or $n = 13$. Thirteen people are enrolled in both history and mathematics. Note that $20 + 18 - 13 = 25$, which is the general addition rule for two sets (see section 4.1.9).

Example 2: In a certain production lot, 40 percent of the toys are red and the remaining toys are green. Half of the toys are small and half are large. If 10 percent of the toys are red and small, and 40 toys are green and large, how many of the toys are red and large?

Solution: For this kind of problem, it is helpful to organize the information in a table:

	Red	Green	Total
Small	10%		50%
Large			50%
Total	40%	60%	100%

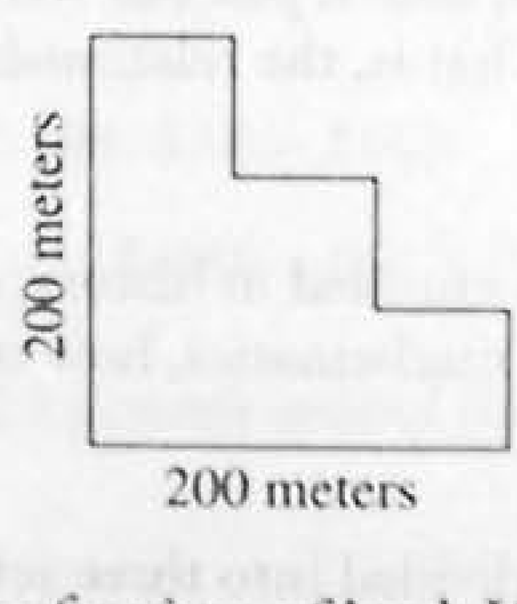
The numbers in the table are the percents given. The following percents can be computed on the basis of what is given:

	Red	Green	Total
Small	10%	40%	50%
Large	30%	20%	50%
Total	40%	60%	100%

Since 20% of the number of toys (n) are green and large, $0.20n = 40$ (40 toys are green and large), or $n = 200$. Therefore, 30% of the 200 toys, or $(0.3)(200) = 60$, are red and large.

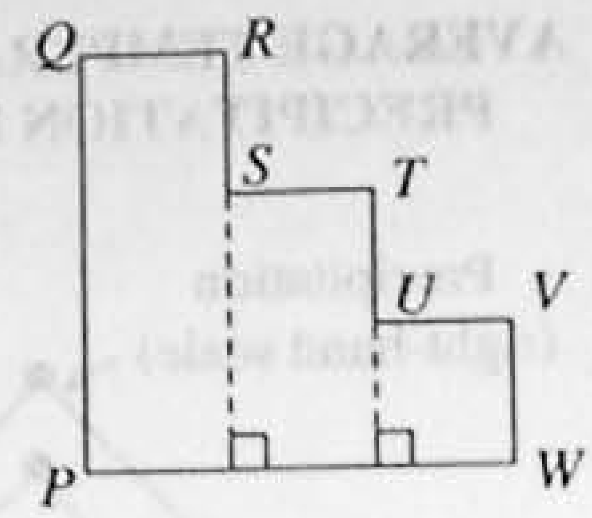
8. Geometry Problems

The following is an example of a word problem involving geometry.
Example:



The figure above shows an aerial view of a piece of land. If all angles shown are right angles, what is the perimeter of the piece of land?

Solution: For reference, label the figure as



If all the angles are right angles, then $QR + ST + UV = PW$, and $RS + TU + VW = PQ$. Hence, the perimeter of the land is $2PW + 2PQ = 2 \times 200 + 2 \times 200 = 800$ meters.

9. Measurement Problems

Some questions on the GMAT® involve metric units of measure, whereas others involve English units of measure. However, except for units of time, if a question requires conversion from one unit of measure to another, the relationship between those units will be given.

Example: A train travels at a constant rate of 25 meters per second. How many kilometers does it travel in 5 minutes? (1 kilometer = 1,000 meters)

Solution: In 1 minute the train travels (25)(60) = 1,500 meters, so in 5 minutes it travels 7,500 meters. Since 1 kilometer = 1,000 meters, it follows that 7,500 meters equals $\frac{7{,}500}{1{,}000}$, or 7.5 kilometers.

10. Data Interpretation

Occasionally a question or set of questions will be based on data provided in a table or graph. Some examples of tables and graphs are given below.

Example 1:

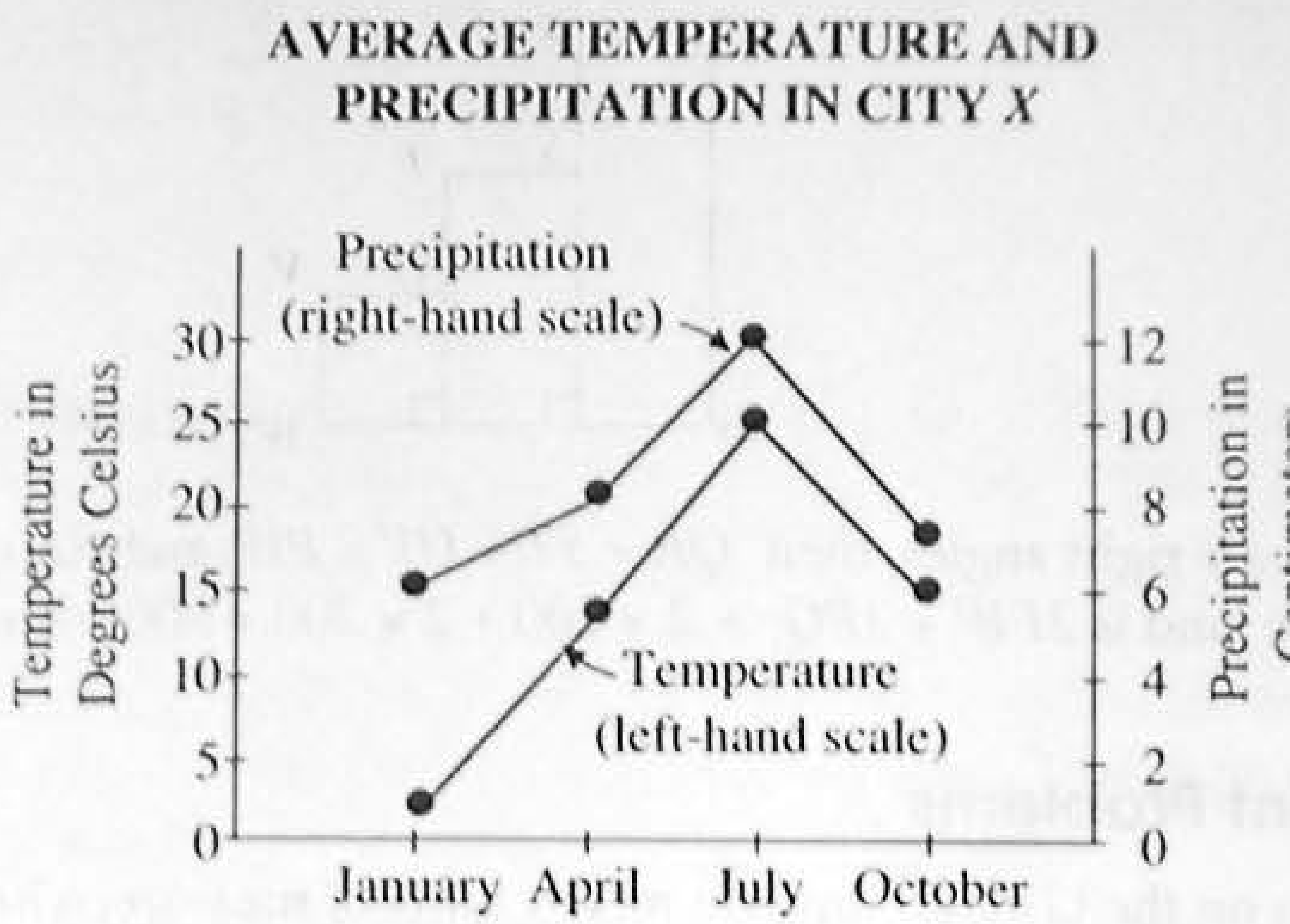
Population by Age Group
(in thousands)

Age	Population
17 years and under	63,376
18–44 years	86,738
45–64 years	43,845
65 years and over	24,054

How many people are 44 years old or younger?

Solution: The figures in the table are given in thousands. The answer in thousands can be obtained by adding 63,376 thousand and 86,738 thousand. The result is 150,114 thousand, which is 150,114,000.

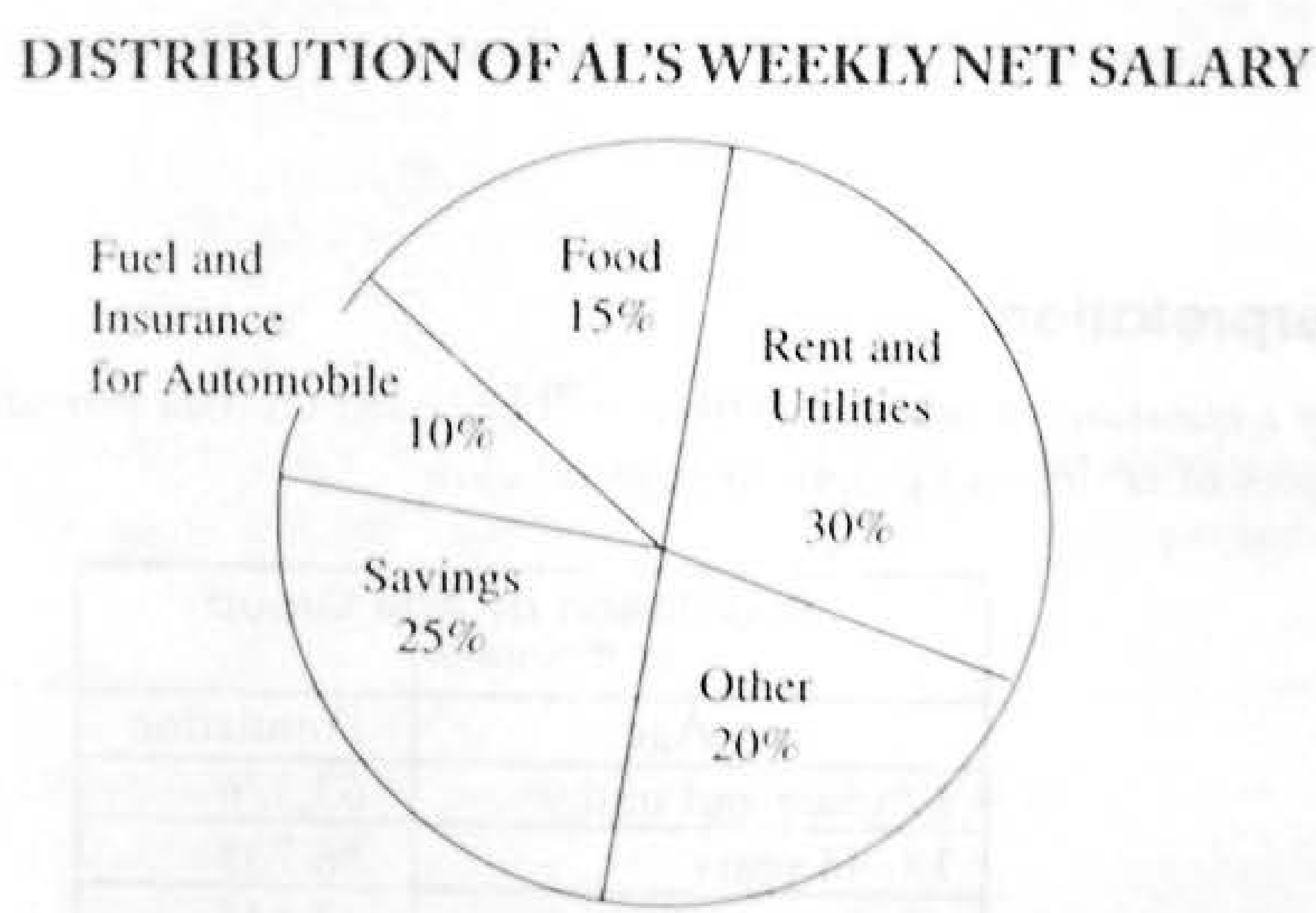
Example 2:



What are the average temperature and precipitation in City X during April?

Solution: Note that the scale on the left applies to the temperature line graph and the one on the right applies to the precipitation line graph. According to the graph, during April the average temperature is approximately 14° Celsius and the average precipitation is 8 centimeters.

Example 3:



To how many of the categories listed was at least $80 of Al's weekly net salary allocated?

Solution: In the circle graph, the relative sizes of the sectors are proportional to their corresponding values and the sum of the percents given is 100%. Note that $\frac{80}{350}$ is approximately 23%, so at least $80 was allocated to each of 2 categories—Rent and Utilities, and Savings—since their allocations are each greater than 23%.

5.0 Problem Solving

The Quantitative section of the GMAT® test uses problem solving and data sufficiency questions to gauge your skill level. This chapter focuses on problem solving questions. Remember that quantitative questions require knowledge of the following:

- Arithmetic
- Elementary algebra
- Commonly known concepts of geometry

Problem solving questions are designed to test your basic mathematical skills and understanding of elementary mathematical concepts, as well as your ability to reason quantitatively, solve quantitative problems, and interpret graphic data. The mathematics knowledge required to answer the questions is no more advanced than what is generally taught in secondary school (or high school) mathematics classes.

In these questions, you are asked to solve each problem and select the best of the five answer choices given. Begin by reading the question thoroughly to determine exactly what information is given and to make sure you understand what is being asked. Scan the answer choices to understand your options. If the problem seems simple, take a few moments to see whether you can determine the answer. Then check your answer against the choices provided.

If you do not see your answer among the choices, or if the problem is complicated, take a closer look at the answer choices and think again about what the problem is asking. See whether you can eliminate some of the answer choices and narrow down your options. If you are still unable to narrow the answer down to a single choice, reread the question. Keep in mind that the answer will be based solely on the information provided in the question—don't allow your own experience and assumptions to interfere with your ability to find the correct answer to the question.

If you find yourself stuck on a question or unable to select the single correct answer, keep in mind that you have about two minutes to answer each quantitative question. You may run out of time if you take too long to answer any one question, so you may simply need to pick the answer that seems to make the most sense. Although guessing is generally not the best way to achieve a high GMAT® score, making an educated guess is a good strategy for answering questions you are unsure of. Even if your answer to a particular question is incorrect, your answers to other questions will allow the test to accurately gauge your ability level.

The following pages include the directions that will precede questions of this type, test-taking strategies, sample questions, and explanations for all the problems. These explanations present problem solving strategies that could be helpful in answering the questions.

5.1 Test-Taking Strategies for Problem Solving Questions

1. **Pace yourself.**
   Consult the on-screen timer periodically. Work as carefully as possible, but do not spend valuable time checking answers or pondering problems that you find difficult.

2. **Use the erasable notepad provided.**
   Working a problem out may help you avoid errors in solving the problem. If diagrams or figures are not presented, it may help if you draw your own.

3. **Read each question carefully to determine what is being asked.**
   For word problems, take one step at a time, reading each sentence carefully and translating the information into equations or other useful mathematical representations.

4. **Scan the answer choices before attempting to answer a question.**
   Scanning the answers can prevent you from putting answers in a form that is not given (e.g., finding the answer in decimal form, such as 0.25, when the choices are given in fractional form, such as 1/4). Also, if the question requires approximations, a shortcut could serve well (e.g., you may be able to approximate 48 percent of a number by using half).

5. **Don't waste time trying to solve a problem that is too difficult for you.**
   Make your best guess and move on to the next question.

5.2 The Directions

These directions are very similar to those you will see for problem solving questions when you take the GMAT® test. If you read them carefully and understand them clearly before sitting for the GMAT® exam, you will not need to spend too much time reviewing them once the test begins.

Solve the problem and indicate the best of the answer choices given.

Numbers: All numbers used are real numbers.

Figures: A figure accompanying a problem solving question is intended to provide information useful in solving the problem. Figures are drawn as accurately as possible EXCEPT when it is stated in a specific problem that its figure is not drawn to scale. Straight lines may sometimes appear jagged. All figures lie in a plane unless otherwise indicated.

5.3 Problem Solving Sample Questions

Solve the problem and indicate the best of the answer choices given.
Numbers: All numbers used are real numbers.
Figures: A figure accompanying a problem solving question is intended to provide information useful in solving the problem. Figures are drawn as accurately as possible EXCEPT when it is stated in a specific problem that its figure is not drawn to scale. Straight lines may sometimes appear jagged. All figures lie in a plane unless otherwise indicated.

1. A project scheduled to be carried out over a single fiscal year has a budget of $12,600, divided into 12 equal monthly allocations. At the end of the fourth month of that fiscal year, the total amount actually spent on the project was $4,580. By how much was the project over its budget?

(A) $ 380
(B) $ 540
(C) $1,050
(D) $1,380
(E) $1,430

2. For which of the following values of n is $\frac{100 + n}{n}$ NOT an integer?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

3. Rectangular floors X and Y have equal area. If floor X is 12 feet by 18 feet and floor Y is 9 feet wide, what is the length of floor Y, in feet?

(A) $13\frac{1}{2}$
(B) 18
(C) $18\frac{3}{4}$
(D) 21
(E) 24

4. A case contains c cartons. Each carton contains b boxes, and each box contains 100 paper clips. How many paper clips are contained in 2 cases?

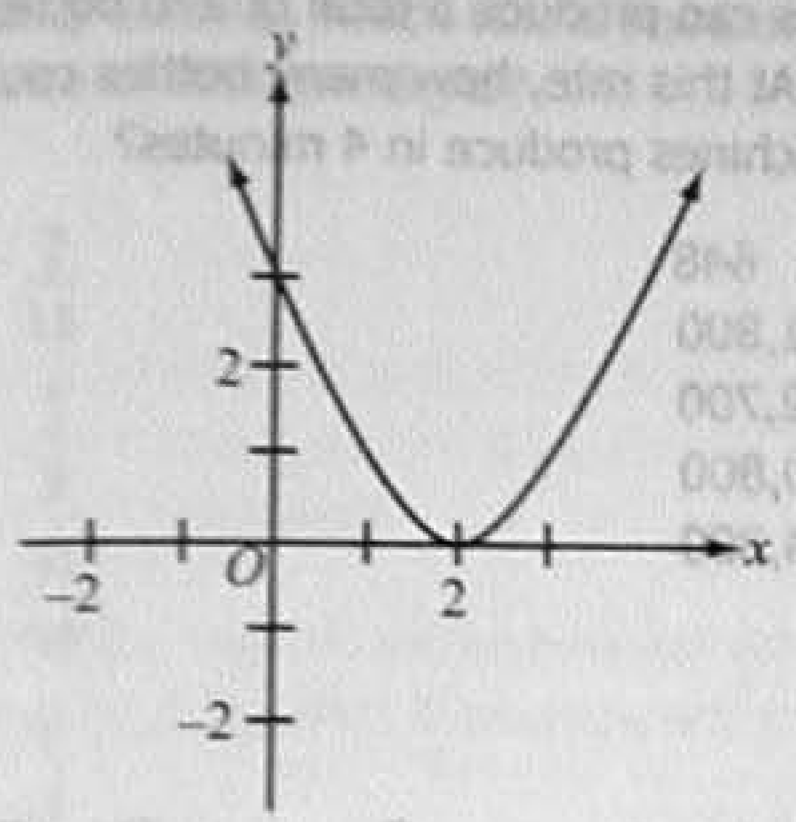
(A) $100bc$
(B) $\frac{100b}{c}$
(C) $200bc$
(D) $\frac{200b}{c}$
(E) $\frac{200}{bc}$

5. The sum of prime numbers that are greater than 60 but less than 70 is

(A) 67
(B) 128
(C) 191
(D) 197
(E) 260

6. A rainstorm increased the amount of water stored in State J reservoirs from 124 billion gallons to 138 billion gallons. If the storm increased the amount of water in the reservoirs to 82 percent of total capacity, approximately how many billion gallons of water were the reservoirs short of total capacity prior to the storm?

(A) 9
(B) 14
(C) 25
(D) 30
(E) 44



7. On the graph above, when $x = \frac{1}{2}$, $y = 2$; and when $x = 1$, $y = 1$. The graph is symmetric with respect to the vertical line at $x = 2$. According to the graph, when $x = 3$, $y =$

(A) -1
(B) $-\frac{1}{2}$
(C) 0
(D) $\frac{1}{2}$
(E) 1

8. When $\frac{1}{10}$ percent of 5,000 is subtracted from $\frac{1}{10}$ of 5,000, the difference is

(A) 0
(B) 50
(C) 450
(D) 495
(E) 500

9. Which of the following is the value of $\sqrt{\sqrt[3]{0.000064}}$?

(A) 0.004
(B) 0.008
(C) 0.02
(D) 0.04
(E) 0.2

10. Raffle tickets numbered consecutively from 101 through 350 are placed in a box. What is the probability that a ticket selected at random will have a number with a hundreds digit of 2?

(A) $\frac{2}{5}$
(B) $\frac{2}{7}$
(C) $\frac{33}{83}$
(D) $\frac{99}{250}$
(E) $\frac{100}{249}$

11. On Monday, a person mailed 8 packages weighing an average (arithmetic mean) of $12\frac{3}{8}$ pounds, and on Tuesday, 4 packages weighing an average of $15\frac{1}{4}$ pounds. What was the average weight, in pounds, of all the packages the person mailed on both days?

(A) $13\frac{1}{3}$
(B) $13\frac{13}{16}$
(C) $15\frac{1}{2}$
(D) $15\frac{15}{16}$
(E) $16\frac{1}{2}$

12. $0.1 + (0.1)^2 + (0.1)^3 =$

(A) 0.1
(B) 0.111
(C) 0.1211
(D) 0.2341
(E) 0.3

13. A carpenter constructed a rectangular sandbox with a capacity of 10 cubic feet. If the carpenter were to make a similar sandbox twice as long, twice as wide, and twice as high as the first sandbox, what would be the capacity, in cubic feet, of the second sandbox?

(A) 20
(B) 40
(C) 60
(D) 80
(E) 100

14. Which of the following CANNOT be a value of $\frac{1}{x-1}$?

(A) -1
(B) 0
(C) $\frac{2}{3}$
(D) 1
(E) 2

15. A bakery opened yesterday with its daily supply of 40 dozen rolls. Half of the rolls were sold by noon, and 80 percent of the remaining rolls were sold between noon and closing time. How many dozen rolls had not been sold when the bakery closed yesterday?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

16. What is the combined area, in square inches, of the front and back of a rectangular sheet of paper measuring $8\frac{1}{2}$ inches by 11 inches?

(A) 38
(B) 44
(C) 88
(D) 176
(E) 187

17. 150 is what percent of 30?

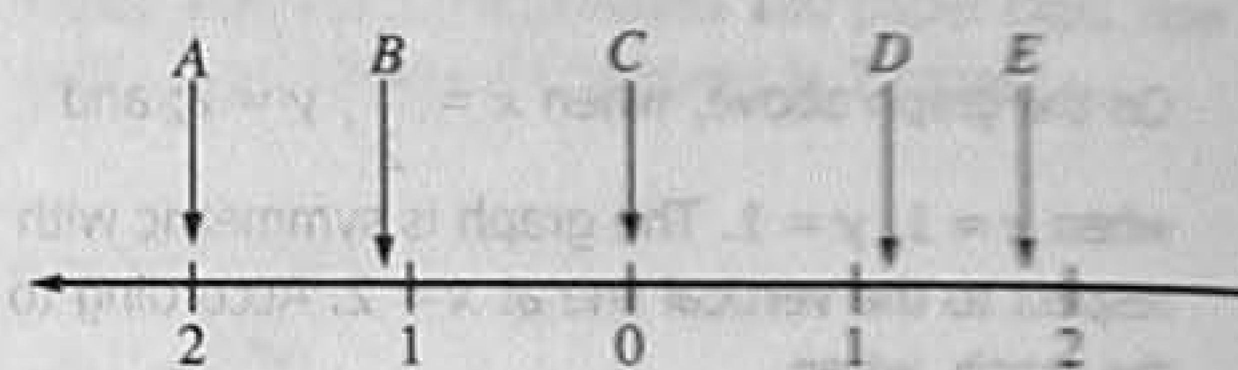
(A) 5%
(B) 20%
(C) 50%
(D) 200%
(E) 500%

18. The ratio 2 to $\frac{1}{3}$ is equal to the ratio

(A) 6 to 1
(B) 5 to 1
(C) 3 to 2
(D) 2 to 3
(E) 1 to 6

19. Running at the same constant rate, 6 identical machines can produce a total of 270 bottles per minute. At this rate, how many bottles could 10 such machines produce in 4 minutes?

(A) 648
(B) 1,800
(C) 2,700
(D) 10,800
(E) 64,800



20. Of the five coordinates associated with points A, B, C, D, and E on the number line above, which has the greatest absolute value?

(A) A
(B) B
(C) C
(D) D
(E) E

21. If x and y are prime numbers, which of the following CANNOT be the sum of x and y?

(A) 5
(B) 9
(C) 13
(D) 16
(E) 23

22. If each of the following fractions were written as a repeating decimal, which would have the longest sequence of different digits?

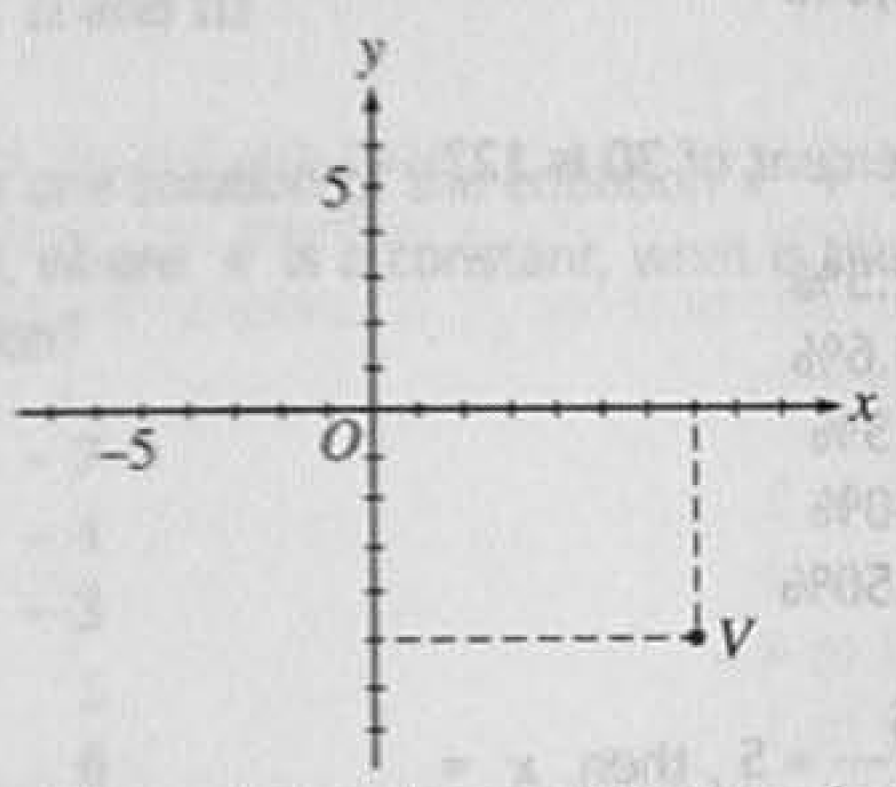
(A) $\frac{2}{11}$

(B) $\frac{1}{3}$

(C) $\frac{41}{99}$

(D) $\frac{2}{3}$

(E) $\frac{23}{37}$



23. In the figure above, the coordinates of point V are

(A) (−7, 5)
(B) (−5, 7)
(C) (5, 7)
(D) (7, 5)
(E) (7,−5)

24. A rope 40 feet long is cut into two pieces. If one piece is 18 feet longer than the other, what is the length, in feet, of the shorter piece?

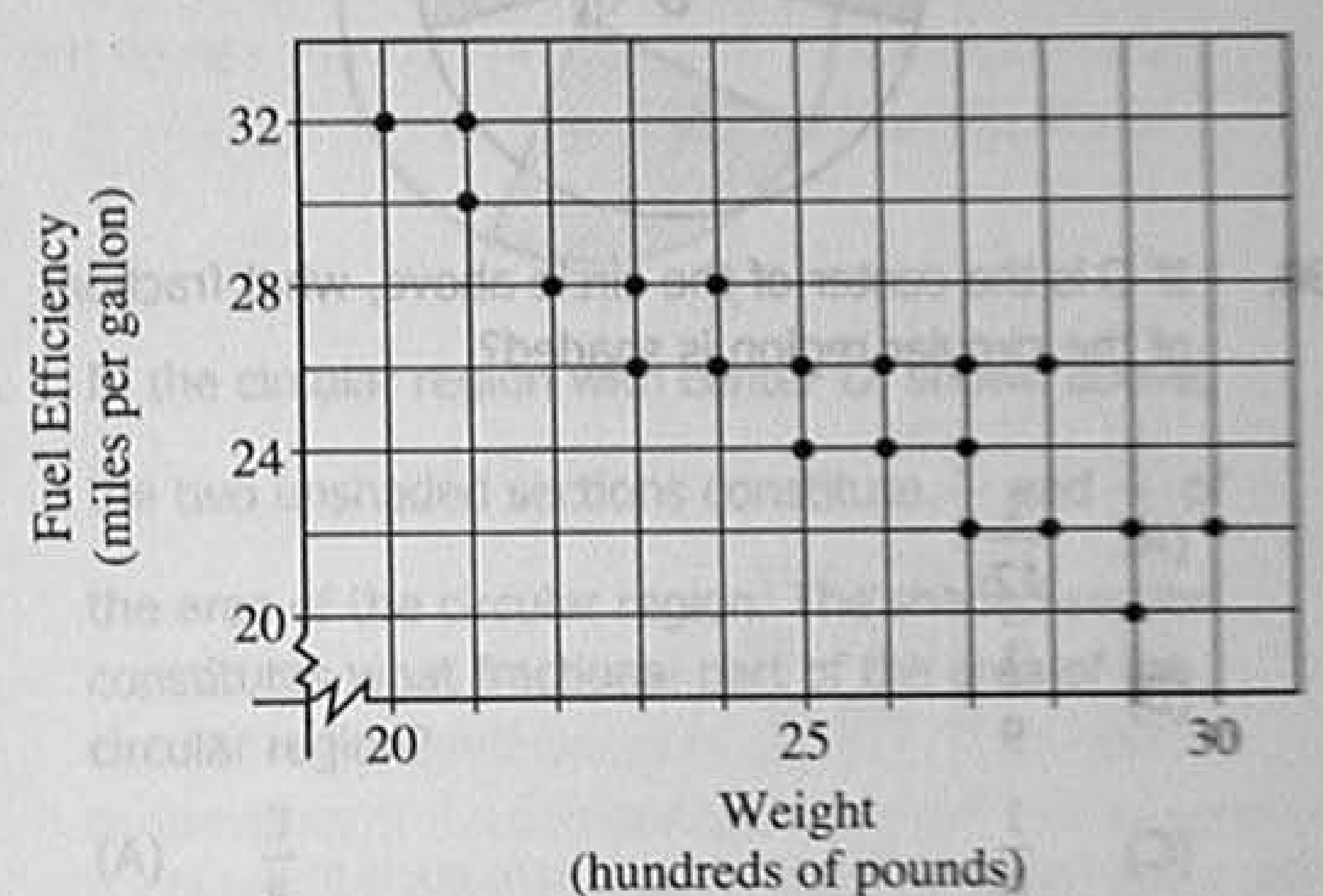
(A) 9
(B) 11
(C) 18
(D) 22
(E) 29

25. The Earth travels around the Sun at a speed of approximately 18.5 miles per second. This approximate speed is how many miles per hour?

(A) 1,080
(B) 1,160
(C) 64,800
(D) 66,600
(E) 3,996,000

26. If the quotient $\frac{a}{b}$ is positive, which of the following must be true?

(A) $a > 0$
(B) $b > 0$
(C) $ab > 0$
(D) $a - b > 0$
(E) $a + b > 0$



27. The dots on the graph above indicate the weights and fuel efficiency ratings for 20 cars. How many of the cars weigh more than 2,500 pounds and also get more than 22 miles per gallon?

(A) 3
(B) 5
(C) 8
(D) 10
(E) 11

28. How many minutes does it take John to type y words if he types at the rate of x words per minute?

(A) $\frac{x}{y}$

(B) $\frac{y}{x}$

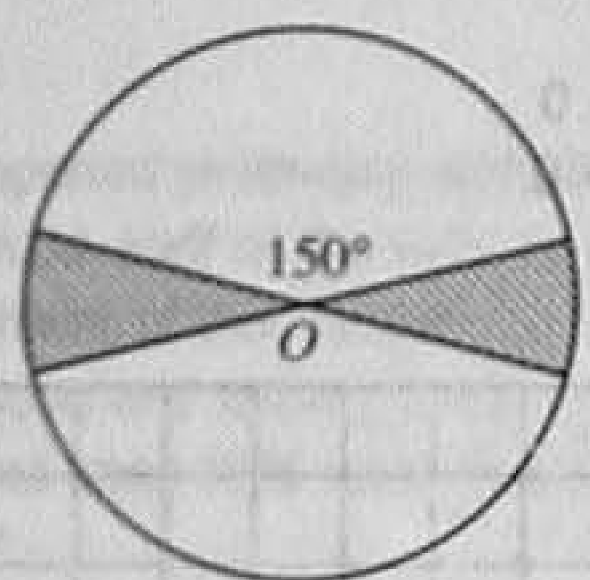
(C) xy

(D) $\frac{60x}{y}$

(E) $\frac{y}{60x}$

29. $\sqrt{(16)(20)+(8)(32)} =$

(A) $4\sqrt{20}$
(B) 24
(C) 25
(D) $4\sqrt{20}+8\sqrt{2}$
(E) 32



30. If O is the center of the circle above, what fraction of the circular region is shaded?

(A) $\frac{1}{12}$
(B) $\frac{1}{9}$
(C) $\frac{1}{6}$
(D) $\frac{1}{4}$
(E) $\frac{1}{3}$

31. If Juan takes 11 seconds to run y yards, how many seconds will it take him to run x yards at the same rate?

(A) $\frac{11x}{y}$
(B) $\frac{11y}{x}$
(C) $\frac{x}{11y}$
(D) $\frac{11}{xy}$
(E) $\frac{xy}{11}$

32. John has 10 pairs of matched socks. If he loses 7 individual socks, what is the greatest number of pairs of matched socks he can have left?

(A) 7
(B) 6
(C) 5
(D) 4
(E) 3

33. What is the lowest positive integer that is divisible by each of the integers 1 through 7, inclusive?

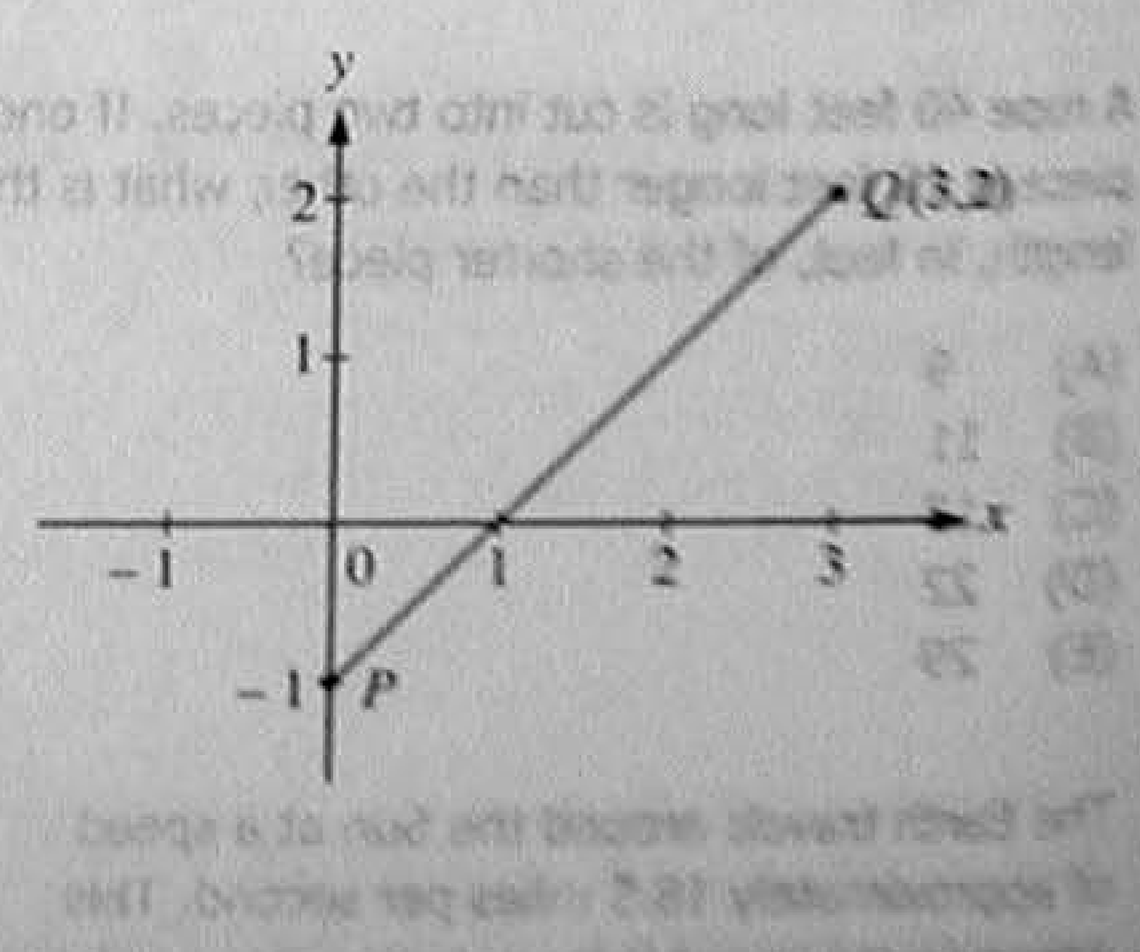
(A) 420
(B) 840
(C) 1,260
(D) 2,520
(E) 5,040

34. What percent of 30 is 12?

(A) 2.5%
(B) 3.6%
(C) 25%
(D) 40%
(E) 250%

35. If $\frac{1.5}{0.2+x} = 5$, then $x =$

(A) -3.7
(B) 0.1
(C) 0.3
(D) 0.5
(E) 2.8



36. In the figure above, the point on segment PQ that is twice as far from P as from Q is

(A) (3, 1)
(B) (2, 1)
(C) (2, − 1)
(D) (1.5, 0.5)
(E) (1, 0)

37. If a positive integer n is divisible by both 5 and 7, then n must also be divisible by which of the following?

I. 12
II. 35
III. 70

(A) None
(B) I only
(C) II only
(D) I and II
(E) II and III

38. If 4 is one solution of the equation $x^2 + 3x + k = 10$, where k is a constant, what is the other solution?

(A) − 7
(B) − 4
(C) − 3
(D) 1
(E) 6

39. If $x = -3$, what is the value of $-3x^2$?

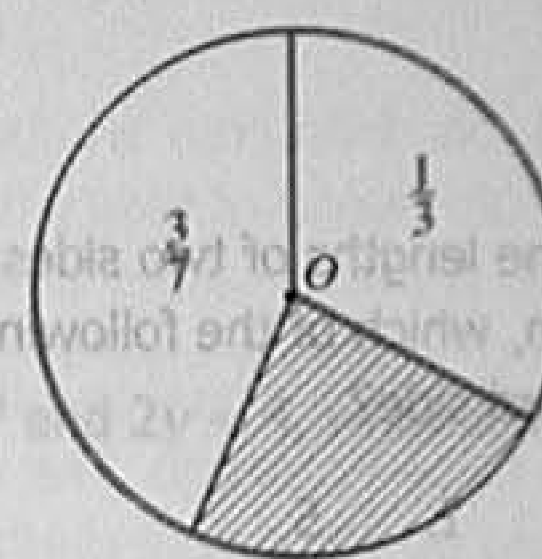
(A) −27
(B) −18
(C) 18
(D) 27
(E) 81

40. $\dfrac{29^2 + 29}{29} =$

(A) 870
(B) 841
(C) 58
(D) 31
(E) 30

41. If $x = 1 - 3t$ and $y = 2t - 1$, then for what value of t does $x = y$?

(A) $\frac{5}{2}$
(B) $\frac{3}{2}$
(C) $\frac{2}{3}$
(D) $\frac{2}{5}$
(E) 0



42. In the circular region with center O, shown above, the two unshaded sections constitute $\frac{3}{7}$ and $\frac{1}{3}$ of the area of the circular region. The shaded section constitutes what fractional part of the area of the circular region?

(A) $\frac{3}{5}$
(B) $\frac{6}{7}$
(C) $\frac{2}{21}$
(D) $\frac{5}{21}$
(E) $\frac{16}{21}$

43. $\dfrac{(0.3)^5}{(0.3)^3} =$

(A) 0.001
(B) 0.01
(C) 0.09
(D) 0.9
(E) 1.0

44. In a horticultural experiment, 200 seeds were planted in plot I and 300 were planted in plot II. If 57 percent of the seeds in plot I germinated and 42 percent of the seeds in plot II germinated, what percent of the total number of planted seeds germinated?

(A) 45.5%
(B) 46.5%
(C) 48.0%
(D) 49.5%
(E) 51.0%

45. If 3 and 8 are the lengths of two sides of a triangular region, which of the following can be the length of the third side?

I. 5
II. 8
III. 11

(A) II only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

46. How many integers n are there such that $1 < 5n + 5 < 25$?

(A) Five
(B) Four
(C) Three
(D) Two
(E) One

47. A car dealer sold x used cars and y new cars during May. If the number of used cars sold was 10 greater than the number of new cars sold, which of the following expresses this relationship?

(A) $x > 10y$
(B) $x > y + 10$
(C) $x > y - 10$
(D) $x = y + 10$
(E) $x = y - 10$

48. If a 10 percent deposit that has been paid toward the purchase of a certain product is $110, how much more remains to be paid?

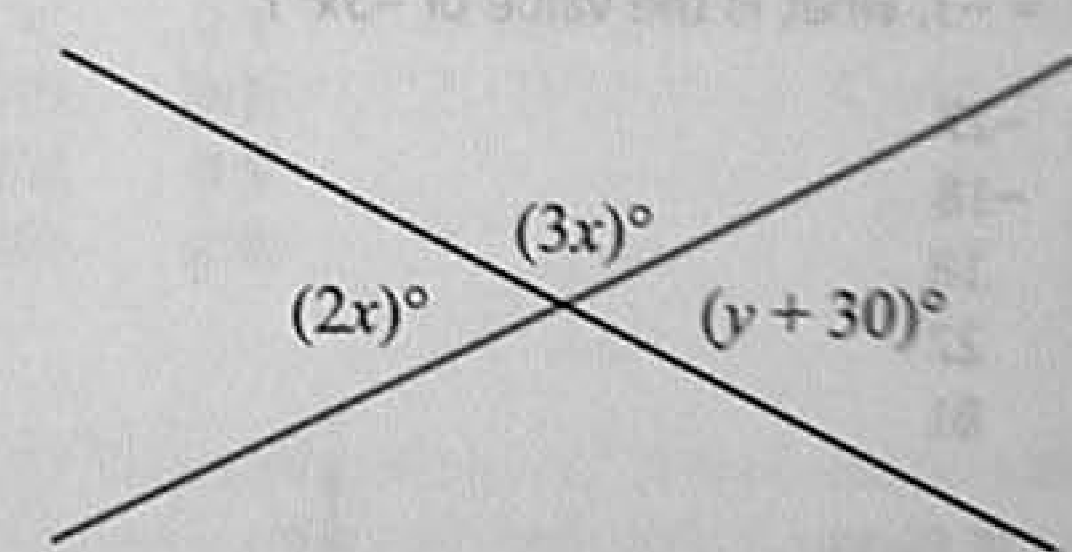
(A) $880
(B) $990
(C) $1,000
(D) $1,100
(E) $1,210

49. $\left(\sqrt{7} + \sqrt{7}\right)^2$

(A) 98
(B) 49
(C) 28
(D) 21
(E) 14

50. In a certain population, there are 3 times as many people aged 21 or under as there are people over 21. The ratio of those 21 or under to the total population is

(A) 1 to 2
(B) 1 to 3
(C) 1 to 4
(D) 2 to 3
(E) 3 to 4



51. In the figure above, the value of y is

(A) 6
(B) 12
(C) 24
(D) 36
(E) 42

52. Kelly and Chris packed several boxes with books. If Chris packed 60 percent of the total number of boxes, what was the ratio of the number of boxes Kelly packed to the number of boxes Chris packed?

(A) 1 to 6
(B) 1 to 4
(C) 2 to 5
(D) 3 to 5
(E) 2 to 3

53. Of the following, which is the closest approximation of $\frac{50.2 \times 0.49}{199.8}$?

(A) $\frac{1}{10}$
(B) $\frac{1}{8}$
(C) $\frac{1}{4}$
(D) $\frac{5}{4}$
(E) $\frac{25}{2}$

54. The average (arithmetic mean) of 10, 30, and 50 is 5 more than the average of 20, 40, and

(A) 15
(B) 25
(C) 35
(D) 45
(E) 55

55. If $y = 4 + (x - 3)^2$, then y is lowest when $x =$

(A) 14
(B) 13
(C) 0
(D) 3
(E) 4

56. Which of the following is NOT equal to the square of an integer?

(A) $\sqrt{\sqrt{1}}$
(B) $\sqrt{4}$
(C) $\frac{18}{2}$
(D) $41 - 25$
(E) 36

57. Fermat primes are prime numbers that can be written in the form $2^k + 1$, where k is an integer and a power of 2. Which of the following is NOT a Fermat prime?

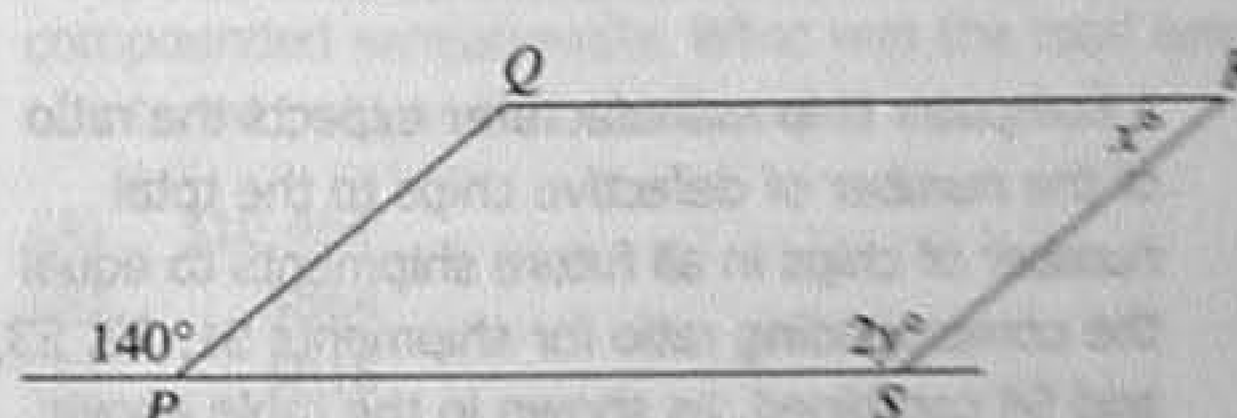
(A) 3
(B) 5
(C) 17
(D) 31
(E) 257

58. If $x^2 = 2y^3$ and $2y = 4$, what is the value of $x^2 + y$?

(A) -14
(B) -2
(C) 3
(D) 6
(E) 18

59. A glucose solution contains 15 grams of glucose per 100 cubic centimeters of solution. If 45 cubic centimeters of the solution were poured into an empty container, how many grams of glucose would be in the container?

(A) 3.00
(B) 5.00
(C) 5.50
(D) 6.50
(E) 6.75



60. In the figure above, if $PQRS$ is a parallelogram, then $y - x =$

(A) 30
(B) 35
(C) 40
(D) 70
(E) 100

61. If 1 kilometer is approximately 0.60 mile, which of the following best approximates the number of kilometers in 2 miles?

(A) $\frac{10}{3}$
(B) 3
(C) $\frac{6}{5}$
(D) $\frac{1}{3}$
(E) $\frac{3}{10}$

62. Lucy invested \$10,000 in a new mutual fund account exactly three years ago. The value of the account increased by 10 percent during the first year, increased by 5 percent during the second year, and decreased by 10 percent during the third year. What is the value of the account today?

(A) \$10,350
(B) \$10,395
(C) \$10,500
(D) \$11,500
(E) \$12,705

Shipment	Number of defective chips in the shipment	Total Number of chips in the shipment
S1	2	5,000
S2	5	12,000
S3	6	18,000
S4	4	16,000

63. A computer chip manufacturer expects the ratio of the number of defective chips to the total number of chips in all future shipments to equal the corresponding ratio for shipments S1, S2, S3, and S4 combined, as shown in the table above. What is the expected number of defective chips in a shipment of 60,000 chips?

(A) 14
(B) 20
(C) 22
(D) 24
(E) 25

$$A = \{2, 3, 4, 5\}$$
$$B = \{4, 5, 6, 7, 8\}$$

64. Two integers will be randomly selected from the sets above, one integer from set A and one integer from set B. What is the probability that the sum of the two integers will equal 9?

(A) 0.15
(B) 0.20
(C) 0.25
(D) 0.30
(E) 0.33

2, 4, 6, 8, n, 3, 5, 7, 9

65. In the list above, if n is an integer between 1 and 10, inclusive, then the median must be

(A) either 4 or 5
(B) either 5 or 6
(C) either 6 or 7
(D) n
(E) 5.50

$$\begin{array}{r} 4\ u\ 7 \\ n\ 2\ 3 \\ +\ 1\ 6\ 2 \\ \hline 1,\ 2\ 2\ 2 \end{array}$$

66. If n and u represent single digits in the correctly worked computation above, what is the value of $n + u$?

(A) 7
(B) 9
(C) 10
(D) 11
(E) 13

$$r = 400\left(\frac{D+S-P}{P}\right)$$

67. If stock is sold three months after it is purchased, the formula above relates P, D, S, and r, where P is the purchase price of the stock, D is the amount of any dividend received, S is the selling price of the stock, and r is the yield of the investment as a percent. If Rose purchased \$400 worth of stock, received a dividend of \$5, and sold the stock for \$420 three months after purchasing it, what was the yield of her investment according to the formula? (Assume that she paid no commissions.)

(A) 1.25%
(B) 5%
(C) 6.25%
(D) 20%
(E) 25%

68. The temperatures in degrees Celsius recorded at 6 in the morning in various parts of a certain country were 10°, 5°, -2°, -1°, -5°, and 15°. What is the median of these temperatures?

(A) −2°C
(B) −1°C
(C) 2°C
(D) 3°C
(E) 5°C

69. If $y\left(\frac{3x-5}{2}\right) = y$ and $y \neq 0$, then $x =$

(A) $\frac{2}{3}$
(B) $\frac{5}{3}$
(C) $\frac{7}{3}$
(D) 1
(E) 4

70. If $x + 5 > 2$ and $x - 3 < 7$, the value of x must be between which of the following pairs of numbers?

(A) −3 and 10
(B) −3 and 4
(C) 2 and 7
(D) 3 and 4
(E) 3 and 10

71. A gym class can be divided into 8 teams with an equal number of players on each team or into 12 teams with an equal number of players on each team. What is the lowest possible number of students in the class?

(A) 20
(B) 24
(C) 36
(D) 48
(E) 96

72. At least $\frac{2}{3}$ of the 40 members of a committee must vote in favor of a resolution for it to pass. What is the greatest number of members who could vote against the resolution and still have it pass?

(A) 19
(B) 17
(C) 16
(D) 14
(E) 13

73. In the Johnsons' monthly budget, the dollar amounts allocated to household expenses, food, and miscellaneous items are in the ratio 5:2:1, respectively. If the total amount allocated to these three categories is $1,800, what is the amount allocated to food?

(A) $900
(B) $720
(C) $675
(D) $450
(E) $225

74. There are 4 more women than men on Centerville's board of education. If there are 10 members on the board, how many are women?

(A) 3
(B) 4
(C) 6
(D) 7
(E) 8

75. Leona bought a 1-year, $10,000 certificate of deposit that paid interest at an annual rate of 8 percent compounded semiannually. What was the total amount of interest paid on this certificate at maturity?

(A) $10,464
(B) $864
(C) $816
(D) $800
(E) $480

76. Which of the following ratios is most nearly equal to the ratio $1 + \sqrt{5}$ to 2?

(A) 8 to 5
(B) 6 to 5
(C) 5 to 4
(D) 2 to 1
(E) 1 to 1

77. $\frac{\frac{7}{\frac{1}{5}}}{} + \frac{\frac{5}{\frac{1}{7}}}{} =$

(A) $\frac{35}{74}$
(B) $\frac{74}{35}$
(C) 35
(D) 70
(E) 74

78. From January 1, 1991, to January 1, 1993, the number of people enrolled in health maintenance organizations increased by 15 percent. The enrollment on January 1, 1993, was 45 million. How many million people, to the nearest million, were enrolled in health maintenance organizations on January 1, 1991?

(A) 38
(B) 39
(C) 40
(D) 41
(E) 42

79. R is the set of positive odd integers less than 50, and S is the set of the squares of the integers in R. How many elements does the intersection of R and S contain?

(A) None
(B) Two
(C) Four
(D) Five
(E) Seven

80. A retail appliance store priced a video recorder at 20 percent above the wholesale cost of \$200. If a store employee applied the 10 percent employee discount to the retail price to buy the recorder, how much did the employee pay for the recorder?

(A) \$198
(B) \$216
(C) \$220
(D) \$230
(E) \$240

$$y = 248 - 398x$$

81. Which of the following values of x gives the greatest value of y in the equation above?

(A) 200
(B) 100
(C) 0.5
(D) 0
(E) −1

82. Machine A produces bolts at a uniform rate of 120 every 40 seconds, and machine B produces bolts at a uniform rate of 100 every 20 seconds. If the two machines run simultaneously, how many seconds will it take for them to produce a total of 200 bolts?

(A) 22
(B) 25
(C) 28
(D) 32
(E) 56

83. What is the decimal equivalent of $\left(\frac{1}{5}\right)^5$?

(A) 0.00032
(B) 0.0016
(C) 0.00625
(D) 0.008
(E) 0.03125

84. $\dfrac{90 - 8(20 \div 4)}{\frac{1}{2}} =$

(A) 25
(B) 50
(C) 100
(D) 116
(E) 170

85. A dealer originally bought 100 identical batteries at a total cost of q dollars. If each battery was sold at 50 percent above the original cost per battery, then, in terms of q, for how many dollars was each battery sold?

(A) $\frac{3q}{200}$

(B) $\frac{3q}{2}$

(C) $150q$

(D) $\frac{q}{100} + 50$

(E) $\frac{150}{q}$

86. In an increasing sequence of 10 consecutive integers, the sum of the first 5 integers is 560. What is the sum of the last 5 integers in the sequence?

(A) 585
(B) 580
(C) 575
(D) 570
(E) 565

87. Machine A produces 100 parts twice as fast as machine B does. Machine B produces 100 parts in 40 minutes. If each machine produces parts at a constant rate, how many parts does machine A produce in 6 minutes?

(A) 30
(B) 25
(C) 20
(D) 15
(E) 7.5

88. A necklace is made by stringing N individual beads together in the repeating pattern red bead, green bead, white bead, blue bead, and yellow bead. If the necklace design begins with a red bead and ends with a white bead, then N could equal

(A) 16
(B) 32
(C) 41
(D) 54
(E) 68

89. In the xy-coordinate system, if (a,b) and $(a+3, b+k)$ are two points on the line defined by the equation $x = 3y - 7$, then $k =$

(A) 9

(B) 3

(C) $\frac{7}{3}$

(D) 1

(E) $\frac{1}{3}$

90. At the rate of m meters per s seconds, how many meters does a cyclist travel in x minutes?

(A) $\frac{m}{sx}$

(B) $\frac{mx}{s}$

(C) $\frac{60m}{sx}$

(D) $\frac{60ms}{x}$

(E) $\frac{60mx}{s}$

91. If Sam were twice as old as he is, he would be 40 years older than Jim. If Jim is 10 years younger than Sam, how old is Sam?

(A) 20
(B) 30
(C) 40
(D) 50
(E) 60

92. In a certain furniture store, each week Nancy earns a salary of $240 plus 5 percent of the amount of her total sales that exceeds $800 for the week. If Nancy earned a total of $450 one week, what were her total sales that week?

(A) $2,200
(B) $3,450
(C) $4,200
(D) $4,250
(E) $5,000

List I: 3, 6, 8, 19
List II: x, 3, 6, 8, 19

93. If the median of the numbers in list I above is equal to the median of the numbers in list II above, what is the value of x?

(A) 6
(B) 7
(C) 8
(D) 9
(E) 10

94. In a certain city, 60 percent of the registered voters are Democrats and the rest are Republicans. In a mayoral race, if 75 percent of the registered voters who are Democrats and 20 percent of the registered voters who are Republicans are expected to vote for Candidate A, what percent of the registered voters are expected to vote for Candidate A?

(A) 50%
(B) 53%
(C) 54%
(D) 55%
(E) 57%

95. A certain company retirement plan has a "rule of 70" provision that allows an employee to retire when the employee's age plus years of employment with the company total at least 70. In what year could a female employee hired in 1986 on her 32nd birthday first be eligible to retire under this provision?

(A) 2003
(B) 2004
(C) 2005
(D) 2006
(E) 2007

96. $\frac{1}{2}+\left[\left(\frac{2}{3}\times\frac{3}{8}\right)\div 4\right]-\frac{9}{16}=$

(A) $\frac{29}{16}$
(B) $\frac{19}{16}$
(C) $\frac{15}{16}$
(D) $\frac{9}{13}$
(E) 0

97. Water consists of hydrogen and oxygen, and the approximate ratio, by mass, of hydrogen to oxygen is 2 : 16. Approximately how many grams of oxygen are there in 144 grams of water?

(A) 16
(B) 72
(C) 112
(D) 128
(E) 142

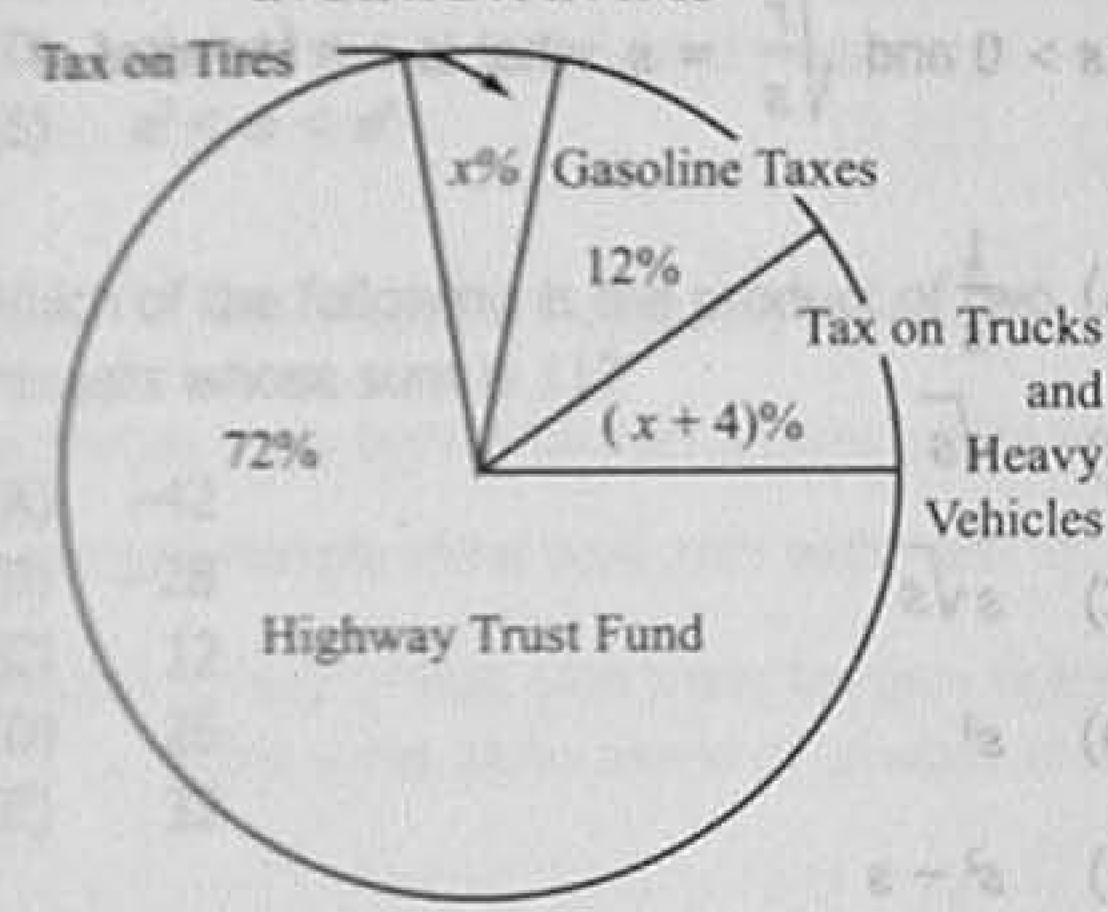
98. If $x(2x + 1) = 0$ and $\left(x+\frac{1}{2}\right)(2x-3)=0$, then $x =$

(A) -3
(B) $-\frac{1}{2}$
(C) 0
(D) $\frac{1}{2}$
(E) $\frac{3}{2}$

99. On a scale that measures the intensity of a certain phenomenon, a reading of $n + 1$ corresponds to an intensity that is 10 times the intensity corresponding to a reading of n. On that scale, the intensity corresponding to a reading of 8 is how many times as great as the intensity corresponding to a reading of 3?

(A) 5
(B) 50
(C) 10^5
(D) 5^{10}
(E) $8^{10} - 3^{10}$

SOURCES OF FUNDS FOR HIGHWAY MAINTENANCE
IN STATE X IN 1983



100. According to the graph above, what percent of the funds for highway maintenance came from the tax on tires?

(A) 3%
(B) 6%
(C) 8%
(D) 10%
(E) 16%

101. A poll reveals that the average (arithmetic mean) income of 10 households is \$25,000. If 6 of the households have incomes of \$30,000 each, what is the average income of the other 4 households?

(A) \$21,500
(B) \$20,000
(C) \$17,500
(D) \$7,500
(E) \$7,000

102. If $T = \frac{5}{9}(K - 32)$, and if $T = 290$, then $K =$

(A) $\frac{1,738}{9}$
(B) 322
(C) 490
(D) 554
(E) $\frac{2,898}{5}$

103. The water from one outlet, flowing at a constant rate, can fill a swimming pool in 9 hours. The water from a second outlet, flowing at a constant rate, can fill the same pool in 5 hours. If both outlets are used at the same time, approximately what is the number of hours required to fill the pool?

(A) 0.22
(B) 0.31
(C) 2.50
(D) 3.21
(E) 4.56

104. Diana bought a stereo for \$530, which was the retail price plus a 6 percent sales tax. How much money could she have saved if she had bought the stereo at the same retail price in a neighboring state where she would have paid a sales tax of 5 percent?

(A) \$1.00
(B) \$2.65
(C) \$4.30
(D) \$5.00
(E) \$5.30

105. If a square mirror has a 20-inch diagonal, what is the approximate perimeter of the mirror, in inches?

(A) 40
(B) 60
(C) 80
(D) 100
(E) 120

106. The present ratio of students to teachers at a certain school is 30 to 1. If the student enrollment were to increase by 50 students and the number of teachers were to increase by 5, the ratio of students to teachers would then be 25 to 1. What is the present number of teachers?

(A) 5
(B) 8
(C) 10
(D) 12
(E) 15

107. What is the smallest integer n for which $25^n > 5^{12}$?

(A) 6
(B) 7
(C) 8
(D) 9
(E) 10

108. If x and y are different prime numbers, each greater than 2, which of the following must be true?

I. $x + y \neq 91$
II. $x - y$ is an even integer.
III. $\frac{x}{y}$ is not an integer.

(A) II only
(B) I and II only
(C) I and III only
(D) II and III only
(E) I, II, and III

109. All the following have the same value EXCEPT

(A) $\frac{1+2+3+4+5}{3}$

(B) $\frac{1}{3}(1+1+1+1+1)$

(C) $\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}$

(D) $\frac{2}{3}\left(\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}\right)$

(E) $\frac{1}{3}+\frac{2}{6}+\frac{3}{9}+\frac{4}{12}+\frac{5}{15}$

110. If candy bars that regularly sell for \$0.40 each are on sale at two for \$0.75, what is the percent reduction in the price of two such candy bars purchased at the sale price?

(A) $2\frac{1}{2}\%$

(B) $6\frac{1}{4}\%$

(C) $6\frac{2}{3}\%$

(D) 8%

(E) $12\frac{1}{2}\%$

111. If $s > 0$ and $\sqrt{\frac{r}{s}} = s$, what is r in terms of s?

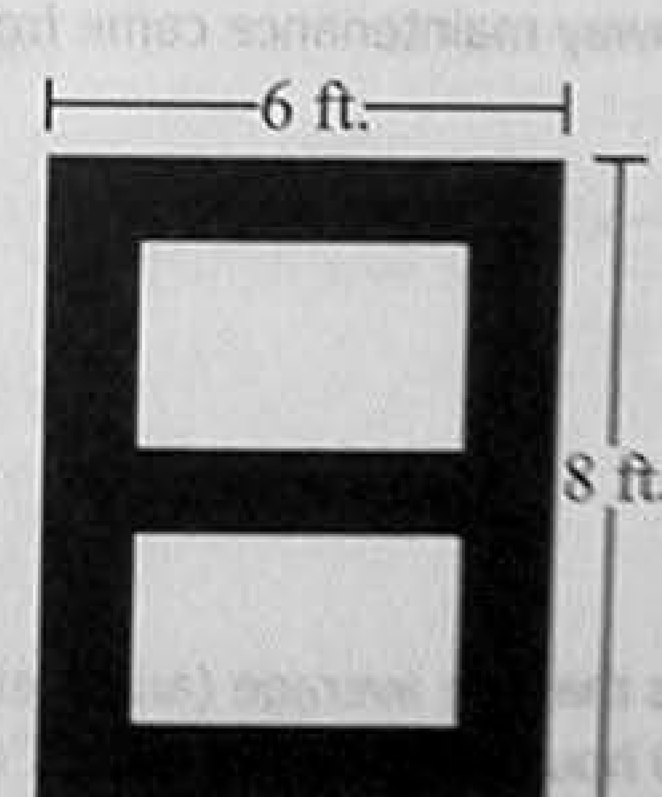
(A) $\frac{1}{s}$

(B) $\sqrt{s}$

(C) $s\sqrt{s}$

(D) s^3

(E) $s^2 - s$



112. The front of a 6-foot-by-8-foot rectangular door has brass rectangular trim, as indicated by the shading in the figure above. If the trim is uniformly 1 foot wide, what fraction of the door's front surface is covered by the trim?

(A) $\frac{13}{48}$

(B) $\frac{5}{12}$

(C) $\frac{1}{2}$

(D) $\frac{7}{12}$

(E) $\frac{5}{8}$

113. If $a = -0.3$, which of the following is true?

(A) $a < a^2 < a^3$
(B) $a < a^3 < a^2$
(C) $a^2 < a < a^3$
(D) $a^2 < a^3 < a$
(E) $a^3 < a < a^2$

114. Which of the following is the product of two integers whose sum is 11?

(A) −42
(B) −28
(C) 12
(D) 26
(E) 32

115. Mary's income is 60 percent more than Tim's income, and Tim's income is 40 percent less than Juan's income. What percent of Juan's income is Mary's income?

(A) 124%
(B) 120%
(C) 96%
(D) 80%
(E) 64%

	City A	City B	City C	City D	City E
City A		•	•	•	•
City B			•	•	•
City C				•	•
City D					•
City E					

116. Each • in the mileage table above represents an entry indicating the distance between a pair of the five cities. If the table were extended to represent the distances between all pairs of 30 cities and each distance were to be represented by only one entry, how many entries would the table then have?

(A) 60
(B) 435
(C) 450
(D) 465
(E) 900

117. Which of the following has a value less than 1?

(A) $2\left(\frac{7}{13}\right)$

(B) $\frac{\sqrt{10}}{2}$

(C) $\frac{2}{\sqrt{2}}$

(D) $\frac{\frac{1}{1}}{\frac{}{2}}$

(E) $\left(\frac{9}{10}\right)^2$

118. The ratio of the length to the width of a rectangular advertising display is approximately 3.3 to 2. If the width of the display is 8 meters, what is the approximate length of the display, in meters?

(A) 7
(B) 11
(C) 13
(D) 16
(E) 26