

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

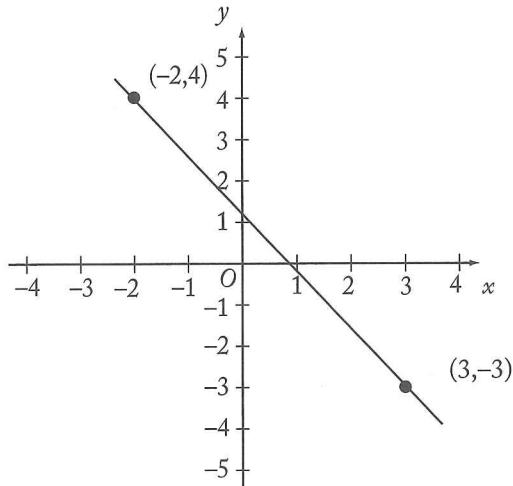
$$\frac{\text{The difference in the } y\text{-coordinates}}{\text{The difference in the } x\text{-coordinates}} = \frac{0 - 2}{2 - (-2)} = \frac{-2}{4} = -\frac{1}{2}.$$

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 $y = -\frac{1}{2}x + 1$. 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

$$\begin{aligned} -\frac{1}{2}x + 1 &= 0 \\ -\frac{1}{2}x &= -1 \\ x &= 2. \end{aligned}$$

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

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

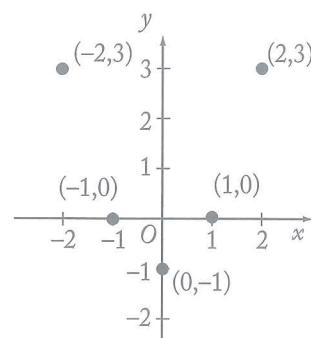
shown above. Similarly, any function $f(x)$ can be graphed by equating y with the value of the function:

$$y = f(x).$$

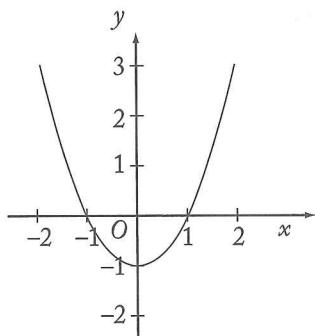
So for any x in the domain of the function f , the point with coordinates $(x, f(x))$ is on the graph of f , and the graph consists entirely of these points.

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 $-2 \leq x \leq 2$, 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 $f(0)$.

3.4 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 \times time = distance, simply multiply $70 \text{ km/hour} \times 4 \text{ hours}$. 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 (mph) and the other half at 50 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 $\frac{1}{r} + \frac{1}{s} = \frac{1}{b}$, 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 b 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 $\frac{1}{b}$ 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:

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

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

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

$$9b = 20$$

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

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:

$$\begin{aligned}\frac{1}{6} + \frac{1}{R} &= \frac{1}{4} \\ \frac{R+6}{6R} &= \frac{1}{4} \\ 4R + 24 &= 6R \\ 24 &= 2R \\ 12 &= R\end{aligned}$$

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

$$\frac{\$10.40}{8} = \$1.30.$$

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) \times (interest rate) \times (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 $\frac{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

$$10,000 + (10,000)(0.05) = \$10,500.$$

The balance after one year would be $10,500 + (10,500)(0.05) = \$11,025$.

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?

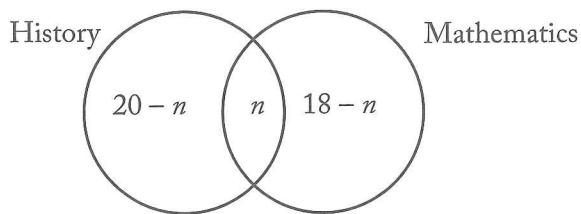
Solution: If s is the selling price of the appliance, then $s - 30 = (0.5)(30)$, or $s = \$45$. The merchant should sell the appliance for \$45.

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 percentages given. The following percentages can be computed on the basis of what is given:

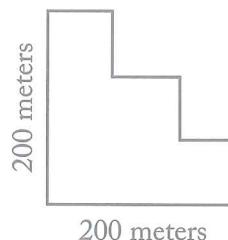
	Red	Green	Total
Small	10%	40%	50%
Large	30%	20%	50%
Total	40%	60%	100%

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

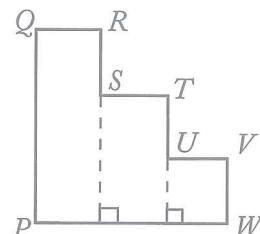
The following is an example of a word problem involving geometry.

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.

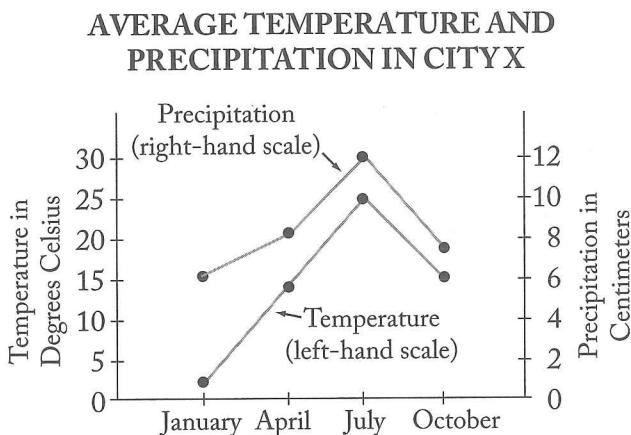
Example 1:

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:

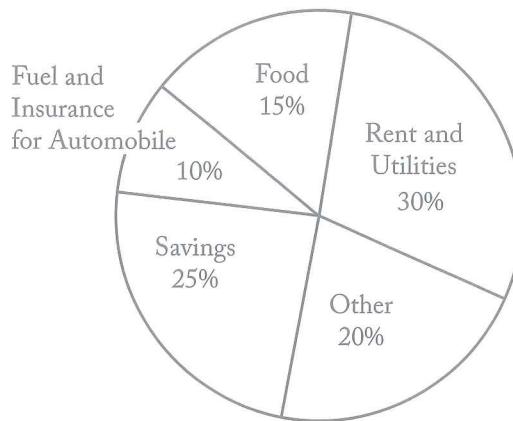


What are the average temperature and precipitation in City X during April?

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 approximately 8 centimeters.

Example 3:

DISTRIBUTION OF AL'S WEEKLY NET SALARY



Al's weekly net salary is \$350. 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%.

4.0 Problem Solving

4.0 Problem Solving

The Quantitative section of the GMAT® exam 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; 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 test-taking strategies, directions that will apply to questions of this type, sample questions, an answer key, and explanations for all the problems. These explanations present problem solving strategies that could be helpful in answering the questions.

4.1 Test-Taking Strategies

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 to 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 $\frac{1}{4}$). 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 then move on to the next question.

4.2 The Directions

These directions are very similar to those you will see for problem solving questions when you take the GMAT exam. 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. Exceptions will be clearly noted. Lines shown as straight are straight, and lines that appear jagged are also straight. The positions of points, angles, regions, etc., exist in the order shown, and angle measures are greater than zero. All figures lie in a plane unless otherwise indicated.

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4.3 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. Exceptions will be clearly noted. Lines shown as straight are straight, and lines that appear jagged are also straight. The positions of points, angles, regions, etc., exist in the order shown, and angle measures are greater than zero. All figures lie in a plane unless otherwise indicated.

*PS03439

1. Working at a constant rate, a copy machine makes 20 copies of a one-page document per minute. If the machine works at this constant rate, how many hours does it take to make 4,800 copies of a one-page document?

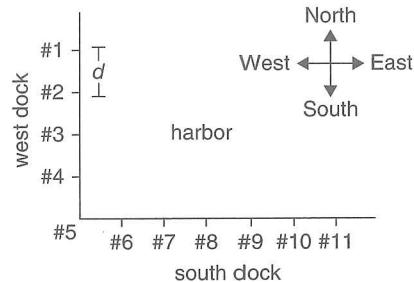
(A) 4
(B) 5
(C) 6
(D) 7
(E) 8

PS11042

2. If $x + y = 2$ and $x^2 + y^2 = 2$, what is the value of xy ?
- (A) -2
(B) -1
(C) 0
(D) 1
(E) 2

PS02978

3. The sum S of the first n consecutive positive even integers is given by $S = n(n + 1)$. For what value of n is this sum equal to 110?
- (A) 10
(B) 11
(C) 12
(D) 13
(E) 14



PS08375

4. A certain harbor has docking stations along its west and south docks, as shown in the figure; any two adjacent docking stations are separated by a uniform distance d . A certain boat left the west dock from docking station #2 and moved in a straight line diagonally until it reached the south dock. If the boat was at one time directly east of docking station #4 and directly north of docking station #7, at which docking station on the south dock did the boat arrive?
- (A) #7
(B) #8
(C) #9
(D) #10
(E) #11

PS03887

5. $6(87.30 + 0.65) - 5(87.30) =$
- (A) 3.90
(B) 39.00
(C) 90.90
(D) 91.20
(E) 91.85

*These numbers correlate with the online test bank question number. See the GMAT Quantitative Review Online Index in the back of this book.

PS13800

6. Points A , B , C , and D , in that order, lie on a line. If $AB = 3$ cm, $AC = 4$ cm, and $BD = 6$ cm, what is CD , in centimeters?

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

PS05292

7. What is the value of $x^2yz - xyz^2$, if $x = -2$, $y = 1$, and $z = 3$?

(A) 20
 (B) 24
 (C) 30
 (D) 32
 (E) 48

PS11468

8. A souvenir vendor purchased 1,000 shirts for a special event at a price of \$5 each. The vendor sold 600 of the shirts on the day of the event for \$12 each and 300 of the shirts in the week following the event for \$4 each. The vendor was unable to sell the remaining shirts. What was the vendor's gross profit on the sale of these shirts?

(A) \$1,000
 (B) \$2,200
 (C) \$2,700
 (D) \$3,000
 (E) \$3,400

PS06937

9. If $x > y$ and $y > z$, which of the following represents the greatest number?

(A) $x - z$
 (B) $x - y$
 (C) $y - x$
 (D) $z - y$
 (E) $z - x$

PS12926

10. To order certain plants from a catalog, it costs \$3.00 per plant, plus a 5 percent sales tax, plus \$6.95 for shipping and handling regardless of the number of plants ordered. If Company C ordered these plants from the catalog at the total cost of \$69.95, how many plants did Company C order?

(A) 22
 (B) 21
 (C) 20
 (D) 19
 (E) 18

PS00812

11. A rug manufacturer produces rugs at a cost of \$75 per rug. What is the manufacturer's gross profit from the sale of 150 rugs if $\frac{2}{3}$ of the rugs are sold for \$150 per rug and the rest are sold for \$200 per rug?

(A) \$10,350
 (B) \$11,250
 (C) \$13,750
 (D) \$16,250
 (E) \$17,800

PS07793

12. The value of Maureen's investment portfolio has decreased by 5.8 percent since her initial investment in the portfolio. If her initial investment was \$16,800, what is the current value of the portfolio?

(A) \$7,056.00
 (B) \$14,280.00
 (C) \$15,825.60
 (D) \$16,702.56
 (E) \$17,774.40

PS03036

13. Company C produces toy trucks at a cost of \$5.00 each for the first 100 trucks and \$3.50 for each additional truck. If 500 toy trucks were produced by Company C and sold for \$10.00 each, what was Company C's gross profit?

(A) \$2,250
 (B) \$2,500
 (C) \$3,100
 (D) \$3,250
 (E) \$3,500

PS07694

14. A group of store managers must assemble 280 displays for an upcoming sale. If they assemble 25 percent of the displays during the first hour and 40 percent of the remaining displays during the second hour, how many of the displays will not have been assembled by the end of the second hour?
- (A) 70
 (B) 98
 (C) 126
 (D) 168
 (E) 182

Division	Profit or Loss (in millions of dollars)				
	1991	1992	1993	1994	1995
A	1.1	(3.4)	1.9	2.0	0.6
B	(2.3)	5.5	(4.5)	3.9	(2.9)
C	10.0	(6.6)	5.3	1.1	(3.0)

PS02019

15. The annual profit or loss for the three divisions of Company T for the years 1991 through 1995 are summarized in the table shown, where losses are enclosed in parentheses. For which division and which three consecutive years shown was the division's profit or loss for the three-year period closest to \$0?
- (A) Division A for 1991–1993
 (B) Division A for 1992–1994
 (C) Division B for 1991–1993
 (D) Division B for 1993–1995
 (E) Division C for 1992–1994

PS13583

16. Of the following, which is least?
- (A) $\frac{0.03}{0.00071}$
 (B) $\frac{0.03}{0.0071}$
 (C) $\frac{0.03}{0.071}$
 (D) $\frac{0.03}{0.71}$
 (E) $\frac{0.03}{7.1}$

PS07385

17. The maximum recommended pulse rate R , when exercising, for a person who is x years of age is given by the equation $R = 176 - 0.8x$. What is the age, in years, of a person whose maximum recommended pulse rate when exercising is 140?
- (A) 40
 (B) 45
 (C) 50
 (D) 55
 (E) 60
- PS08011
18. If the average (arithmetic mean) of 5 numbers $j, j + 5, 2j - 1, 4j - 2$, and $5j - 1$ is 8, what is the value of j ?
- (A) $\frac{1}{3}$
 (B) $\frac{7}{13}$
 (C) 1
 (D) 3
 (E) 8

PS14037

19. Guadalupe owns 2 rectangular tracts of land. One is 300 m by 500 m and the other is 250 m by 630 m. The combined area of these 2 tracts is how many square meters?
- (A) 3,360
 (B) 307,500
 (C) 621,500
 (D) 704,000
 (E) 2,816,000

PS03918

20. There are five sales agents in a certain real estate office. One month Andy sold twice as many properties as Ellen, Bob sold 3 more than Ellen, Cary sold twice as many as Bob, and Dora sold as many as Bob and Ellen together. Who sold the most properties that month?
- (A) Andy
 (B) Bob
 (C) Cary
 (D) Dora
 (E) Ellen

PS10862

21. In a field day at a school, each child who competed in n events and scored a total of p points was given an overall score of $\frac{p}{n} + n$. Andrew competed in 1 event and scored 9 points. Jason competed in 3 events and scored 5, 6, and 7 points, respectively. What was the ratio of Andrew's overall score to Jason's overall score?
- (A) $\frac{10}{23}$
 (B) $\frac{7}{10}$
 (C) $\frac{4}{5}$
 (D) $\frac{10}{9}$
 (E) $\frac{12}{7}$

PS06719

22. A certain work plan for September requires that a work team, working every day, produce an average of 200 items per day. For the first half of the month, the team produced an average of 150 items per day. How many items per day must the team average during the second half of the month if it is to attain the average daily production rate required by the work plan?
- (A) 225
 (B) 250
 (C) 275
 (D) 300
 (E) 350

PS01949

23. A company sells radios for \$15.00 each. It costs the company \$14.00 per radio to produce 1,000 radios and \$13.50 per radio to produce 2,000 radios. How much greater will the company's gross profit be from the production and sale of 2,000 radios than from the production and sale of 1,000 radios?
- (A) \$500
 (B) \$1,000
 (C) \$1,500
 (D) \$2,000
 (E) \$2,500

PS06555

24. Which of the following represent positive numbers?
- I. $-3 - (-5)$
 II. $(-3)(-5)$
 III. $-5 - (-3)$
- (A) I only
 (B) II only
 (C) III only
 (D) I and II
 (E) II and III

PS02948

25. If $\frac{x}{4}$ is 2 more than $\frac{x}{8}$, then $x =$
- (A) 4
 (B) 8
 (C) 16
 (D) 32
 (E) 64

PS09983

26. Point X lies on side BC of rectangle ABCD, which has length 12 and width 8. What is the area of triangular region AXD?
- (A) 96
 (B) 48
 (C) 32
 (D) 24
 (E) 20

PS07659

27. A grocer has 400 pounds of coffee in stock, 20 percent of which is decaffeinated. If the grocer buys another 100 pounds of coffee of which 60 percent is decaffeinated, what percent, by weight, of the grocer's stock of coffee is decaffeinated?
- (A) 28%
 (B) 30%
 (C) 32%
 (D) 34%
 (E) 40%

PS05129

28. The toll T , in dollars, for a truck using a certain bridge is given by the formula $T = 1.50 + 0.50(x - 2)$, where x is the number of axles on the truck. What is the toll for an 18-wheel truck that has 2 wheels on its front axle and 4 wheels on each of its other axles?

(A) \$2.50
 (B) \$3.00
 (C) \$3.50
 (D) \$4.00
 (E) \$5.00

PS13917

29. For what value of x between -4 and 4 , inclusive, is the value of $x^2 - 10x + 16$ the greatest?

(A) -4
 (B) -2
 (C) 0
 (D) 2
 (E) 4

PS15994

30. If $x = -\frac{5}{8}$ and $y = -\frac{1}{2}$, what is the value of the expression $-2x - y^2$?

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

PS13686

31. If $x - y = R$ and $xy = S$, then $(x - 2)(y + 2) =$

(A) $R + S - 4$
 (B) $R + 2S - 4$
 (C) $2R - S - 4$
 (D) $2R + S - 4$
 (E) $2R + S$

PS01466

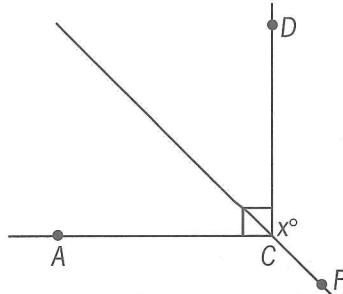
32. For positive integers a and b , the remainder when a is divided by b is equal to the remainder when b is divided by a . Which of the following could be a value of ab ?

I. 24
 II. 30
 III. 36
 (A) II only
 (B) III only
 (C) I and II only
 (D) II and III only
 (E) I, II, and III

PS01867

33. List S consists of the positive integers that are multiples of 9 and are less than 100. What is the median of the integers in S ?

(A) 36
 (B) 45
 (C) 49
 (D) 54
 (E) 63



PS07397

34. In the figure above, if F is a point on the line that bisects angle ACD and the measure of angle DCF is x° , which of the following is true of x ?

(A) $90 \leq x < 100$
 (B) $100 \leq x < 110$
 (C) $110 \leq x < 120$
 (D) $120 \leq x < 130$
 (E) $130 \leq x < 140$

PS07380

35. A rope 20.6 meters long is cut into two pieces. If the length of one piece of rope is 2.8 meters shorter than the length of the other, what is the length, in meters, of the longer piece of rope?

(A) 7.5
 (B) 8.9
 (C) 9.9
 (D) 10.3
 (E) 11.7

PS01120

36. If x and y are integers and $x - y$ is odd, which of the following must be true?

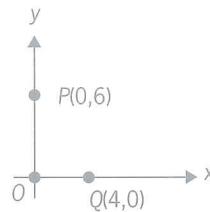
I. xy is even.
 II. $x^2 + y^2$ is odd.
 III. $(x + y)^2$ is even.

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

PS00335

37. On Monday, the opening price of a certain stock was \$100 per share and its closing price was \$110 per share. On Tuesday the closing price of the stock was 10 percent less than its closing price on Monday, and on Wednesday the closing price of the stock was 4 percent greater than its closing price on Tuesday. What was the approximate percent change in the price of the stock from its opening price on Monday to its closing price on Wednesday?

(A) A decrease of 6%
 (B) A decrease of 4%
 (C) A decrease of 1%
 (D) An increase of 3%
 (E) An increase of 4%



PS05109

38. In the rectangular coordinate system shown above, points O, P, and Q represent the sites of three proposed housing developments. If a fire station can be built at any point in the coordinate system, at which point would it be equidistant from all three developments?

(A) (3,1)
 (B) (1,3)
 (C) (3,2)
 (D) (2,2)
 (E) (2,3)

PS05008

39. What is the perimeter, in meters, of a rectangular garden 6 meters wide that has the same area as a rectangular playground 16 meters long and 12 meters wide?

(A) 48
 (B) 56
 (C) 60
 (D) 76
 (E) 192

PS00918

40. $1 - 0.000001 =$

(A) (1.01)(0.99)
 (B) (1.11)(0.99)
 (C) (1.001)(0.999)
 (D) (1.111)(0.999)
 (E) (1.0101)(0.0909)

PS04362

41. $|-4|(|-20|-|5|) =$

- (A) -100
- (B) -60
- (C) 60
- (D) 75
- (E) 100

PS12934

42. Of the total amount that Jill spent on a shopping trip, excluding taxes, she spent 50 percent on clothing, 20 percent on food, and 30 percent on other items. If Jill paid a 4 percent tax on the clothing, no tax on the food, and an 8 percent tax on all other items, then the total tax that she paid was what percent of the total amount that she spent, excluding taxes?

- (A) 2.8%
- (B) 3.6%
- (C) 4.4%
- (D) 5.2%
- (E) 6.0%

PS15469

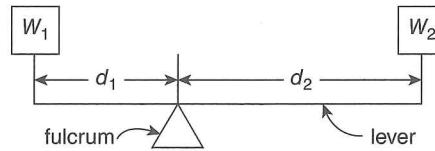
43. How many integers x satisfy both $2 < x \leq 4$ and $0 \leq x \leq 3$?

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

PS09322

44. At the opening of a trading day at a certain stock exchange, the price per share of stock K was \$8. If the price per share of stock K was \$9 at the closing of the day, what was the percent increase in the price per share of stock K for that day?

- (A) 1.4%
- (B) 5.9%
- (C) 11.1%
- (D) 12.5%
- (E) 23.6%



PS14237

45. As shown in the diagram above, a lever resting on a fulcrum has weights of w_1 pounds and w_2 pounds, located d_1 feet and d_2 feet from the fulcrum. The lever is balanced and $w_1d_1 = w_2d_2$. Suppose w_1 is 50 pounds and w_2 is 30 pounds. If d_1 is 4 feet less than d_2 , what is d_2 , in feet?

- (A) 1.5
- (B) 2.5
- (C) 6
- (D) 10
- (E) 20

PS00037

46. The number of rooms at Hotel G is 10 less than twice the number of rooms at Hotel H. If the total number of rooms at Hotel G and Hotel H is 425, what is the number of rooms at Hotel G?

- (A) 140
- (B) 180
- (C) 200
- (D) 240
- (E) 280

PS17036

47. $\frac{3}{100} + \frac{5}{1,000} + \frac{7}{100,000} =$

- (A) 0.357
- (B) 0.3507
- (C) 0.35007
- (D) 0.0357
- (E) 0.03507

PS01650

48. If r and s are positive integers such that $(2^r)(4^s) = 16$, then $2r + s =$

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

PS06726

49. Three people each contributed x dollars toward the purchase of a car. They then bought the car for y dollars, an amount less than the total number of dollars contributed. If the excess amount is to be refunded to the three people in equal amounts, each person should receive a refund of how many dollars?
- (A) $\frac{3x - y}{3}$
 (B) $\frac{x - y}{3}$
 (C) $\frac{x - 3y}{3}$
 (D) $\frac{y - 3x}{3}$
 (E) $3(x - y)$

$$2x + 2y = -4$$

$$4x + y = 1$$

PS07331

50. In the system of equations above, what is the value of x ?
- (A) -3
 (B) -1
 (C) $\frac{2}{5}$
 (D) 1
 (E) $1\frac{3}{4}$

PS07080

51. Last week Jack worked 70 hours and earned \$1,260. If he earned his regular hourly wage for the first 40 hours worked, $1\frac{1}{2}$ times his regular hourly wage for the next 20 hours worked, and 2 times his regular hourly wage for the remaining 10 hours worked, what was his regular hourly wage?
- (A) \$7.00
 (B) \$14.00
 (C) \$18.00
 (D) \$22.00
 (E) \$31.50

PS02402

52. If Mel saved more than \$10 by purchasing a sweater at a 15 percent discount, what is the smallest amount the original price of the sweater could be, to the nearest dollar?
- (A) 45
 (B) 67
 (C) 75
 (D) 83
 (E) 150

PS13426

53. If a and b are positive integers and $(2^a)^b = 2^3$, what is the value of $2^a 2^b$?
- (A) 6
 (B) 8
 (C) 16
 (D) 32
 (E) 64

PS03777

54. $\frac{1}{3 - \frac{1}{3 - \frac{1}{3 - \frac{1}{3 - 1}}}} =$
- (A) $\frac{7}{23}$
 (B) $\frac{5}{13}$
 (C) $\frac{2}{3}$
 (D) $\frac{23}{7}$
 (E) $\frac{13}{5}$

PS07386

55. After 4,000 gallons of water were added to a large water tank that was already filled to $\frac{3}{4}$ of its capacity, the tank was then at $\frac{4}{5}$ of its capacity. How many gallons of water does the tank hold when filled to capacity?
- (A) 5,000
 (B) 6,200
 (C) 20,000
 (D) 40,000
 (E) 80,000

PS01099

56. Five machines at a certain factory operate at the same constant rate. If four of these machines, operating simultaneously, take 30 hours to fill a certain production order, how many fewer hours does it take all five machines, operating simultaneously, to fill the same production order?

(A) 3
 (B) 5
 (C) 6
 (D) 16
 (E) 24

PS01443

57. A certain toll station on a highway has 7 tollbooths, and each tollbooth collects \$0.75 from each vehicle that passes it. From 6 o'clock yesterday morning to 12 o'clock midnight, vehicles passed each of the tollbooths at the average rate of 4 vehicles per minute. Approximately how much money did the toll station collect during that time period?

(A) \$1,500
 (B) \$3,000
 (C) \$11,500
 (D) \$23,000
 (E) \$30,000

PS13829

58. How many integers between 1 and 16, inclusive, have exactly 3 different positive integer factors?
 (Note: 6 is NOT such an integer because 6 has 4 different positive integer factors: 1, 2, 3, and 6.)

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

PS06288

59. If $d = 2.0453$ and d^* is the decimal obtained by rounding d to the nearest hundredth, what is the value of $d^* - d$?

(A) -0.0053
 (B) -0.0003
 (C) 0.0007
 (D) 0.0047
 (E) 0.0153

PS14063

60. Stephanie has $2\frac{1}{4}$ cups of milk on hand and makes 2 batches of cookies, using $\frac{2}{3}$ cup of milk for each batch of cookies. Which of the following describes the amount of milk remaining after she makes the cookies?

(A) Less than $\frac{1}{2}$ cup
 (B) Between $\frac{1}{2}$ cup and $\frac{3}{4}$ cup
 (C) Between $\frac{3}{4}$ cup and 1 cup
 (D) Between 1 cup and $1\frac{1}{2}$ cups
 (E) More than $1\frac{1}{2}$ cups

PS01656

61. The expression $n!$ is defined as the product of the integers from 1 through n . If p is the product of the integers from 100 through 299 and q is the product of the integers from 200 through 299, which of the following is equal to $\frac{p}{q}$?

(A) 99!
 (B) 199!
 (C) $\frac{199!}{99!}$
 (D) $\frac{299!}{99!}$
 (E) $\frac{299!}{199!}$

PS15753

62. A school club plans to package and sell dried fruit to raise money. The club purchased 12 containers of dried fruit, each containing $16\frac{3}{4}$ pounds. What is the maximum number of individual bags of dried fruit, each containing $\frac{1}{4}$ pounds, that can be sold from the dried fruit the club purchased?

(A) 50
 (B) 64
 (C) 67
 (D) 768
 (E) 804

Height	Price
Less than 5 ft	\$14.95
5 ft to 6 ft	\$17.95
Over 6 ft	\$21.95

PS02498

63. A nursery sells fruit trees priced as shown in the chart above. In its inventory 54 trees are less than 5 feet in height. If the expected revenue from the sale of its entire stock is estimated at \$2,450, approximately how much of this will come from the sale of trees that are at least 5 feet tall?
- (A) \$1,730
 (B) \$1,640
 (C) \$1,410
 (D) \$1,080
 (E) \$810

PS10539

64. The sequence a_1, a_2, a_3, a_4, a_5 is such that $a_n = a_{n-1} + 5$ for $2 \leq n \leq 5$. If $a_5 = 31$, what is the value of a_1 ?
- (A) 1
 (B) 6
 (C) 11
 (D) 16
 (E) 21

PS04971

65. A certain bridge is 4,024 feet long. Approximately how many minutes does it take to cross this bridge at a constant speed of 20 miles per hour? (1 mile = 5,280 feet)
- (A) 1
 (B) 2
 (C) 4
 (D) 6
 (E) 7

PS04009

66. If $S = \{0, 4, 5, 2, 11, 8\}$, how much greater than the median of the numbers in S is the mean of the numbers in S ?
- (A) 0.5
 (B) 1.0
 (C) 1.5
 (D) 2.0
 (E) 2.5

PS12657

67. The annual interest rate earned by an investment increased by 10 percent from last year to this year. If the annual interest rate earned by the investment this year was 11 percent, what was the annual interest rate last year?
- (A) 1%
 (B) 1.1%
 (C) 9.1%
 (D) 10%
 (E) 10.8%

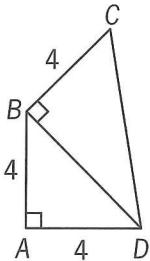
PS07394

68. A total of 5 liters of gasoline is to be poured into two empty containers with capacities of 2 liters and 6 liters, respectively, such that both containers will be filled to the same percent of their respective capacities. What amount of gasoline, in liters, must be poured into the 6-liter container?

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

PS02775

69. List S consists of 10 consecutive odd integers, and list T consists of 5 consecutive even integers. If the least integer in S is 7 more than the least integer in T , how much greater is the average (arithmetic mean) of the integers in S than the average of the integers in T ?
- (A) 2
 (B) 7
 (C) 8
 (D) 12
 (E) 22



PS05616

70. In the figure above, what is the area of triangular region BCD ?

(A) $4\sqrt{2}$
 (B) 8
 (C) $8\sqrt{2}$
 (D) 16
 (E) $16\sqrt{2}$

PS13882

71. What is the larger of the 2 solutions of the equation $x^2 - 4x = 96$?

(A) 8
 (B) 12
 (C) 16
 (D) 32
 (E) 100

PS10493

72. Of the goose eggs laid at a certain pond, $\frac{2}{3}$ hatched, and $\frac{3}{4}$ of the geese that hatched from those eggs survived the first month. Of the geese that survived the first month, $\frac{3}{5}$ did not survive the first year. If 120 geese survived the first year and if no more than one goose hatched from each egg, how many goose eggs were laid at the pond?

(A) 280
 (B) 400
 (C) 540
 (D) 600
 (E) 840

PS09305

73. If $x^2 - 2x - 15 = 0$ and $x > 0$ which of the following must be equal to 0?

I. $x^2 - 6x + 9$
 II. $x^2 - 7x + 10$
 III. $x^2 - 10x + 25$
 (A) I only
 (B) II only
 (C) III only
 (D) II and III only
 (E) I, II, and III

PS10921

74. $\frac{(39,897)(0.0096)}{198.76}$ is approximately

(A) 0.02
 (B) 0.2
 (C) 2
 (D) 20
 (E) 200

PS13205

75. If a square region has area n , what is the length of the diagonal of the square in terms of n ?

(A) $\sqrt{2n}$
 (B) \sqrt{n}
 (C) $2\sqrt{n}$
 (D) $2n$
 (E) $2n^2$

PS00817

76. The “prime sum” of an integer n greater than 1 is the sum of all the prime factors of n , including repetitions. For example, the prime sum of 12 is 7, since $12 = 2 \times 2 \times 3$ and $2 + 2 + 3 = 7$. For which of the following integers is the prime sum greater than 35?

(A) 440
 (B) 512
 (C) 620
 (D) 700
 (E) 750

PS02256

77. Each machine at a toy factory assembles a certain kind of toy at a constant rate of one toy every 3 minutes. If 40 percent of the machines at the factory are to be replaced by new machines that assemble this kind of toy at a constant rate of one toy every 2 minutes, what will be the percent increase in the number of toys assembled in one hour by all the machines at the factory, working at their constant rates?
- (A) 20%
 (B) 25%
 (C) 30%
 (D) 40%
 (E) 50%

PS10339

78. When a subscription to a new magazine was purchased for m months, the publisher offered a discount of 75 percent off the regular monthly price of the magazine. If the total value of the discount was equivalent to buying the magazine at its regular monthly price for 27 months, what was the value of m ?
- (A) 18
 (B) 24
 (C) 30
 (D) 36
 (E) 48

PS10422

79. At a garage sale, all of the prices of the items sold were different. If the price of a radio sold at the garage sale was both the 15th highest price and the 20th lowest price among the prices of the items sold, how many items were sold at the garage sale?
- (A) 33
 (B) 34
 (C) 35
 (D) 36
 (E) 37

PS11738

80. Half of a large pizza is cut into 4 equal-sized pieces, and the other half is cut into 6 equal-sized pieces. If a person were to eat 1 of the larger pieces and 2 of the smaller pieces, what fraction of the pizza would remain uneaten?
- (A) $\frac{5}{12}$
 (B) $\frac{13}{24}$
 (C) $\frac{7}{12}$
 (D) $\frac{2}{3}$
 (E) $\frac{17}{24}$

81. PS14293 If $a = 1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64}$ and $b = 1 + \frac{1}{4}a$, then what is the value of $a - b$?

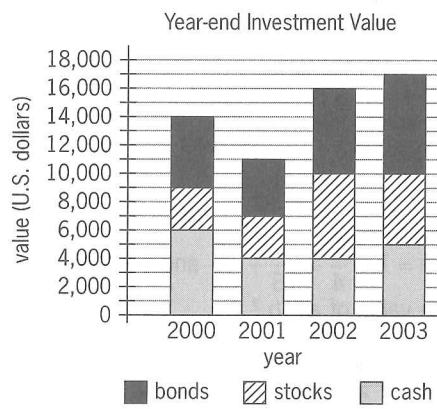
- (A) $-\frac{85}{256}$
 (B) $-\frac{1}{256}$
 (C) $-\frac{1}{4}$
 (D) $\frac{125}{256}$
 (E) $\frac{169}{256}$

PS10174

82. In a certain learning experiment, each participant had three trials and was assigned, for each trial, a score of either -2 , -1 , 0 , 1 , or 2 . The participant's final score consisted of the sum of the first trial score, 2 times the second trial score, and 3 times the third trial score. If Anne received scores of 1 and -1 for her first two trials, not necessarily in that order, which of the following could NOT be her final score?
- (A) -4
 (B) -2
 (C) 1
 (D) 5
 (E) 6

PS00111

83. For all positive integers m and v , the expression $m \Theta v$ represents the remainder when m is divided by v . What is the value of $(98 \Theta 33) \Theta 17 - (98 \Theta (33 \Theta 17))$?
- (A) -10
 (B) -2
 (C) 8
 (D) 13
 (E) 17



PS13841

84. The chart above shows year-end values for Darnella's investments. For just the stocks, what was the increase in value from year-end 2000 to year-end 2003?

- (A) \$1,000
 (B) \$2,000
 (C) \$3,000
 (D) \$4,000
 (E) \$5,000

PS05775

85. If the sum of the reciprocals of two consecutive odd integers is $\frac{12}{35}$, then the greater of the two integers is
- (A) 3
 (B) 5
 (C) 7
 (D) 9
 (E) 11

PS05916

86. What is the sum of the odd integers from 35 to 85, inclusive?

- (A) 1,560
 (B) 1,500
 (C) 1,240
 (D) 1,120
 (E) 1,100

PS00777

87. In a certain sequence, each term after the first term is one-half the previous term. If the tenth term of the sequence is between 0.0001 and 0.001, then the twelfth term of the sequence is between

- (A) 0.0025 and 0.025
 (B) 0.00025 and 0.0025
 (C) 0.000025 and 0.00025
 (D) 0.0000025 and 0.000025
 (E) 0.00000025 and 0.0000025

PS04765

88. A certain drive-in movie theater has a total of 17 rows of parking spaces. There are 20 parking spaces in the first row and 21 parking spaces in the second row. In each subsequent row there are 2 more parking spaces than in the previous row. What is the total number of parking spaces in the movie theater?

- (A) 412
 (B) 544
 (C) 596
 (D) 632
 (E) 692

PS10810

89. Ada and Paul received their scores on three tests. On the first test, Ada's score was 10 points higher than Paul's score. On the second test, Ada's score was 4 points higher than Paul's score. If Paul's average (arithmetic mean) score on the three tests was 3 points higher than Ada's average score on the three tests, then Paul's score on the third test was how many points higher than Ada's score?

- (A) 9
 (B) 14
 (C) 17
 (D) 23
 (E) 25

PS06180

90. The price of a certain stock increased by 0.25 of 1 percent on a certain day. By what fraction did the price of the stock increase that day?

- (A) $\frac{1}{2,500}$
 (B) $\frac{1}{400}$
 (C) $\frac{1}{40}$
 (D) $\frac{1}{25}$
 (E) $\frac{1}{4}$

PS03831

91. For each trip, a taxicab company charges \$4.25 for the first mile and \$2.65 for each additional mile or fraction thereof. If the total charge for a certain trip was \$62.55, how many miles at most was the trip?
- (A) 21
 (B) 22
 (C) 23
 (D) 24
 (E) 25

PS12857

92. When 24 is divided by the positive integer n , the remainder is 4. Which of the following statements about n must be true?
- I. n is even.
 - II. n is a multiple of 5.
 - III. n is a factor of 20.

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

PS12759

93. What is the thousandths digit in the decimal equivalent of $\frac{53}{5,000}$?
- (A) 0
 (B) 1
 (C) 3
 (D) 5
 (E) 6

PS00986

94. The average (arithmetic mean) of the positive integers x , y , and z is 3. If $x < y < z$, what is the greatest possible value of z ?

- (A) 5
 (B) 6
 (C) 7
 (D) 8
 (E) 9

PS14087

95. The product of 3,305 and the 1-digit integer x is a 5-digit integer. The units (ones) digit of the product is y and the hundreds digit is y . If A is the set of all possible values of x and B is the set of all possible values of y , then which of the following gives the members of A and B ?

- | <u>A</u> | <u>B</u> |
|---------------------|--------------------------------|
| (A) {1, 3, 5, 7, 9} | {0, 1, 2, 3, 4, 5, 6, 7, 8, 9} |
| (B) {1, 3, 5, 7, 9} | {1, 3, 5, 7, 9} |
| (C) {3, 5, 7, 9} | {1, 5, 7, 9} |
| (D) {5, 7, 9} | {1, 5, 7} |
| (E) {5, 7, 9} | {1, 5, 9} |

PS05083

96. What is the largest integer n such that $\frac{1}{2^n} > 0.01$?
- (A) 5
 (B) 6
 (C) 7
 (D) 10
 (E) 51

PS07001

97. If x and y are integers such that $2 < x \leq 8$ and $2 < y \leq 9$, what is the maximum value of $\frac{1}{x} - \frac{x}{y}$?
- (A) $-3\frac{1}{8}$
 (B) 0
 (C) $\frac{1}{4}$
 (D) $\frac{5}{18}$
 (E) 2

PS01875

98. Items that are purchased together at a certain discount store are priced at \$3 for the first item purchased and \$1 for each additional item purchased. What is the maximum number of items that could be purchased together for a total price that is less than \$30?
- (A) 25
 (B) 26
 (C) 27
 (D) 28
 (E) 29

PS00774

99. What is the least integer z for which $(0.000125)(0.0025)(0.00000125) \times 10^z$ is an integer?
- (A) 18
 (B) 10
 (C) 0
 (D) -10
 (E) -18

PS08407

100. The average (arithmetic mean) length per film for a group of 21 films is t minutes. If a film that runs for 66 minutes is removed from the group and replaced by one that runs for 52 minutes, what is the average length per film, in minutes, for the new group of films, in terms of t ?
- (A) $t + \frac{2}{3}$
 (B) $t - \frac{2}{3}$
 (C) $21t + 14$
 (D) $t + \frac{3}{2}$
 (E) $t - \frac{3}{2}$

PS08051

101. An open box in the shape of a cube measuring 50 centimeters on each side is constructed from plywood. If the plywood weighs 1.5 grams per square centimeter, which of the following is closest to the total weight, in kilograms, of the plywood used for the box? (1 kilogram = 1,000 grams)
- (A) 2
 (B) 4
 (C) 8
 (D) 13
 (E) 19

PS03614

102. A garden center sells a certain grass seed in 5-pound bags at \$13.85 per bag, 10-pound bags at \$20.43 per bag, and 25-pound bags at \$32.25 per bag. If a customer is to buy at least 65 pounds of the grass seed, but no more than 80 pounds, what is the least possible cost of the grass seed that the customer will buy?
- (A) \$94.03
 (B) \$96.75
 (C) \$98.78
 (D) \$102.07
 (E) \$105.36

PS12785

103. If $x = -|w|$, which of the following must be true?
- (A) $x = -w$
 (B) $x = w$
 (C) $x^2 = w$
 (D) $x^2 = w^2$
 (E) $x^3 = w^3$

PS05965

104. Which of the following lines in the xy -plane does not contain any point with integers as both coordinates?
- (A) $y = x$
 (B) $y = x + \frac{1}{2}$
 (C) $y = x + 5$
 (D) $y = \frac{1}{2}x$
 (E) $y = \frac{1}{2}x + 5$

PS04160

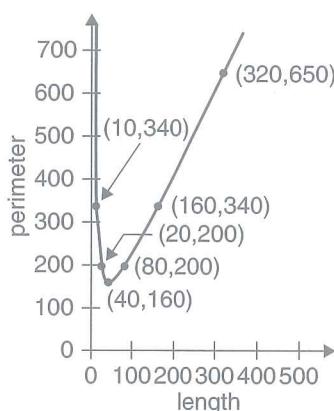
105. A certain financial institution reported that its assets totaled \$2,377,366.30 on a certain day. Of this amount, \$31,724.54 was held in cash. Approximately what percent of the reported assets was held in cash on that day?
- (A) 0.00013%
 (B) 0.0013%
 (C) 0.013%
 (D) 0.13%
 (E) 1.3%

$$\begin{array}{r} AB \\ + BA \\ \hline AAC \end{array}$$

PS09820

106. In the correctly worked addition problem shown, where the sum of the two-digit positive integers AB and BA is the three-digit integer AAC , and A , B , and C are different digits, what is the units digit of the integer AAC ?

- (A) 9
- (B) 6
- (C) 3
- (D) 2
- (E) 0



PS14060

107. Planning is in progress for a fenced, rectangular playground with an area of 1,600 square meters. The graph above shows the perimeter, in meters, as a function of the length of the playground. The length of the playground should be how many meters to minimize the perimeter and, therefore, the amount of fencing needed to enclose the playground?

- (A) 10
- (B) 40
- (C) 60
- (D) 160
- (E) 340

$$\begin{aligned} 3r &\leq 4s + 5 \\ |s| &\leq 5 \end{aligned}$$

108. Given the inequalities above, which of the following CANNOT be the value of r ?

- (A) -20
- (B) -5
- (C) 0
- (D) 5
- (E) 20

PS11647

109. If m is an even integer, v is an odd integer, and $m > v > 0$, which of the following represents the number of even integers less than m and greater than v ?

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

PS02378

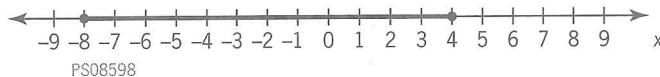
110. A positive integer is divisible by 9 if and only if the sum of its digits is divisible by 9. If n is a positive integer, for which of the following values of k is $25 \times 10^n + k \times 10^{2n}$ divisible by 9?

- (A) 9
- (B) 16
- (C) 23
- (D) 35
- (E) 47

PS17806

111. The perimeter of rectangle A is 200 meters. The length of rectangle B is 10 meters less than the length of rectangle A and the width of rectangle B is 10 meters more than the width of rectangle A. If rectangle B is a square, what is the width, in meters, of rectangle A?

- (A) 10
- (B) 20
- (C) 40
- (D) 50
- (E) 60



112. On the number line, the shaded interval is the graph of which of the following inequalities?

- (A) $|x| \leq 4$
 (B) $|x| \leq 8$
 (C) $|x - 2| \leq 4$
 (D) $|x - 2| \leq 6$
 (E) $|x + 2| \leq 6$

PS12450

113. Last year members of a certain professional organization for teachers consisted of teachers from 49 different school districts, with an average (arithmetic mean) of 9.8 schools per district. Last year the average number of teachers at these schools who were members of the organization was 22. Which of the following is closest to the total number of members of the organization last year?

- (A) 10^7
 (B) 10^6
 (C) 10^5
 (D) 10^4
 (E) 10^3

PS09294

114. Of all the students in a certain dormitory, $\frac{1}{2}$ are first-year students and the rest are second-year students. If $\frac{4}{5}$ of the first-year students have not declared a major and if the fraction of second-year students who have declared a major is 3 times the fraction of first-year students who have declared a major, what fraction of all the students in the dormitory are second-year students who have not declared a major?

- (A) $\frac{1}{15}$
 (B) $\frac{1}{5}$
 (C) $\frac{4}{15}$
 (D) $\frac{1}{3}$
 (E) $\frac{2}{5}$

PS09050

115. If the average (arithmetic mean) of x , y , and z is $7x$ and $x \neq 0$, what is the ratio of x to the sum of y and z ?

- (A) 1:21
 (B) 1:20
 (C) 1:6
 (D) 6:1
 (E) 20:1

PS02352

116. In the coordinate plane, line k passes through the origin and has slope 2. If points $(3,y)$ and $(x,4)$ are on line k , then $x + y =$

- (A) 3.5
 (B) 7
 (C) 8
 (D) 10
 (E) 14

PS08661

117. If a , b , and c are constants, $a > b > c$, and $x^3 - x = (x - a)(x - b)(x - c)$ for all numbers x , what is the value of b ?

- (A) -3
 (B) -1
 (C) 0
 (D) 1
 (E) 3

PS06273

118. $17^3 + 17^4 =$

- (A) 17^7
 (B) $17^3(18)$
 (C) $17^6(18)$
 (D) $2(17^3) + 17$
 (E) $2(17^3) - 17$

PS02934

119. Company K's earnings were \$12 million last year. If this year's earnings are projected to be 150 percent greater than last year's earnings, what are Company K's projected earnings this year?

- (A) \$13.5 million
 (B) \$15 million
 (C) \$18 million
 (D) \$27 million
 (E) \$30 million

PS05413

120. Jonah drove the first half of a 100-mile trip in x hours and the second half in y hours. Which of the following is equal to Jonah's average speed, in miles per hour, for the entire trip?

- (A) $\frac{50}{x+y}$
- (B) $\frac{100}{x+y}$
- (C) $\frac{25}{x} + \frac{25}{y}$
- (D) $\frac{50}{x} + \frac{50}{y}$
- (E) $\frac{100}{x} + \frac{100}{y}$

PS06135

121. What is the greatest number of identical bouquets that can be made out of 21 white and 91 red tulips if no flowers are to be left out? (Two bouquets are identical whenever the number of red tulips in the two bouquets is equal and the number of white tulips in the two bouquets is equal.)

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

PS11454

122. In the xy -plane, the points (c, d) , $(c, -d)$, and $(-c, -d)$ are three vertices of a certain square. If $c < 0$ and $d > 0$, which of the following points is in the same quadrant as the fourth vertex of the square?

- (A) $(-5, -3)$
- (B) $(-5, 3)$
- (C) $(5, -3)$
- (D) $(3, -5)$
- (E) $(3, 5)$

PS05470

123. If the amount of federal estate tax due on an estate valued at \$1.35 million is \$437,000 plus 43 percent of the value of the estate in excess of \$1.25 million, then the federal tax due is approximately what percent of the value of the estate?

- A. 30%
- B. 35%
- C. 40%
- D. 45%
- E. 50%

PS05924

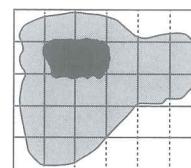
124. If $\frac{3}{10^4} = x\%$, then $x =$

- (A) 0.3
- (B) 0.03
- (C) 0.003
- (D) 0.0003
- (E) 0.00003

PS01285

125. What is the remainder when 3^{24} is divided by 5?

- (A) 0
- (B) 1
- (C) 2
- (D) 3
- (E) 4



PS11692

126. In the figure shown, a square grid is superimposed on the map of a park, represented by the shaded region, in the middle of which is a pond, represented by the black region. If the area of the pond is 5,000 square yards, which of the following is closest to the area of the park, in square yards, including the area of the pond?

- (A) 30,000
- (B) 45,000
- (C) 60,000
- (D) 75,000
- (E) 90,000

PS03623

127. If the volume of a ball is 32,490 cubic millimeters, what is the volume of the ball in cubic centimeters? (1 millimeter = 0.1 centimeter)

(A) 0.3249
 (B) 3.249
 (C) 32.49
 (D) 324.9
 (E) 3,249

PS07058

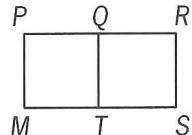
128. David used part of \$100,000 to purchase a house. Of the remaining portion, he invested $\frac{1}{3}$ of it at 4 percent simple annual interest and $\frac{2}{3}$ of it at 6 percent simple annual interest. If after a year the income from the two investments totaled \$320, what was the purchase price of the house?

(A) \$96,000
 (B) \$94,000
 (C) \$88,000
 (D) \$75,000
 (E) \$40,000

PS11537

129. In the sequence $x_0, x_1, x_2, \dots, x_n$, each term from x_1 to x_k is 3 greater than the previous term, and each term from x_{k+1} to x_n is 3 less than the previous term, where n and k are positive integers and $k < n$. If $x_0 = x_n = 0$ and if $x_k = 15$, what is the value of n ?

(A) 5
 (B) 6
 (C) 9
 (D) 10
 (E) 15



Note: Not drawn to scale.

PS11145

130. In the figure shown above, line segment QR has length 12, and rectangle MPQT is a square. If the area of rectangular region MPRS is 540, what is the area of rectangular region TQRS?

(A) 144
 (B) 216
 (C) 324
 (D) 360
 (E) 396

PS09439

131. A certain manufacturer sells its product to stores in 113 different regions worldwide, with an average (arithmetic mean) of 181 stores per region. If last year these stores sold an average of 51,752 units of the manufacturer's product per store, which of the following is closest to the total number of units of the manufacturer's product sold worldwide last year?

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

PS17708

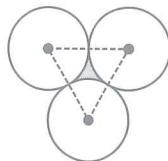
132. Andrew started saving at the beginning of the year and had saved \$240 by the end of the year. He continued to save and by the end of 2 years had saved a total of \$540. Which of the following is closest to the percent increase in the amount Andrew saved during the second year compared to the amount he saved during the first year?

(A) 11%
 (B) 25%
 (C) 44%
 (D) 56%
 (E) 125%

PS19062

133. Two numbers differ by 2 and sum to S . Which of the following is the greater of the numbers in terms of S ?

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



PS00904

134. The figure shown above consists of three identical circles that are tangent to each other. If the area of the shaded region is $64\sqrt{3} - 32\pi$, what is the radius of each circle?

- (A) 4
- (B) 8
- (C) 16
- (D) 24
- (E) 32

PS02053

135. In a numerical table with 10 rows and 10 columns, each entry is either a 9 or a 10. If the number of 9s in the n th row is $n - 1$ for each n from 1 to 10, what is the average (arithmetic mean) of all the numbers in the table?

- (A) 9.45
- (B) 9.50
- (C) 9.55
- (D) 9.65
- (E) 9.70

PS08485

136. A positive integer n is a perfect number provided that the sum of all the positive factors of n , including 1 and n , is equal to $2n$. What is the sum of the reciprocals of all the positive factors of the perfect number 28?

- (A) $\frac{1}{4}$
- (B) $\frac{56}{27}$
- (C) 2
- (D) 3
- (E) 4

PS11430

137. The infinite sequence $a_1, a_2, \dots, a_n, \dots$ is such that $a_1 = 2, a_2 = -3, a_3 = 5, a_4 = -1$, and $a_n = a_{n-4}$ for $n > 4$. What is the sum of the first 97 terms of the sequence?

- (A) 72
- (B) 74
- (C) 75
- (D) 78
- (E) 80

PS09901

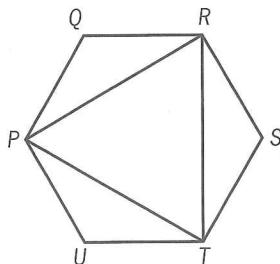
138. The sequence $a_1, a_2, \dots, a_n, \dots$ is such that $a_n = 2a_{n-1} - x$ for all positive integers $n \geq 2$ and for a certain number x . If $a_5 = 99$ and $a_3 = 27$, what is the value of x ?

- (A) 3
- (B) 9
- (C) 18
- (D) 36
- (E) 45

PS03779

139. A window is in the shape of a regular hexagon with each side of length 80 centimeters. If a diagonal through the center of the hexagon is w centimeters long, then $w =$

- (A) 80
- (B) 120
- (C) 150
- (D) 160
- (E) 240



PS03695

140. In the figure shown, $PQRSTU$ is a regular polygon with sides of length x . What is the perimeter of triangle PRT in terms of x ?

- (A) $\frac{x\sqrt{3}}{2}$
- (B) $x\sqrt{3}$
- (C) $\frac{3x\sqrt{3}}{2}$
- (D) $3x\sqrt{3}$
- (E) $4x\sqrt{3}$

PS11755

141. In a certain medical survey, 45 percent of the people surveyed had the type A antigen in their blood and 3 percent had both the type A antigen and the type B antigen. Which of the following is closest to the percent of those with the type A antigen who also had the type B antigen?

- (A) 1.35%
- (B) 6.67%
- (C) 13.50%
- (D) 15.00%
- (E) 42.00%

PS05146

142. On a certain transatlantic crossing, 20 percent of a ship's passengers held round-trip tickets and also took their cars aboard the ship. If 60 percent of the passengers with round-trip tickets did not take their cars aboard the ship, what percent of the ship's passengers held round-trip tickets?

- (A) $33\frac{1}{3}\%$
- (B) 40%
- (C) 50%
- (D) 60%
- (E) $66\frac{2}{3}\%$

PS03696

143. If x and k are integers and $(12^x)(4^{2x+1}) = (2^k)(3^2)$, what is the value of k ?

- (A) 5
- (B) 7
- (C) 10
- (D) 12
- (E) 14

PS11024

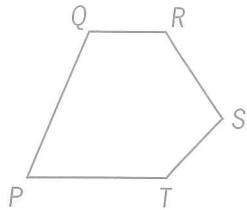
144. If S is the sum of the reciprocals of the 10 consecutive integers from 21 to 30, then S is between which of the following two fractions?

- (A) $\frac{1}{3}$ and $\frac{1}{2}$
- (B) $\frac{1}{4}$ and $\frac{1}{3}$
- (C) $\frac{1}{5}$ and $\frac{1}{4}$
- (D) $\frac{1}{6}$ and $\frac{1}{5}$
- (E) $\frac{1}{7}$ and $\frac{1}{6}$

PS08729

145. For every even positive integer m , $f(m)$ represents the product of all even integers from 2 to m , inclusive. For example, $f(12) = 2 \times 4 \times 6 \times 8 \times 10 \times 12$. What is the greatest prime factor of $f(24)$?

- (A) 23
- (B) 19
- (C) 17
- (D) 13
- (E) 11



Note: Not drawn to scale.

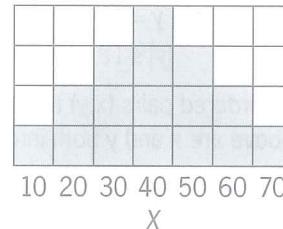
PS08572

146. In pentagon $PQRST$, $PQ = 3$, $QR = 2$, $RS = 4$, and $ST = 5$. Which of the lengths 5, 10, and 15 could be the value of PT ?
- (A) 5 only
 (B) 15 only
 (C) 5 and 10 only
 (D) 10 and 15 only
 (E) 5, 10, and 15

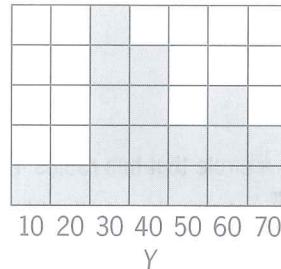
$$3, k, 2, 8, m, 3$$

PS07771

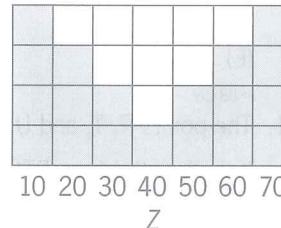
147. The arithmetic mean of the list of numbers above is 4. If k and m are integers and $k \neq m$, what is the median of the list?
- (A) 2
 (B) 2.5
 (C) 3
 (D) 3.5
 (E) 4



10 20 30 40 50 60 70
 X



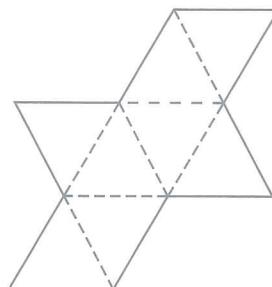
10 20 30 40 50 60 70
 Y



10 20 30 40 50 60 70
 Z

PS04987

148. If the variables, X , Y , and Z take on only the values 10, 20, 30, 40, 50, 60, or 70 with frequencies indicated by the shaded regions above, for which of the frequency distributions is the mean equal to the median?
- (A) X only
 (B) Y only
 (C) Z only
 (D) X and Y
 (E) X and Z



PS15538

149. When the figure above is cut along the solid lines, folded along the dashed lines, and taped along the solid lines, the result is a model of a geometric solid. This geometric solid consists of 2 pyramids, each with a square base that they share. What is the sum of the number of edges and the number of faces of this geometric solid?
- (A) 10
 (B) 18
 (C) 20
 (D) 24
 (E) 25

$$\begin{aligned}2x + y &= 12 \\|y| &\leq 12\end{aligned}$$

PS03356

150. For how many ordered pairs (x,y) that are solutions of the system above are x and y both integers?

- (A) 7
- (B) 10
- (C) 12
- (D) 13
- (E) 14

PS08859

151. The points R , T , and U lie on a circle that has radius 4. If the length of arc RTU is $\frac{4\pi}{3}$, what is the length of line segment RU ?

- (A) $\frac{4}{3}$
- (B) $\frac{8}{3}$
- (C) 3
- (D) 4
- (E) 6

PS02955

152. A certain university will select 1 of 7 candidates eligible to fill a position in the mathematics department and 2 of 10 candidates eligible to fill 2 identical positions in the computer science department. If none of the candidates is eligible for a position in both departments, how many different sets of 3 candidates are there to fill the 3 positions?

- (A) 42
- (B) 70
- (C) 140
- (D) 165
- (E) 315

PS06189

153. A survey of employers found that during 1993 employment costs rose 3.5 percent, where employment costs consist of salary costs and fringe-benefit costs. If salary costs rose 3 percent and fringe-benefit costs rose 5.5 percent during 1993, then fringe-benefit costs represented what percent of employment costs at the beginning of 1993?

- (A) 16.5%
- (B) 20%
- (C) 35%
- (D) 55%
- (E) 65%

PS02528

154. The subsets of the set $\{w, x, y\}$ are $\{w\}$, $\{x\}$, $\{y\}$, $\{w, x\}$, $\{w, y\}$, $\{x, y\}$, $\{w, x, y\}$, and $\{\}$ (the empty subset). How many subsets of the set $\{w, x, y, z\}$ contain w ?

- (A) Four
- (B) Five
- (C) Seven
- (D) Eight
- (E) Sixteen

PS10309

155. There are 5 cars to be displayed in 5 parking spaces, with all the cars facing the same direction. Of the 5 cars, 3 are red, 1 is blue, and 1 is yellow. If the cars are identical except for color, how many different display arrangements of the 5 cars are possible?

- (A) 20
- (B) 25
- (C) 40
- (D) 60
- (E) 125

PS17461

156. The number $\sqrt{63 - 36\sqrt{3}}$ can be expressed as $x + y\sqrt{3}$ for some integers x and y . What is the value of xy ?

- (A) -18
- (B) -6
- (C) 6
- (D) 18
- (E) 27

PS01334

157. There are 10 books on a shelf, of which 4 are paperbacks and 6 are hardbacks. How many possible selections of 5 books from the shelf contain at least one paperback and at least one hardback?

- (A) 75
- (B) 120
- (C) 210
- (D) 246
- (E) 252

PS03774

158. If x is to be chosen at random from the set $\{1, 2, 3, 4\}$ and y is to be chosen at random from the set $\{5, 6, 7\}$, what is the probability that xy will be even?

- (A) $\frac{1}{6}$
- (B) $\frac{1}{3}$
- (C) $\frac{1}{2}$
- (D) $\frac{2}{3}$
- (E) $\frac{5}{6}$

PS04254

159. The function f is defined for each positive three-digit integer n by $f(n) = 2^x 3^y 5^z$, where x , y , and z are the hundreds, tens, and units digits of n , respectively. If m and v are three-digit positive integers such that $f(m) = 9f(v)$, then $m - v =$

- (A) 8
- (B) 9
- (C) 18
- (D) 20
- (E) 80

PS06312

160. If $10^{50} - 74$ is written as an integer in base 10 notation, what is the sum of the digits in that integer?

- (A) 424
- (B) 433
- (C) 440
- (D) 449
- (E) 467

PS09056

161. A certain company that sells only cars and trucks reported that revenues from car sales in 1997 were down 11 percent from 1996 and revenues from truck sales in 1997 were up 7 percent from 1996. If total revenues from car sales and truck sales in 1997 were up 1 percent from 1996, what is the ratio of revenue from car sales in 1996 to revenue from truck sales in 1996?

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

PS14267

162. Becky rented a power tool from a rental shop. The rent for the tool was \$12 for the first hour and \$3 for each additional hour. If Becky paid a total of \$27, excluding sales tax, to rent the tool, for how many hours did she rent it?

- (A) 5
- (B) 6
- (C) 9
- (D) 10
- (E) 12

PS06959

163. If $4 < \frac{7-x}{3}$, which of the following must be true?

- I. $5 < x$
 - II. $|x + 3| > 2$
 - III. $-(x + 5)$ is positive.
- (A) II only
 - (B) III only
 - (C) I and II only
 - (D) II and III only
 - (E) I, II, and III

PS08654

164. A certain right triangle has sides of length x , y , and z , where $x < y < z$. If the area of this triangular region is 1, which of the following indicates all of the possible values of y ?

- (A) $y > \sqrt{2}$
- (B) $\frac{\sqrt{3}}{2} < y < \sqrt{2}$
- (C) $\frac{\sqrt{2}}{3} < y < \frac{\sqrt{3}}{2}$
- (D) $\frac{\sqrt{3}}{4} < y < \frac{\sqrt{2}}{3}$
- (E) $y < \frac{\sqrt{3}}{4}$

PS14397

165. On a certain day, a bakery produced a batch of rolls at a total production cost of \$300. On that day, $\frac{4}{5}$ of the rolls in the batch were sold, each at a price that was 50 percent greater than the average (arithmetic mean) production cost per roll. The remaining rolls in the batch were sold the next day, each at a price that was 20 percent less than the price of the day before. What was the bakery's profit on this batch of rolls?

(A) \$150
 (B) \$144
 (C) \$132
 (D) \$108
 (E) \$90

PS05972

166. A set of numbers has the property that for any number t in the set, $t + 2$ is in the set. If -1 is in the set, which of the following must also be in the set?

I. -3
 II. 1
 III. 5
 (A) I only
 (B) II only
 (C) I and II only
 (D) II and III only
 (E) I, II, and III

PS04780

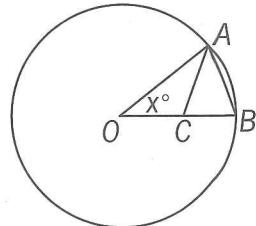
167. A couple decides to have 4 children. If they succeed in having 4 children and each child is equally likely to be a boy or a girl, what is the probability that they will have exactly 2 girls and 2 boys?

(A) $\frac{3}{8}$
 (B) $\frac{1}{4}$
 (C) $\frac{3}{16}$
 (D) $\frac{1}{8}$
 (E) $\frac{1}{16}$

PS01564

168. The closing price of Stock X changed on each trading day last month. The percent change in the closing price of Stock X from the first trading day last month to each of the other trading days last month was less than 50 percent. If the closing price on the second trading day last month was \$10.00, which of the following CANNOT be the closing price on the last trading day last month?

(A) \$3.00
 (B) \$9.00
 (C) \$19.00
 (D) \$24.00
 (E) \$29.00



PS02389

169. In the figure above, point O is the center of the circle and $OC = AC = AB$. What is the value of x ?

(A) 40
 (B) 36
 (C) 34
 (D) 32
 (E) 30

PS16967

170. An airline passenger is planning a trip that involves three connecting flights that leave from Airports A, B, and C, respectively. The first flight leaves Airport A every hour, beginning at 8:00 a.m., and arrives at Airport B $2\frac{1}{2}$ hours later. The second flight leaves Airport B every 20 minutes, beginning at 8:00 a.m., and arrives at Airport C $1\frac{1}{6}$ hours later. The third flight leaves Airport C every hour, beginning at 8:45 a.m. What is the least total amount of time the passenger must spend between flights if all flights keep to their schedules?

(A) 25 min
 (B) 1 hr 5 min
 (C) 1 hr 15 min
 (D) 2 hr 20 min
 (E) 3 hr 40 min

PS07426

171. If n is a positive integer and n^2 is divisible by 72, then the largest positive integer that must divide n is

- (A) 6
- (B) 12
- (C) 24
- (D) 36
- (E) 48

PS16977

172. A certain grocery purchased x pounds of produce for p dollars per pound. If y pounds of the produce had to be discarded due to spoilage and the grocery sold the rest for s dollars per pound, which of the following represents the gross profit on the sale of the produce?

- (A) $(x - y)s - xp$
- (B) $(x - y)p - ys$
- (C) $(s - p)y - xp$
- (D) $xp - ys$
- (E) $(x - y)(s - p)$

PS16990

173. If x , y , and z are positive integers such that x is a factor of y , and x is a multiple of z , which of the following is NOT necessarily an integer?

- (A) $\frac{x+z}{z}$
- (B) $\frac{y+z}{x}$
- (C) $\frac{x+y}{z}$
- (D) $\frac{xy}{z}$
- (E) $\frac{yz}{x}$

PS08416

174. Running at their respective constant rates, Machine X takes 2 days longer to produce w widgets than Machine Y. At these rates, if the two machines together produce $\frac{5}{4}w$ widgets in 3 days, how many days would it take Machine X alone to produce $2w$ widgets?

- (A) 4
- (B) 6
- (C) 8
- (D) 10
- (E) 12

PS07117

175. A square wooden plaque has a square brass inlay in the center, leaving a wooden strip of uniform width around the brass square. If the ratio of the brass area to the wooden area is 25 to 39, which of the following could be the width, in inches, of the wooden strip?

- I. 1
 - II. 3
 - III. 4
- (A) I only
 - (B) II only
 - (C) I and II only
 - (D) I and III only
 - (E) I, II, and III

PS16963

$$176. \frac{2\frac{3}{5} - 1\frac{2}{3}}{\frac{2}{3} - \frac{3}{5}} =$$

- (A) 16
- (B) 14
- (C) 3
- (D) 1
- (E) -1

4.4 Answer Key

1. A	33. D	65. B	97. B
2. D	34. E	66. A	98. C
3. A	35. E	67. D	99. A
4. B	36. D	68. C	100. B
5. D	37. D	69. D	101. E
6. E	38. E	70. C	102. B
7. C	39. D	71. B	103. D
8. E	40. C	72. D	104. B
9. A	41. C	73. D	105. E
10. C	42. C	74. C	106. E
11. C	43. E	75. A	107. B
12. C	44. D	76. C	108. E
13. C	45. D	77. A	109. B
14. C	46. E	78. D	110. E
15. E	47. E	79. B	111. C
16. E	48. D	80. E	112. E
17. B	49. A	81. B	113. D
18. D	50. D	82. E	114. B
19. B	51. B	83. D	115. B
20. C	52. B	84. B	116. C
21. D	53. C	85. C	117. C
22. B	54. B	86. A	118. B
23. D	55. E	87. C	119. E
24. D	56. C	88. C	120. B
25. C	57. D	89. D	121. E
26. B	58. B	90. B	122. E
27. A	59. D	91. C	123. B
28. B	60. C	92. D	124. B
29. A	61. C	93. A	125. B
30. C	62. E	94. B	126. B
31. D	63. B	95. D	127. C
32. B	64. C	96. B	128. B

- | | | | |
|--------|--------|--------|--------|
| 129. D | 141. B | 153. B | 165. C |
| 130. B | 142. C | 154. D | 166. D |
| 131. D | 143. E | 155. A | 167. A |
| 132. B | 144. A | 156. A | 168. A |
| 133. D | 145. E | 157. D | 169. B |
| 134. B | 146. C | 158. D | 170. B |
| 135. C | 147. C | 159. D | 171. B |
| 136. C | 148. E | 160. C | 172. A |
| 137. B | 149. C | 161. A | 173. B |
| 138. A | 150. D | 162. B | 174. E |
| 139. D | 151. D | 163. D | 175. E |
| 140. D | 152. E | 164. A | 176. B |

4.5 Answer Explanations

The following discussion is intended to familiarize you with the most efficient and effective approaches to the kinds of problems common to problem solving questions. The particular questions in this chapter are generally representative of the kinds of problem solving questions you will encounter on the GMAT. Remember that it is the problem solving strategy that is important, not the specific details of a particular question.

*PS03439

1. Working at a constant rate, a copy machine makes 20 copies of a one-page document per minute. If the machine works at this constant rate, how many hours does it take to make 4,800 copies of a one-page document?
- (A) 4
 (B) 5
 (C) 6
 (D) 7
 (E) 8

Arithmetic Rate

The copy machine produces 20 copies of the one-page document each minute. Because there are 60 minutes in an hour, the constant rate of 20 copies per minute is equal to $60 \times 20 = 1,200$ copies per hour. With the machine working at this rate, the amount of time that it takes to produce 4,800 copies of the document is

$$\frac{4800 \text{ copies}}{1200 \frac{\text{copies}}{\text{hour}}} = 4 \text{ hours.}$$

The correct answer is A.

PS11042

2. If $x + y = 2$ and $x^2 + y^2 = 2$, what is the value of xy ?
- (A) -2
 (B) -1
 (C) 0
 (D) 1
 (E) 2

Algebra Second-degree equations

$$\begin{aligned}x + y &= 2 && \text{given} \\y &= 2 - x && \text{subtract } x \text{ from both sides} \\x^2 + (2 - x)^2 &= 2 && \text{substitute } y = 2 - x \text{ into} \\x^2 + y^2 &= 2 && \\2x^2 - 4x + 4 &= 2 && \text{expand and combine like} \\2x^2 - 4x + 2 &= 0 && \text{terms} \\x^2 - 2x + 1 &= 0 && \text{subtract 2 from both sides} \\(x - 1)(x - 1) &= 0 && \text{divide both sides by 2} \\x - 1 &= 0 && \text{factor} \\x &= 1 && \text{set each factor equal to 0} \\y &= 1 && \text{use } x = 1 \text{ and } y = 2 - x \\xy &= 1 && \text{multiply 1 and 1}\end{aligned}$$

Alternatively, the value of xy can be found by first squaring both sides of the equation $x + y = 2$.

$$\begin{aligned}x + y &= 2 && \text{given} \\(x + y)^2 &= 4 && \text{square both sides} \\x^2 + 2xy + y^2 &= 4 && \text{expand and combine like terms} \\2 + 2xy &= 4 && \text{replace } x^2 + y^2 \text{ with 2} \\2xy &= 2 && \text{subtract 2 from both sides} \\xy &= 1 && \text{divide both sides by 2}\end{aligned}$$

The correct answer is D.

PS02978

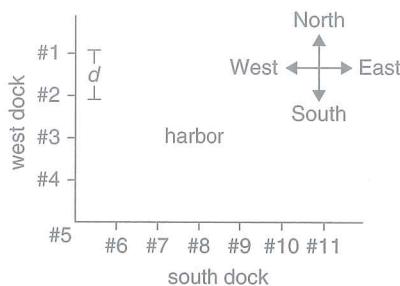
3. The sum S of the first n consecutive positive even integers is given by $S = n(n + 1)$. For what value of n is this sum equal to 110?
- (A) 10
 (B) 11
 (C) 12
 (D) 13
 (E) 14

*These numbers correlate with the online test bank question number. See the GMAT Quantitative Review Online Index in the back of this book.

Algebra Factoring

Given that the sum of the first n even numbers is $n(n + 1)$, the sum is equal to 110 when $110 = n(n + 1)$. To find the value of n in this case, we need to find the two consecutive integers whose product is 110. These integers are 10 and 11; $10 \times 11 = 110$. The smaller of these numbers is n .

The correct answer is A.



PS08375

4. A certain harbor has docking stations along its west and south docks, as shown in the figure; any two adjacent docking stations are separated by a uniform distance d . A certain boat left the west dock from docking station #2 and moved in a straight line diagonally until it reached the south dock. If the boat was at one time directly east of docking station #4 and directly north of docking station #7, at which docking station on the south dock did the boat arrive?
- (A) #7
(B) #8
(C) #9
(D) #10
(E) #11

Geometry Coordinate geometry

The boat traveled in a straight line from docking station #2 on the west dock to one of the docking stations on the south dock, passing through a single point that is both due east of docking station #4 and due north of docking station #7. Call this point P . Having traveled to P , the boat was both $2d$ south of its starting point and $2d$ east of its starting point. Therefore, traveling in a straight line, the boat traveled one unit south for every one unit traveled east. And because at point P the boat was a distance d north of the south dock, the boat must have reached the south dock at a point which is a distance of d east of docking

station #7 (which is due south of point P). This point is the position of docking station #8. The boat therefore arrived at docking station #8.

The correct answer is B.

PS03887

5. $6(87.30 + 0.65) - 5(87.30) =$
- (A) 3.90
(B) 39.00
(C) 90.90
(D) 91.20
(E) 91.85

Arithmetic Factors, multiples, and divisibility

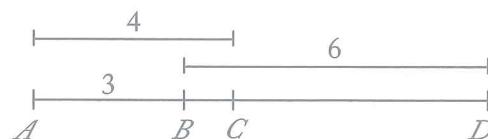
This question is most efficiently answered by distributing the 6 over 87.30 and 0.65, and then combining the terms that contain a factor of 87.30, as follows:

$$6(87.30 + 0.65) - 5(87.30) = 6(87.30) + 6(0.65) - 5(87.30) = (6 - 5)87.30 + 6(0.65) = 87.30 + 3.90 = 91.20$$

The correct answer is D.

PS13800

6. Points A , B , C , and D , in that order, lie on a line. If $AB = 3$ cm, $AC = 4$ cm, and $BD = 6$ cm, what is CD , in centimeters?
- (A) 1
(B) 2
(C) 3
(D) 4
(E) 5

Geometry Lines and segments

The figure shows points A , B , C , and D as well as the given measurements. Since $AC = AB + BC$, it follows that $4 = 3 + BC$, and so $BC = 1$. Then, since $BD = BC + CD$, it follows that $6 = 1 + CD$, and so $CD = 5$.

Alternately, $AD = AB + BD = 3 + 6 = 9$. Also, $AD = AC + CD$, so $9 = 4 + CD$ and $CD = 5$.

The correct answer is E.

PS05292

7. What is the value of $x^2yz - xyz^2$, if $x = -2$, $y = 1$, and $z = 3$?
- (A) 20
 (B) 24
 (C) 30
 (D) 32
 (E) 48

Algebra Operations on integers

Given that $x = -2$, $y = 1$, and $z = 3$, it follows by substitution that

$$\begin{aligned}x^2yz - xyz^2 &= (-2)^2(1)(3) - (-2)(1)(3^2) \\&= (4)(1)(3) - (-2)(1)(9) \\&= 12 - (-18) \\&= 12 + 18 \\&= 30\end{aligned}$$

The correct answer is C.

PS11468

8. A souvenir vendor purchased 1,000 shirts for a special event at a price of \$5 each. The vendor sold 600 of the shirts on the day of the event for \$12 each and 300 of the shirts in the week following the event for \$4 each. The vendor was unable to sell the remaining shirts. What was the vendor's gross profit on the sale of these shirts?
- (A) \$1,000
 (B) \$2,200
 (C) \$2,700
 (D) \$3,000
 (E) \$3,400

Arithmetic Applied problems

The vendor's gross profit on the sale of the shirts is equal to the total revenue from the shirts that were sold minus the total cost for all of the shirts. The total cost for all of the shirts is equal to the number of shirts the vendor purchased multiplied by the price paid by the vendor for each shirt: $1,000 \times \$5 = \$5,000$. The total revenue from the shirts that were sold is equal to the total revenue from the 600 shirts sold for \$12 each plus the total revenue from the 300 shirts that were sold

for \$4 each: $600 \times \$12 + 300 \times \$4 = \$7,200 + \$1,200 = \$8,400$. The gross profit is therefore $\$8,400 - \$5,000 = \$3,400$.

The correct answer is E.

PS06937

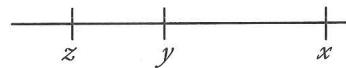
9. If $x > y$ and $y > z$, which of the following represents the greatest number?
- (A) $x - z$
 (B) $x - y$
 (C) $y - x$
 (D) $z - y$
 (E) $z - x$

Algebra Inequalities

From $x > y$ and $y > z$, it follows that $x > z$. These inequalities imply the following about the differences that are given in the answer choices:

Answer choice	Difference	Algebraic sign	Reason
(A)	$x - z$	positive	$x > z$ implies $x - z > 0$
(B)	$x - y$	positive	$x > y$ implies $x - y > 0$
(C)	$y - x$	negative	$x - y > 0$ implies $y - x < 0$
(D)	$z - y$	negative	$y > z$ implies $0 > z - y$
(E)	$z - x$	negative	$x - z > 0$ implies $z - x < 0$

Since the expressions in A and B represent positive numbers and the expressions in C, D, and E represent negative numbers, the latter can be eliminated because every negative number is less than every positive number. To determine which of $x - z$ and $x - y$ is greater, consider the placement of points with coordinates x , y , and z on the number line.



The distance between x and z (that is, $x - z$) is the sum of the distance between x and y (that is, $x - y$) and the distance between y and z (that is, $y - z$).

Therefore, $(x - z) > (x - y)$, which means that $x - z$ represents the greater of the numbers represented by $(x - z)$ and $(x - y)$. Thus, $x - z$ represents the greatest of the numbers represented by the answer choices.

Alternatively,

$$\begin{aligned}y &> z && \text{given} \\-y &< -z && \text{multiply both sides by } -1 \\x - y &< x - z && \text{add } x \text{ to both sides}\end{aligned}$$

Thus, $x - z$ represents the greater of the numbers represented by $(x - z)$ and $(x - y)$. Therefore, $x - z$ represents the greatest of the numbers represented by the answer choices.

The correct answer is A.

PS12926

10. To order certain plants from a catalog, it costs \$3.00 per plant, plus a 5 percent sales tax, plus \$6.95 for shipping and handling regardless of the number of plants ordered. If Company C ordered these plants from the catalog at the total cost of \$69.95, how many plants did Company C order?

- (A) 22
(B) 21
(C) 20
(D) 19
(E) 18

Algebra First-degree equations

Letting x represent the number of plants Company C bought from the catalog, then, in dollars, $3.00x$ is the cost of the plants, $(0.05)(3.00x)$ is the sales tax, and 6.95 is the shipping and handling fee. It follows that

$$\begin{aligned}3.00x + (0.05)(3.00x) + 6.95 &= 69.95 && \text{plants + tax +} \\&&& \text{shipping = total} \\(3.00x)(1.05) + 6.95 &= 69.95 && \text{add like terms} \\(3.00x)(1.05) &= 63.00 && \text{subtract 6.95} \\x &= 20 && \text{from both sides} \\&&& \text{divide both sides} \\&&& \text{by } (3.00)(1.05)\end{aligned}$$

Therefore, Company C bought 20 plants from the catalog.

The correct answer is C.

PS00812

11. A rug manufacturer produces rugs at a cost of \$75 per rug. What is the manufacturer's gross profit from the sale of 150 rugs if $\frac{2}{3}$ of the rugs are sold for \$150 per rug and the rest are sold for \$200 per rug?

- (A) \$10,350
(B) \$11,250
(C) \$13,750
(D) \$16,250
(E) \$17,800

Arithmetic Applied problems; Proportions

The gross profit from the sale of 150 rugs is equal to the revenue from the sale of the rugs minus the cost of producing them. For $\frac{2}{3}$ of the 150 rugs—100 of them—the gross profit per rug is $\$150 - \$75 = \$75$. For the remaining 50 rugs, the gross profit per rug is $\$200 - \$75 = \$125$. The gross profit from the sale of the 150 rugs is therefore $100 \times \$75 + 50 \times \$125 = \$13,750$.

The correct answer is C.

PS07793

12. The value of Maureen's investment portfolio has decreased by 5.8 percent since her initial investment in the portfolio. If her initial investment was \$16,800, what is the current value of the portfolio?

- (A) \$7,056.00
(B) \$14,280.00
(C) \$15,825.60
(D) \$16,702.56
(E) \$17,774.40

Arithmetic Percents

Maureen's initial investment was \$16,800, and it has decreased by 5.8%. Its current value is therefore $(100\% - 5.8\%) = 94.2\%$ of \$16,800, which is equal to $0.942 \times \$16,800$. To make the multiplication simpler, this can be expressed as $\$(942 \times 16.8)$. Thus multiplying, we obtain the result of \$15,825.60.

The correct answer is C.

PS03036

13. Company C produces toy trucks at a cost of \$5.00 each for the first 100 trucks and \$3.50 for each additional truck. If 500 toy trucks were produced by Company C and sold for \$10.00 each, what was Company C's gross profit?
- (A) \$2,250
 (B) \$2,500
 (C) \$3,100
 (D) \$3,250
 (E) \$3,500

Arithmetic Applied problems

The company's gross profit on the 500 toy trucks is the company's revenue from selling the trucks minus the company's cost of producing the trucks. The revenue is $(500)(\$10.00) = \$5,000$. The cost for the first 100 trucks is $(100)(\$5.00) = \500 , and the cost for the other 400 trucks is $(400)(\$3.50) = \$1,400$ for a total cost of $\$500 + \$1,400 = \$1,900$. Thus, the company's gross profit is $\$5,000 - \$1,900 = \$3,100$.

The correct answer is C.

PS07694

14. A group of store managers must assemble 280 displays for an upcoming sale. If they assemble 25 percent of the displays during the first hour and 40 percent of the remaining displays during the second hour, how many of the displays will not have been assembled by the end of the second hour?
- (A) 70
 (B) 98
 (C) 126
 (D) 168
 (E) 182

Arithmetic Percents

If, during the first hour, 25 percent of the total displays were assembled, then $280(0.25) = 70$ displays were assembled, leaving $280 - 70 = 210$ displays remaining to be assembled. Since 40 percent of the remaining displays were assembled during the second hour, $0.40(210) = 84$ displays were assembled during the second hour. Thus, $70 + 84 = 154$ displays were assembled during the first two hours and $280 - 154 = 126$ displays had not been assembled by the end of the second hour.

The correct answer is C.

Division	Profit or Loss (in millions of dollars)				
	1991	1992	1993	1994	1995
A	1.1	(3.4)	1.9	2.0	0.6
B	(2.3)	5.5	(4.5)	3.9	(2.9)
C	10.0	(6.6)	5.3	1.1	(3.0)

PS02019

15. The annual profit or loss for the three divisions of Company T for the years 1991 through 1995 are summarized in the table shown, where losses are enclosed in parentheses. For which division and which three consecutive years shown was the division's profit or loss for the three-year period closest to \$0?
- (A) Division A for 1991–1993
 (B) Division A for 1992–1994
 (C) Division B for 1991–1993
 (D) Division B for 1993–1995
 (E) Division C for 1992–1994

Arithmetic Applied problems

For completeness, the table shows all 9 of the profit or loss amounts, in millions of dollars, for each of the 3 divisions and the 3 three-year periods.

	1991–1993	1992–1994	1993–1995
A	-0.4	0.5	4.5
B	-1.3	4.9	-3.5
C	8.7	-0.2	3.4

The correct answer is E.

PS13583

16. Of the following, which is least?
- (A) $\frac{0.03}{0.00071}$
 (B) $\frac{0.03}{0.0071}$
 (C) $\frac{0.03}{0.071}$
 (D) $\frac{0.03}{0.71}$
 (E) $\frac{0.03}{7.1}$

Arithmetic Operations on rational numbers

Since the numerator of all of the fractions in the answer choices is 0.03, the least of the fractions will be the fraction with the greatest denominator. The greatest denominator is 7.1, and so the least of the fractions is $\frac{0.03}{7.1}$.

The correct answer is E.

PS07385

17. The maximum recommended pulse rate R , when exercising, for a person who is x years of age is given by the equation $R = 176 - 0.8x$. What is the age, in years, of a person whose maximum recommended pulse rate when exercising is 140?
- (A) 40
 (B) 45
 (C) 50
 (D) 55
 (E) 60

Algebra Substitution; Operations with rational numbers

Substitute 140 for R in the given equation and solve for x .

$$\begin{aligned} 140 &= 176 - 0.8x \\ -36 &= -0.8x \\ \frac{-36}{-0.8} &= x \\ 45 &= x \end{aligned}$$

The correct answer is B.

PS08011

18. If the average (arithmetic mean) of 5 numbers $j, j + 5, 2j - 1, 4j - 2$, and $5j - 1$ is 8, what is the value of j ?

- (A) $\frac{1}{3}$
 (B) $\frac{7}{13}$
 (C) 1
 (D) 3
 (E) 8

Algebra First-degree equations

$$\frac{j + (j + 5) + (2j - 1) + (4j - 2) + (5j - 1)}{5} = 8 \quad \text{given}$$

$$j + (j + 5) + (2j - 1) + (4j - 2) + (5j - 1) = 40 \quad \text{multiply both sides by 5}$$

$$13j + 1 = 40 \quad \text{combine like terms}$$

$$13j = 39 \quad \text{subtract 1 from both sides}$$

$$j = 3 \quad \text{divide both sides by 13}$$

The correct answer is D.

PS14037

19. Guadalupe owns 2 rectangular tracts of land. One is 300 m by 500 m and the other is 250 m by 630 m. The combined area of these 2 tracts is how many square meters?

- (A) 3,360
 (B) 307,500
 (C) 621,500
 (D) 704,000
 (E) 2,816,000

Geometry Area

The area of a rectangle can be found by multiplying the length and width of the rectangle. Therefore, the combined area, in square meters, of the 2 rectangular tracts of land is $(300)(500) + (250)(630) = 150,000 + 157,500 = 307,500$.

The correct answer is B.

PS03918

20. There are five sales agents in a certain real estate office. One month Andy sold twice as many properties as Ellen, Bob sold 3 more than Ellen, Cary sold twice as many as Bob, and Dora sold as many as Bob and Ellen together. Who sold the most properties that month?

- (A) Andy
 (B) Bob
 (C) Cary
 (D) Dora
 (E) Ellen

Algebra Order

Let x represent the number of properties that Ellen sold, where $x \geq 0$. Then, since Andy sold twice as many properties as Ellen, $2x$ represents the number of properties that Andy sold. Bob sold 3 more properties than Ellen, so $(x + 3)$ represents the number of properties that Bob sold. Cary sold twice as many properties as Bob, so $2(x + 3) = (2x + 6)$ represents the number of properties that Cary sold. Finally, Dora sold as many properties as Bob and Ellen combined, so $[(x + 3) + x] = (2x + 3)$ represents the number of properties that Dora sold. The following table summarizes these results.

Agent	Properties sold
Andy	$2x$
Bob	$x + 3$
Cary	$2x + 6$
Dora	$2x + 3$
Ellen	x

Since $x \geq 0$, clearly $2x + 6$ exceeds x , $x + 3$, $2x$, and $2x + 3$. Therefore, Cary sold the most properties.

The correct answer is C.

PS10862

21. In a field day at a school, each child who competed in n events and scored a total of p points was given an overall score of $\frac{p}{n} + n$. Andrew competed in 1 event and scored 9 points. Jason competed in 3 events and scored 5, 6, and 7 points, respectively. What was the ratio of Andrew's overall score to Jason's overall score?

- (A) $\frac{10}{23}$
- (B) $\frac{7}{10}$
- (C) $\frac{4}{5}$
- (D) $\frac{10}{9}$
- (E) $\frac{12}{7}$

Algebra Applied problems; Substitution

Andrew participated in 1 event and scored 9 points, so his overall score was $\frac{9}{1} + 1 = 10$. Jason participated in 3 events and scored $5 + 6 + 7 = 18$ points, so his overall score was $\frac{18}{3} + 3 = 9$. The ratio of Andrew's overall score to Jason's overall score was $\frac{10}{9}$.

The correct answer is D.

PS06719

22. A certain work plan for September requires that a work team, working every day, produce an average of 200 items per day. For the first half of the month, the team produced an average of 150 items per day. How many items per day must the team average during the second half of the month if it is to attain the average daily production rate required by the work plan?
- (A) 225
 - (B) 250
 - (C) 275
 - (D) 300
 - (E) 350

Arithmetic Rate problem

The work plan requires that the team produce an average of 200 items per day in September. Because the team has only produced an average of 150 items per day in the first half of September, it has a shortfall of $200 - 150 = 50$ items per day for the first half of the month. The team must make up for this shortfall in the second half of the month, which has an equal number of days as the first half of the month. The team must therefore produce in the second half of the month an average amount per day that is 50 items greater than the required average of 200 items per day for the entire month. This amount for the second half of September is 250 items per day.

The correct answer is B.