

## MATH TEST

60 Minutes—60 Questions

**Directions:** Solve each of the following problems, select the correct answer, and then fill in the corresponding space on your answer sheet.

Don't linger over problems that are too time-consuming. Do as many as you can, then come back to the others in the time you have remaining.

Calculator use is permitted, but some problems can best be solved without a calculator.

Note: Unless otherwise noted, all of the following should be assumed.

1. Illustrative figures are *not* necessarily drawn to scale.
2. All geometric figures lie in a plane.
3. The term *line* indicates a straight line.
4. The term *average* indicates arithmetic mean.

1. The regular price for a certain bicycle is \$125.00. If that price is reduced by 20%, what is the new price?

DO YOUR FIGURING HERE.

PERCENT DECREASE

If you get a 20% reduction, then you are only paying 80% of full price. 80% of \$125.00 equals \$100.00

- A. \$100.00  
B. \$105.00  
A C. \$112.50  
D. \$120.00  
E. \$122.50

2. If  $x = -5$ , then  $2x^2 - 6x + 5 = ?$

SUBSTITUTE X WITH -5

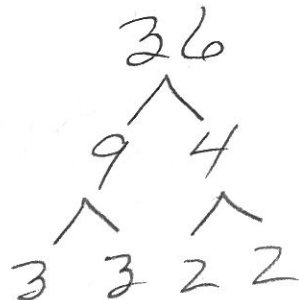
- F. -15  
G. 15  
H. 25  
→ J. 85  
K. 135

$2(-5)^2 - 6(-5) + 5$  Do as much as you can in your head  
 $50 - (-30) + 5$   
 $50 + 30 + 5 = 85$

3. How many **distinct** prime factors does the number 36 have?

PRIME FACTORIZATION

- A. 2  
B. 3  
C. 4  
D. 5  
E. 6



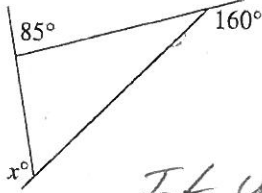
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2 and 3 are the only two **distinct** Prime Numbers

Exterior Angle Theorem  $\rightarrow$   
Sum of Exterior Angles equals  $360^\circ$

4. In the figure below, what is the value of  $x$ ?

DO YOUR FIGURING HERE.



$$85 + 160 + x = 360$$

$$x = 115$$

G

If you didn't know this, you could also use Supplemental Angles and  $180^\circ$  in triangle.  $85^\circ + 95^\circ = 180$

$$160^\circ + 20^\circ = 180 \quad 180 - (95 + 20) = 65 \quad 65^\circ + x = 180$$

- F.  $105^\circ$
- $\rightarrow$  G.  $115^\circ$
- H.  $135^\circ$
- J.  $245^\circ$
- K.  $255^\circ$

5. What is the average of  $\frac{1}{20}$  and  $\frac{1}{30}$ ?

Average Formula  $\rightarrow$   $\frac{\text{Sum of terms}}{\text{Number of terms}}$

- A.  $\frac{1}{25}$
- $\rightarrow$  B.  $\frac{1}{24}$
- C.  $\frac{2}{25}$
- D.  $\frac{1}{12}$
- E.  $\frac{1}{6}$

$$\frac{\frac{1}{20} + \frac{1}{30}}{2} = \frac{\frac{3}{60} + \frac{2}{60}}{2} = \frac{\frac{5}{60}}{2} = \frac{5}{120} = \frac{1}{24} \text{ or}$$

$$\frac{\frac{1}{20} + \frac{1}{30}}{2} = \frac{1}{40} + \frac{1}{60} = \frac{60 + 40}{2400} = \frac{100}{2400} = \frac{1}{24}$$

6. The toll for driving a segment of a certain freeway is \$1.50 plus 25 cents for each mile traveled. Joy paid a \$25.00 toll for driving a segment of the freeway. How many miles did she travel?

Arithmetic / RATES

Work backwards from TOTAL

Subtract \$1.50 from \$25.00 then divide by \$0.25

$$\text{Use calculator } \frac{\$23.50}{0.25} = 94$$

- F. 10
- G. 75
- $\rightarrow$  H. 94
- J. 96
- K. 100

7. For all  $x$ ,  $3x^2 \cdot 5x^3 = ?$

Rules of Exponents / Multiplying

MONOMIALS

- A.  $8x^5$
- B.  $8x^6$
- $\rightarrow$  C.  $15x^5$
- D.  $15x^6$
- E.  $15x^8$

$$b^a \times b^c = b^{a+c}$$

$$3x^2 \times 5x^3 = 3 \times 5 \times x^2 \times x^3$$

$$= 15x^{2+3} = 15x^5$$

You can do a problem like this all in your head.

GO ON TO THE NEXT PAGE  $\rightarrow$

Distance formula  $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$   
Based on Pythagorean Theorem

8. How many units apart are the points P (-1, -2) and Q (2, 2) in the standard (x, y) coordinate plane?

DO YOUR FIGURING HERE.

J

- F. 2  
G. 3  
H. 4  
→ J. 5  
K. 6

$$\sqrt{((2 - (-1))^2 + ((2 - (-2))^2}$$

$$\sqrt{(9) + 16} = \sqrt{25} = 5$$

It may be easier to see that this is a 3, 4 5 RIGHT TRIANGLE

9. In a group of 25 students, 16 are female. What percentage of the group is female?

Percent and Fractions

D

- A. 16%  
B. 40%  
C. 60%  
→ D. 64%  
E. 75%

$$\frac{16}{25} = \frac{16 \times 4}{25 \times 4} = \frac{64}{100} = 64\% \text{ or}$$

$$(x\%) \times 25 = 16 \Rightarrow x\% = \frac{16}{25} = 64\%$$

10. For how many integer values of x will  $\frac{7}{x}$  be greater than  $\frac{1}{4}$  and less than  $\frac{1}{3}$ ?

FRACTIONS AND INTEGERS

F

- F. 6  
G. 7  
H. 12  
J. 28  
K. Infinitely many

Think of  $\frac{7}{x}$  as  $\frac{1}{4}$  and  $\frac{1}{3}$

$$\frac{7}{x} = \frac{1}{4} \quad \frac{7}{x} = \frac{1}{3}$$

$$x = 28 \quad x = 21$$

How many integers between 28 and 21  
(28 - 21) - 1 = 6

11. Which of the following is a polynomial factor of  $6x^2 - 13x + 6$ ?

Factoring Trinomials

B

- B.  $3x - 2$   
A.  $2x + 3$   
C.  $3x + 2$   
D.  $6x - 2$   
E.  $6x + 2$

Since the first sign is (-) and the second sign is (+) you know both factors must have (-)'s. Therefore, the answer can't be A, C or E.

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Try both C and D and see which one works (6x - 2) doesn't match up.

FOIL METHOD IN REVERSE

Rules of Fractions =  $\frac{a+b}{c} = \frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$

Since all the denominators are the same, you can add

12. What is the value of  $a$  if  $\frac{1}{a} + \frac{2}{a} + \frac{3}{a} + \frac{4}{a} = 5$ ?

- F.  $\frac{1}{2}$
- G. 2
- H. 4
- J.  $12\frac{1}{2}$
- K. 50

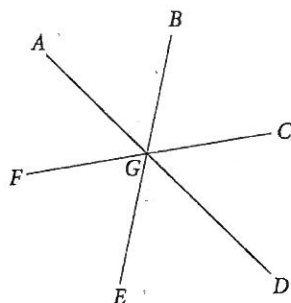
$$\frac{1}{a} + \frac{2}{a} + \frac{3}{a} + \frac{4}{a} = 5$$

$$\frac{1+2+3+4}{a} = 5$$

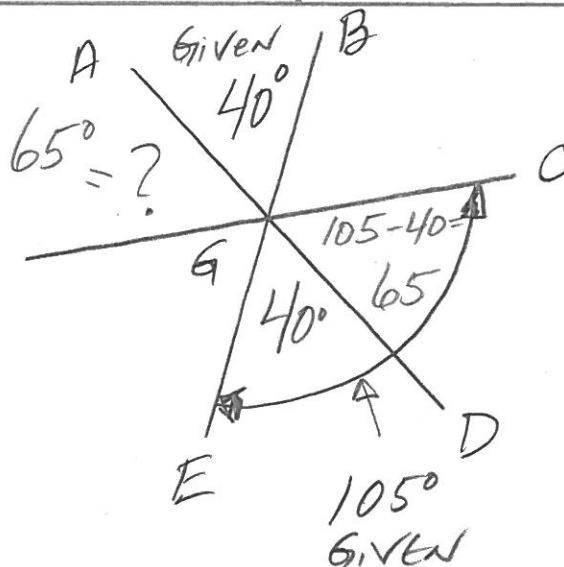
$$\frac{10}{a} = 5 \quad 10 \div a = 5$$

$$\frac{10}{5} = \frac{5a}{5} = 2 \quad a = 2$$

13. In the figure below,  $\overline{AD}$ ,  $\overline{BE}$ , and  $\overline{CF}$  all intersect at point  $G$ . If the measure of  $\angle AGB$  is  $40^\circ$  and the measure of  $\angle CGE$  is  $105^\circ$ , what is the measure of  $\angle AGF$ ?



Label answer with question mark



- A.  $35^\circ$
- B.  $45^\circ$
- C.  $55^\circ$
- D.  $65^\circ$
- E.  $75^\circ$

Intersecting lines, vertical angles and subtraction

14. Which of the following is the solution statement for the inequality  $-3 < 4x - 5$ ?

- F.  $x > -2$
- G.  $x > \frac{1}{2}$
- H.  $x < -2$
- J.  $x < \frac{1}{2}$
- K.  $x < 2$

Inequalities

Reverse sign only if multiplying or dividing by negative number

Simplify

$$-3 < 4x - 5$$

$$+5 \qquad +5$$

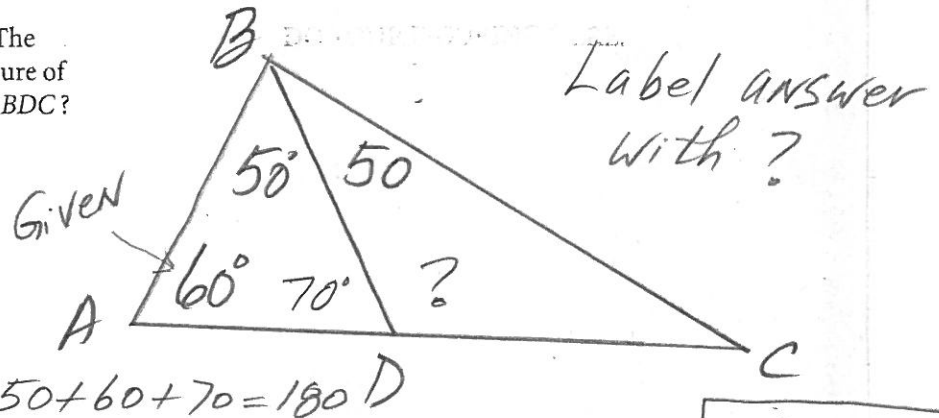
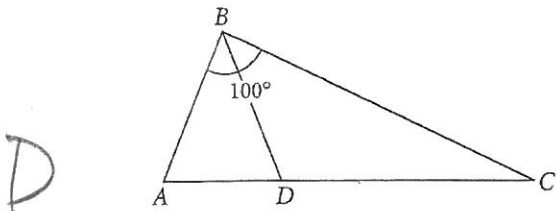
$$\frac{2}{4} < \frac{4x}{4} \implies \frac{1}{2} < x$$

is the same thing as  $x > \frac{1}{2}$

Total degree measure of angles in triangle =  $180^\circ$

angle bisectors cut angle in half

15. In the figure below,  $\overline{BD}$  bisects  $\angle ABC$ . The measure of  $\angle ABC$  is  $100^\circ$  and the measure of  $\angle BAD$  is  $60^\circ$ . What is the measure of  $\angle BDC$ ?



- A.  $80^\circ$   
B.  $90^\circ$   
C.  $100^\circ$   
→ D.  $110^\circ$   
E.  $120^\circ$

Supplemental Angles =  $180^\circ$   
 $70 + ? = 180^\circ$   
 $? = 110^\circ$

$x$	$y$
$x + y = 180$	

16. If  $x + 2y - 3 = xy$ , where  $x$  and  $y$  are positive, then which of the following equations expresses  $y$  in terms of  $x$ ?

- F →  
E.  $y = \frac{3-x}{2-x}$   
G.  $y = \frac{3-x}{x-2}$   
H.  $y = \frac{x-3}{2-x}$   
J.  $y = \frac{x-2}{x-3}$   
K.  $y = \frac{6-x}{x-2}$

Solving for ONE Variable in terms of other Values

$y$  in terms of  $x$  Means solving for  $y$ .

$$x + 2y - 3 = xy$$

$$2y - xy = 3 - x$$

$$\frac{y(2-x)}{(2-x)} = \frac{3-x}{2-x}$$

17. In a group of 50 students, 28 speak English and 37 speak Spanish. If everyone in the group speaks at least one of the two languages, how many speak both English and Spanish?

- A. 11  
B. 12  
C. 13  
D. 14  
E. 15

Distributing Groups of Both/Neither Type  
Group<sub>1</sub> + Group<sub>2</sub> + Neither - Both = TOTAL

$$28 + 37 + 0 - x = 50$$

$$65 - 50 = x$$

$$15 = x$$

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# RATES and Proportion

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

18. A car travels 288 miles in 6 hours. At that rate, how many miles will it travel in 8 hours?

DO YOUR FIGURING HERE.

- F. 216  
G. 360  
H. 368  
J. 376  
→ K. 384

K

$$\frac{288}{6} = \text{Rate} = 48/\text{hr} \quad 48 \times 8 = 384$$

OR  
PROPORTION

$$\frac{288}{6} = \frac{x}{8} \quad x = \frac{288 \times 8}{6}$$

19. When  $\frac{4}{11}$  is written as a decimal, what is the 100th digit after the decimal point?

REPEATING DECIMALS

D

$$\frac{4}{11} = 0.363636\dots$$

- A. 3  
B. 4  
C. 5  
→ D. 6  
E. 7

EVEN PLACES END WITH 6  
ODD PLACES END WITH 3

100 IS AN EVEN NUMBER SO 6

20. What is the solution for  $x$  in the system of equations below?

SYSTEMS OF EQUATIONS

G

$$\begin{aligned} 3x + 4y &= 31 \\ 3x - 4y &= -1 \end{aligned}$$

SINCE  $x$  IS WHAT YOU NEED, ELIMINATE  $y$

- F. 4  
→ G. 5  
H. 6  
J. 9  
K. 10

$$\begin{aligned} 3x + 4y &= 31 \\ + (3x - 4y &= -1) \\ \hline 6x &= 30 \\ x &= 5 \end{aligned}$$

21. In the standard  $(x, y)$  coordinate plane, points  $P$  and  $Q$  have coordinates  $(2, 3)$  and  $(12, -15)$ , respectively. What are the coordinates of the midpoint of  $PQ$ ?

MID POINT FORMULA

$$\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

- E
- A.  $(6, -12)$   
B.  $(6, -9)$   
C.  $(6, -6)$   
D.  $(7, -9)$   
→ E.  $(7, -6)$

$$\left( \frac{2+12}{2}, \frac{3+(-15)}{2} \right)$$

$$\left( \frac{14}{2}, \frac{-12}{2} \right)$$

$$(7, -6)$$

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SOH CAHTOA

$$\sin = \frac{O}{H}$$

$$\cos = \frac{A}{H}$$

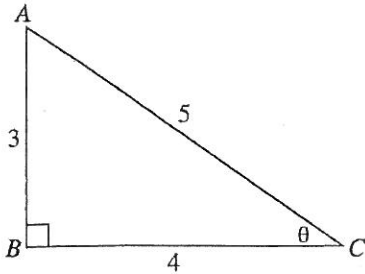
$$\tan = \frac{O}{A}$$

DO YOUR FIGURING HERE.

Basic Trigonometry

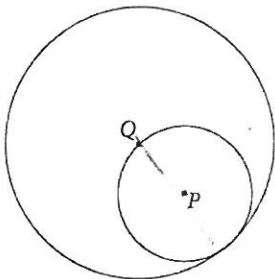
$$\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} = \frac{4}{5}$$

22. In the figure below,  $\angle B$  is a right angle, and the measure of  $\angle C$  is  $\theta$ . What is the value of  $\cos \theta$ ?



- H  
→ H.
- F.  $\frac{3}{4}$
  - G.  $\frac{3}{5}$
  - H.  $\frac{4}{5}$
  - J.  $\frac{5}{4}$
  - K.  $\frac{4}{3}$

23. In the figure below, the circle centered at  $P$  is tangent to the circle centered at  $Q$ . Point  $Q$  is on the circumference of circle  $P$ . If the circumference of circle  $P$  is 6 inches, what is the circumference, in inches, of circle  $Q$ ?



Circumference is distance around a circle

$$C = 2\pi r$$

$$C \text{ of circle } P = 6$$

$$6 = 2\pi r$$

$$\frac{6}{2\pi} = r = \frac{3}{\pi} = \text{Circumference of Circle } P$$

Because  $P$  is tangent to  $Q$ , the radius of  $Q$  is TWICE  $P$

$$2 \times \frac{3}{\pi} = \frac{6}{\pi} = \text{radius of Circle } Q$$

$$C \text{ of } Q = 2\pi \left(\frac{6}{\pi}\right) = 12$$

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Simply put, since the radii are twice the size so are the circumferences

# FUNCTIONS / EVALUATING ALGEBRAIC EXPRESSIONS

Whenever you see  $x$  substitute in  $-3$   
and simplify

DO YOUR FIGURING HERE.

24. If  $f(x) = x^3 - x^2 - x$ , what is the value of  $f(-3)$ ?

- G → F. -39  
G. -33  
H. -21  
J. -15  
K. 0

$$\begin{aligned} & (-3)^3 - (-3)^2 - (-3) \\ & -27 - 9 + 3 \\ & -36 + 3 = -33 \end{aligned}$$

25. If the lengths, in inches, of all three sides of a triangle are integers, and one side is 7 inches long, what is the least possible perimeter of the triangle, in inches?

- C → A. 9  
B. 10  
C. 15  
D. 21  
E. 24



Triangle inequality theorem  
The sum of any two sides is always greater than 3rd side  
 $x + y > 7$  If they are all integer sides, then the least possible sum for  $x + y$  is 8  $8 + 7 = 15$

26. What is the complete factorization of  $2x + 3x^2 + x^3$ ?

- J → F.  $x(x^2 + 2)$   
G.  $x(x - 2)(x + 3)$   
H.  $x(x - 1)(x + 2)$   
J.  $x(x + 1)(x + 2)$   
K.  $x(x + 2)(x + 3)$

FACTORS POLYNOMIALS

$$\begin{aligned} & \rightarrow \text{equals } x(2 + 3x + x^2) = \\ & x(2 + x)(x + 1) = \\ & x(x + 1)(x + 2) \end{aligned}$$

$x + y + 7 = P$
$8 + 7 = P$
$15 = P$

27. If  $xyz \neq 0$ , which of the following is equivalent to  $\frac{x^2 y^3 z^4}{(xyz^2)^2}$ ?

- C → A.  $\frac{1}{y}$   
B.  $\frac{1}{z}$   
C.  $y$   
D.  $\frac{x}{yz}$   
E.  $xyz$

Laws of Exponents

$$\frac{x^2 y^3 z^4}{(xyz^2)^2} = \frac{x^2 y^3 z^4}{x^2 y^2 z^4} = y$$



Converting Fractions to decimals

FRACTIONS AND DECIMALS

$$\frac{2}{3} + \frac{1}{12} = \frac{8}{12} + \frac{1}{12} = \frac{9}{12} = \frac{3}{4} = 0.75$$

28. As a decimal, what is the sum of  $\frac{2}{3}$  and  $\frac{1}{12}$ ?

DO YOUR FIGURING HERE.

- F. 0.2
- G. 0.5
- H. 0.75
- J. 0.833
- K. 0.875

Act will trick you to convert these fractions to decimals then adding, but this is more time consuming.

29. The formula for converting a Fahrenheit temperature reading to Celsius is

Plugging Values into formula

$C = \frac{5}{9}(F - 32)$ , where  $C$  is the reading in degrees Celsius and  $F$  is the reading in degrees Fahrenheit. Which of the following is the Fahrenheit equivalent to a reading of 95° Celsius?

$$95^\circ = \frac{5}{9}(F - 32)$$

- D
- A. 35° F
- B. 53° F
- C. 63° F
- D. 203° F
- E. 207° F

$$\frac{9}{5} * \frac{95}{1} = F - 32$$

$$171 + 32 = F = 203^\circ$$

30. A jar contains 4 green marbles, 5 red marbles, and 11 white marbles. If one marble is chosen at random, what is the probability that it will be green?

Simple Probability

- F.  $\frac{1}{3}$
- G.  $\frac{1}{4}$
- H.  $\frac{1}{5}$
- J.  $\frac{1}{16}$
- K.  $\frac{5}{15}$

$\frac{\text{What you seek}}{\text{All possible options to be sought}} = \text{Probability}$

$$\frac{\text{green}}{\text{Total}} = \frac{4}{4+5+11} = \frac{4}{20} = \frac{1}{5}$$

$$\text{Average} = \frac{\text{Sum of terms}}{\text{number of terms}}$$

31. What is the average of the expressions  $2x + 5$ ,  $5x - 6$ , and  $-4x + 2$ ?

DO YOUR FIGURING HERE.

- A.  $x + \frac{1}{3}$   
B.  $x + 1$   
C.  $3x + \frac{1}{3}$   
D.  $3x + 3$   
E.  $3x + 3\frac{1}{3}$

$$\frac{(2x+5) + (5x-6) + (-4x+2)}{3} = \frac{3x+1}{3} = x + \frac{1}{3}$$

A

32. The line that passes through the points  $(1, 1)$  and  $(2, 16)$  in the standard  $(x, y)$  coordinate plane is parallel to the line that passes through the points  $(-10, -5)$  and  $(a, 25)$ . What is the value of  $a$ ?

Slopes of Parallel lines are equal.

- F. -8  
G. 3  
H. 5  
J. 15  
K. 20

$$\frac{16-1}{2-1} = 15$$

$$15 = \frac{25 - (-5)}{a - (-10)}$$

$$15 = \frac{30}{a+10} \quad a+10=2 \quad a=-8$$

Set up equation

With slope 15 to solve for a

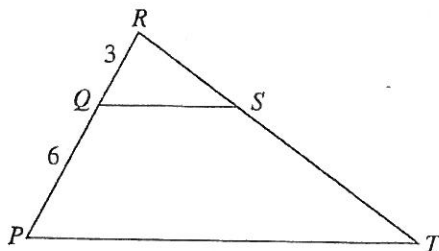
F

33. In the figure below,  $\overline{QS}$  and  $\overline{PT}$  are parallel, and the lengths of  $\overline{QR}$  and  $\overline{PQ}$ , in units, are as marked. If the perimeter of  $\triangle QRS$  is 11 units, how many units long is the perimeter of  $\triangle PRT$ ?

Parallel Lines in triangles create similar triangles

$\triangle QRS$  and  $\triangle PRT$  are similar

Perimeters are in the same proportion as the sides



Since side  $QR = 3$  and side  $PR = 9$ ,  $\triangle PRT$  is 3 times as large as  $\triangle QRS$ .

$$\therefore 11 \times 3 = 33$$

- A. 22  
B. 33  
C. 66  
D. 88  
E. 99

B

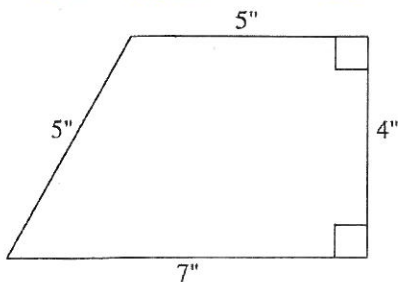
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# Classifying polygons

A Polygon is a closed figure made with

34. The figure shown below belongs in which of the following classifications?

DO YOUR FIGURING HERE. STRAIGHT LINES



Go thru each choice and eliminate those that are Not true.

- I. Polygon ← YES
- II. Quadrilateral ← YES. Quad. is a four sided polygon
- III. Rectangle ← NO. RECTANGLE is a quad. with 4  $\perp$ 's
- IV. Trapezoid ← YES - Trapezoid is a quad with ONLY ONE OF parallel lines.
- F. I only
- G. II only
- H. IV only
- J. I, II, and III only
- K. I, II, and IV only

35. If one solution to the equation  $2x^2 + (a-4)x - 2a = 0$  is  $x = -3$ , what is the value of  $a$ ?

Substitute  $x = -3$  and solve for  $a$ .

- A. 0
- B. 2
- C. 4
- D. 6
- E. 12

$$2x^2 + (a-4)x - 2a = 0$$

$$2(-3) + (a-4)(-3) - 2a = 0$$

$$18 - 3a + 12 - 2a = 0$$

$$-5a = -30$$

$$a = 6$$

36. A menu offers 4 choices for the first course, 5 choices for the second course, and 3 choices for dessert. How many different meals, consisting of a first course, a second course, and a dessert, can one choose from this menu?

Combinations  
Multiply all choices

- F. 12
- G. 24
- H. 30
- J. 36
- K. 60

$$4 * 5 * 3 = 60$$

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All Integers can be expressed as the Product of Prime Numbers

37. If an integer is divisible by 6 and by 9, then the integer **must** be divisible by which of the following? *has at least one 2 and two 3's*  
DO YOUR FIGURING HERE.



*in Prime Factorization*

B

- I. 12 → NO
- II. 18 → YES
- III. 36 → NO
- A. I only
- B. II only
- C. I and II only
- D. I, II, and III
- E. None

12 is not divisible by 9  
18 is divisible by 6 and 9,  
18 is divisible by 6 and 9,  
but 18 isn't divisible  
by 36

38. For all  $x \neq 0$ ,  $\frac{x^2 + x^2 + x^2}{x^2} = ?$

F

- F. 3
- G.  $3x$
- H.  $x^2$
- J.  $x^3$
- K.  $x^4$

$$\frac{x^2}{x^2} + \frac{x^2}{x^2} + \frac{x^2}{x^2} = 1 + 1 + 1 = 3$$

39. Joan has  $q$  quarters,  $d$  dimes,  $n$  nickels, and no other coins in her pocket. Which of the following represents the total number of coins in Joan's pocket?

A

- A.  $q + d + n$
- B.  $5q + 2d + n$
- C.  $.25q + .10d + .05n$
- D.  $(25 + 10 + 5)(q + d + n)$
- E.  $25q + 10d + 5n$

Answer the question asked. They want the total number of coins, not the value of the coins.

$$q + d + n = \text{Total \# of coins}$$

Solid dot used for  $\geq$  or  $\leq$   
OPEN Dot used for  $>$  or  $<$

40. Which graph below represents the solutions for  $x$  of the inequality  $5x - 2(1 - x) \geq 4(x + 1)$ ?

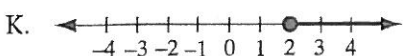
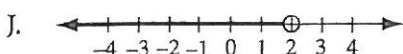
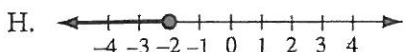
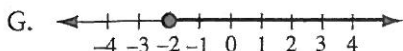
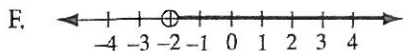
DO YOUR FIGURING HERE.

Simplify inequality first  
 $5x - 2(1 - x) \geq 4(x + 1)$

$$7x - 4x \geq 6$$

$$3x \geq 6$$

$$x \geq 2$$



K



41. In the standard  $(x, y)$  coordinate plane, line  $m$  is perpendicular to the line containing the points  $(5, 6)$  and  $(6, 10)$ . What is the slope of line  $m$ ?

Slopes of perpendicular lines are opposite

$$\frac{\Delta y}{\Delta x} = \frac{10 - 6}{6 - 5} = \frac{4}{1}$$

opposite Reciprocal

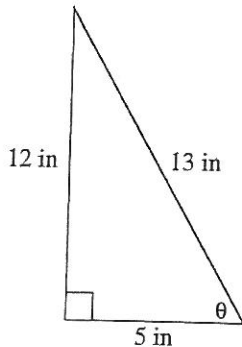
$$\text{of } \frac{4}{1} \text{ is } -\frac{1}{4}$$

B  
→

- A. -4  
B.  $-\frac{1}{4}$   
C.  $\frac{1}{4}$   
D. 4  
E. 8

42. In the right triangle below,  $\sin \theta = ?$

DO YOUR FIGURING HERE.



$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$

$= \frac{12}{13}$

- F.  $\frac{5}{13}$   
G.  $\frac{5}{12}$   
H.  $\frac{12}{13}$   
J.  $\frac{13}{12}$   
K.  $\frac{13}{5}$

Make bases equal

$9 = 3^2$  substitute 9 with  $3^2$

$(3^2)^{2x-1} = 3^{3x+3}$

$3^{4x-2} = 3^{3x+3}$

$4x-2 = 3x+3$

$x = 5$

Now that bases are =, set the exponents equal and solve for x

43. If  $9^{2x-1} = 3^{3x+3}$ , then  $x = ?$

- A. -4  
B.  $-\frac{7}{4}$   
C.  $-\frac{10}{7}$   
D. 2  
E. 5

44. From 1970 through 1980, the population of City Q increased by 20%. From 1980 through 1990, the population increased by 30%. What was the combined percent increase for the period 1970–1990?

- F. 25%  
G. 26%  
H. 36%  
J. 50%  
K. 56%

You can't just add the INCREASES. You need to break them down as separate INCREASES.

x = beginning

$((x)(1.2))1.3 = 1.56x$

x becomes 56% larger

Another Method

New # = original # + 30% of original #

# Average and Finding Missing Term

45. Martin's average score after 4 tests is 89. What score on the 5th test would bring Martin's average up to exactly 90?

Sum or total score of ALL four tests is  $4 \times 89 = 356$

$$356 + x = 90$$

$$\begin{array}{r} 5 \\ \hline 356 + x = 450 \\ x = 94 \end{array}$$

- E
- A. 90
  - B. 91
  - C. 92
  - D. 93
  - E. 94

46. Which of the following is an equation for the circle in the standard  $(x, y)$  coordinate plane that has its center at  $(-1, -1)$  and passes through the point  $(7, 5)$ ?

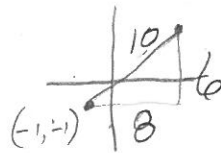
Equation of Circle formula

$$(x-h)^2 + (y-k)^2 = r^2 \quad (h, k) \text{ is center}$$

$h = (-1) \quad k = (-1)$  Center

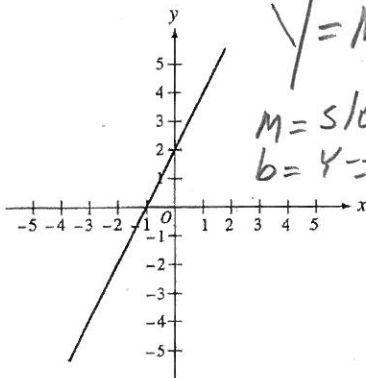
$r = \text{radius}$

- K
- F.  $(x-1)^2 + (y-1)^2 = 10$
  - G.  $(x+1)^2 + (y+1)^2 = 10$
  - H.  $(x-1)^2 + (y-1)^2 = 12$
  - J.  $(x-1)^2 + (y-1)^2 = 100$
  - K.  $(x+1)^2 + (y+1)^2 = 100$



Difference between  $x$  coordinates is 8 and the difference between  $y$  coordinates is  $(5 - (-1)) = 6$ .  $\therefore$  This is a 6, 8, 10 right triangle with  $R = 10$ . If you didn't see this as a 6, 8, 10 right  $\Delta$ , then you could use distance formula to find  $R$ .

47. Which of the following is an equation for the graph in the standard  $(x, y)$  coordinate plane below?



$$y = mx + b$$

$m = \text{slope}$   
 $b = y\text{-intercept}$

- E
- A.  $y = -2x + 1$
  - B.  $y = x + 1$
  - C.  $y = x + 2$
  - D.  $y = 2x + 1$
  - E.  $y = 2x + 2$

Line crosses  $y$  axis @  $y = 2 \therefore b = 2$ . Slope =  $\frac{2-0}{0-(-1)} = \frac{2}{1} = 2$

$M = 2$   
 $b = 2$  substitute into  $y = mx + b$   
 $y = 2x + 2$

Percent "of" =  $\times$

48. What is  $\frac{1}{4}\%$  of 16?

- F. 0.004
- G. 0.04
- H. 0.4
- J. 4
- K. 64

$$\frac{1}{4}\% = 0.25\% = 0.0025$$

Use calculator to multiply 0.0025 by 16  
answer question asked  $\frac{1}{4}\%$  not  $\frac{1}{4}$

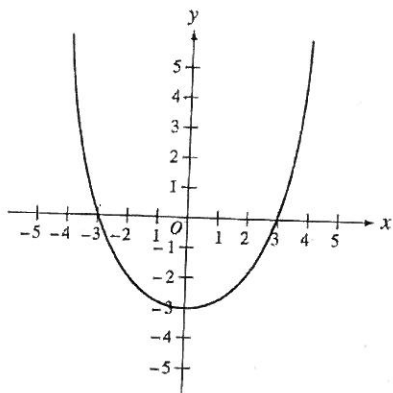
49. For all  $s$ ,  $(s+4)(s-4) + (2s+2)(s-2) = ?$

- A.  $s^2 - 2s - 20$
- B.  $3s^2 - 12$
- C.  $3s^2 - 2s - 20$
- D.  $3s^2 + 2s - 20$
- E.  $5s^2 - 2s - 20$

Multiplying binomials FOIL

$$\begin{aligned} ? &= s^2 - 16 + 2s^2 - 2s - 4 \\ &= s^2 + 2s^2 - 2s - 16 - 4 \\ &= 3s^2 - 2s - 20 \end{aligned}$$

50. Which of the following is an equation of the parabola graphed in the  $(x, y)$  coordinate plane below?



Equation for Parabola

$$y = ax^2 + bx + c$$

More useful equation is

$$f(x) = a(x-h)^2 + k$$

Where  $(h, k)$  is the vertex or point of inflection

Vertex of this parabola is  $(0, -3)$

$$y = a(x-0)^2 + (-3)$$

$$y = ax^2 - 3 \quad \text{find } a \text{ by}$$

using a point on parabola  $(3, 0)$

$$0 = a(3)^2 - 3$$

$$3 = 9a$$

$$\frac{1}{3} = a$$

→ F.  $y = \frac{x^2}{3} - 3$

G.  $y = \frac{x^2 - 3}{3}$

H.  $y = \frac{x^2}{3} + 3$

J.  $y = \frac{x^2 + 3}{3}$

K.  $y = 3x^2 - 3$

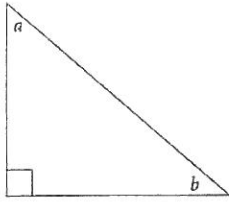
You can also just plug points on parabola into answer choices and see which one works



SOHCAHTOA

EASY  
Trigonometry

51. In the figure below,
- $\sin a = \frac{4}{5}$
- . What is
- $\cos b$
- ?

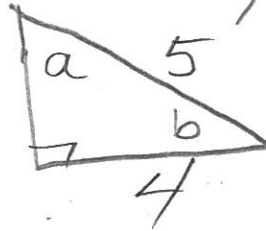


C

- A.  $\frac{3}{4}$   
 B.  $\frac{3}{5}$   
 → C.  $\frac{4}{5}$   
 D.  $\frac{5}{4}$   
 E.  $\frac{4}{3}$

$$\sin = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{4}{5}$$

$$b = 3$$



$b = 3$  because  
 its a 3,4,5  
 right triangle

$$\cos b = \frac{\text{Adjacent}}{\text{hypotenuse}} = \frac{4}{5}$$

52. For all
- $x \neq 0$
- ,
- $\frac{x^2 + x^2 + x^2}{x} = ?$

F

- F.  $3x$   
 G.  $x^3$   
 H.  $x^5$   
 J.  $x^7$   
 K.  $2x^2 + x$

Simplifying algebraic fraction

$$\frac{x^2 + x^2 + x^2}{x} = \frac{3x^2}{x} = 3 * \frac{x^2}{x} = 3x$$

53. One can determine a student's score
- $S$
- on a certain test by dividing the number of wrong answers (
- $w$
- ) by 4 and subtracting the result from the number of right answers (
- $r$
- ). This relation is expressed by which of the following formulas?

B

- A.  $S = \frac{r-w}{4}$   
 → B.  $S = r - \frac{w}{4}$   
 C.  $S = \frac{r}{4} - w$   
 D.  $S = 4r - w$   
 E.  $S = r - 4w$

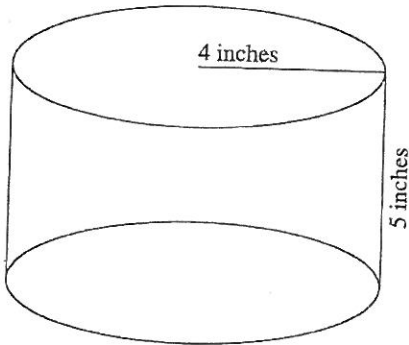
Translating from  
English to Algebra

When you divide  $w$  by 4, this equals  $\frac{w}{4}$ . When you subtract this from  $r$ , you get  $r - \frac{w}{4}$

$$S = r - \frac{w}{4}$$

$$\text{Volume of Cylinder} = \pi r^2 h$$

54. What is the volume, in cubic inches, of the cylinder shown in the figure below?



$$= \pi (4)^2 \times 5$$

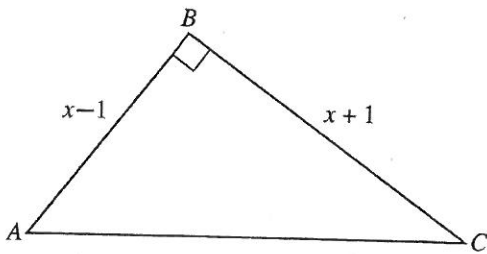
$$= 80\pi$$

J

- F.  $20\pi$
- G.  $40\pi$
- H.  $60\pi$
- J.  $80\pi$
- K.  $100\pi$

55. In the figure below,  $\overline{AB}$  is perpendicular to  $\overline{BC}$ . The lengths of  $\overline{AB}$  and  $\overline{BC}$ , in inches, are given in terms of  $x$ . Which of the following represents the area of  $\triangle ABC$ , in square inches, for all  $x > 1$ ?

E



- A.  $x$
- B.  $2x$
- C.  $x^2$
- D.  $x^2 - 1$
- E.  $\frac{x^2 - 1}{2}$

Area of triangle  
equals  $\frac{bh}{2}$

Base and height of a  
right triangle are the  
legs

$$\frac{(x-1)(x+1)}{2} = \frac{x^2 - 1}{2}$$

The difference of  
two squares

Beginning Year  
1990 + 9 years = 1999

TOWN A 9,400  
TOWN B 7,600  

---

1,800 difference

DO YOUR FIGURING HERE. between two

Since one town decreases by 100 and the other increases by 100, then the difference is 200 per year.

G

56. In 1990, the population of Town A was 9,400 and the population of Town B was 7,600. Since then, each year, the population of Town A has decreased by 100, and the population of Town B has increased by 100. Assuming that in each case the rate continues, in what year will the two populations be equal?

- F. 1998
- G. 1999
- H. 2000
- J. 2008
- K. 2009

Total Change ÷ PER year change = Years it will take until towns are equal

1800 ÷ 200 = 9 years

57. In a certain club, the average age of the male members is 35 and the average age of the female members is 25. If 20% of the members are male, what is the average age of all the club members?

- A. 26
- B. 27
- C. 28
- D. 29
- E. 30

Weighted Average

If 20% of members are male, then 1 out of 5 are male and 4 out of 5 are female.

USE a 5 Member SET

$$\frac{(Age)(\text{Numbers of members}) + (Age)(\text{Number of members})}{\text{TOTAL Members}} = \text{Weighted Average of Members}$$

$$\frac{(35)(1) + (25)(4)}{5} = \frac{135}{5} = 27$$

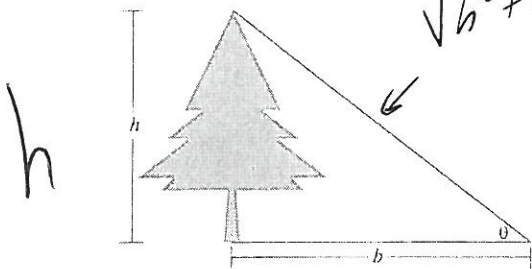
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# Advanced Trigonometry

$h = \sqrt{h^2 + b^2}$  because of Pythagorean Theorem

58. To determine the height  $h$  of a tree, Roger stands  $b$  feet from the base of the tree and measures the angle of elevation to be  $\theta$ , as shown in the figure below. Which of the following relates  $h$  and  $b$ ?

DO YOUR FIGURING HERE.



You need to go thru each one and analyze

- ✓ F)  $\sin \theta = \frac{h}{\text{hypotenuse}} = \frac{h}{\sqrt{h^2 + b^2}}$   
This is ~~tan~~  $\theta = \frac{h}{b}$
- ✓ G) This is  $\cot \theta$
- ✓ H) This is  $\cos \theta$
- ✓ J) Correct =  $\frac{\text{opposite}}{\text{hypotenuse}}$

- F.  $\sin \theta = \frac{h}{b}$
- G.  $\sin \theta = \frac{b}{h}$
- H.  $\sin \theta = \frac{b}{\sqrt{b^2 + h^2}}$
- J.  $\sin \theta = \frac{h}{\sqrt{b^2 + h^2}}$
- K.  $\sin \theta = \frac{\sqrt{b^2 + h^2}}{b}$

59. The formula for the lateral surface area  $S$  of a right circular cone is  $S = \pi r \sqrt{r^2 + h^2}$ , where  $r$  is the radius of the base and  $h$  is the altitude. What is the lateral surface area, in square feet, of a right circular cone with base radius 3 feet and altitude 4 feet?

Following formula  
Plug and chug

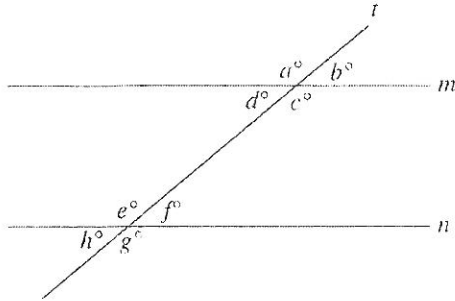
$$\begin{aligned}
 S &= \pi r \sqrt{r^2 + h^2} = \\
 &= \pi (3) \sqrt{3^2 + 4^2} \\
 &= 3\pi \sqrt{25} \\
 &= 3\pi (5) \\
 &= 15\pi
 \end{aligned}$$

GO ON TO THE NEXT PAGE

- A.  $3\pi\sqrt{5}$
- B.  $3\pi\sqrt{7}$
- C.  $15\pi$
- D.  $21\pi$
- E.  $\frac{75\pi}{2}$

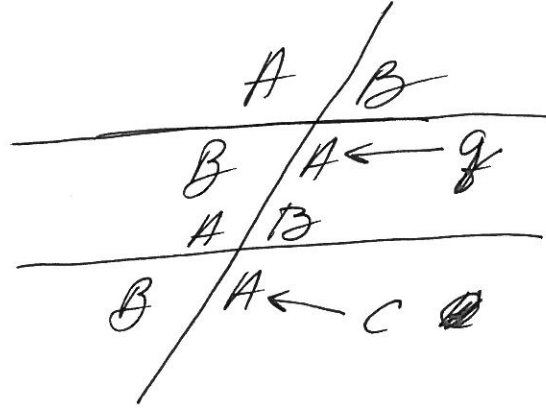
# Parallel Lines and Transversals

60. In the figure below, line  $t$  crosses parallel lines  $m$  and  $n$ . Which of the following statements must be true?



- F.  $a = b$
- G.  $a = d$
- H.  $b = e$
- J.  $c = g$
- K.  $d = g$

DO YOUR FIGURING HERE.



$C = g$

