Grammar Hero's Reference Sheet

Slope of a Line

Let (x_1, y_1) and (x_2, y_2) be two points on the line.

$$\text{Slope} = m = \frac{\text{change in y}}{\text{change in x}} = \frac{y_2 - y_1}{x_2 - x_1}$$

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Note: $ax^2 + bx + c = 0$ and $a \neq 0$

Equations of Lines

Standard Form: $Ax + By = C$

Slope-Intercept Form: $y = mx + b$
where m = slope and b = y – intercept

Point-Slope Form: $y - y_1 = m(x - x_1)$

Distance Formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

d = distance between points (x_1, y_1) and (x_2, y_2).

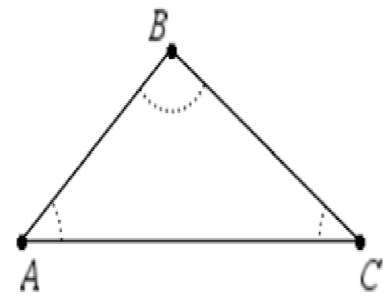
Midpoint Formula

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

M = point halfway between points (x_1, y_1) and (x_2, y_2).

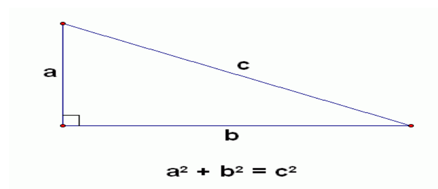
Triangle Sum Theorem

The sum of the three interior angles in a triangle is always 180°: $\angle a + \angle b + \angle c = 180°$



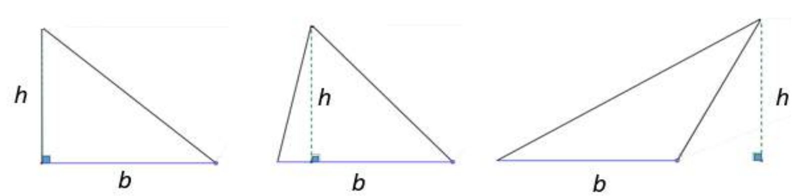
Pythagorean Theorem

In any right triangle, the sum of the squares of the legs is equal to the square of the hypotenuse: $a^2 + b^2 = c^2$



Area of a Triangle

$$A = \frac{1}{2}bh$$



b = the base of any triangle
h = perpendicular height of any triangle

Simple Interest Formula

$$I = prt$$

p = Principal (i.e., loan or investment amount)
I = Interest earned
r = Rate of interest per year in decimal form
t = Time in terms of years

Order of Operations (PEMDAS)

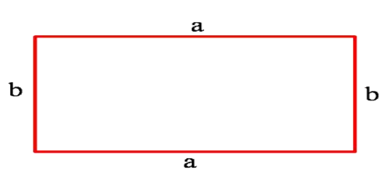
Order of operations refers to the order in which calculations are performed to evaluate an expression. The acronym PEMDAS is useful for remembering it.

P	Parenthesis
E	Exponents
M D	Multiplication and Division (Left to Right)
A S	Addition and Subtraction (Left to Right)

Note: Multiplication and division have equal precedence, so their calculations are performed as they appear in the expression from left to right. Likewise, addition and subtraction have equal precedence, so their calculations are performed as they appear from left to right.

Perimeter

To find the perimeter of any polygon, excluding circles, you simply add up all of its sides. For example:



$$P = 2a + 2b = 2(a + b)$$

Note: The perimeter of a circle is its circumference.

Distance, Rate, and Time Formula

$$d = rt$$

d = distance,
r = rate
t = time

Rate and time must be in proportional units (e.g., if rate is given in terms of miles per hour, time must be in terms of hours)

Percent Change

$$PC = \frac{New\ Value - Old\ Value}{Old\ Value}\ x\ 100$$

PC = Percent Change
If PC is positive, there was an increase.
If PC is negative, there was a decrease

Statistics

$$\textbf{Mean} = \frac{\text{Sum of all Data Points}}{\text{Number of Data Points}}$$

Range = Maximum Value – Minimum Value

Mode = The value in the data set that occurs the most often

Median = The value in the middle of the data set

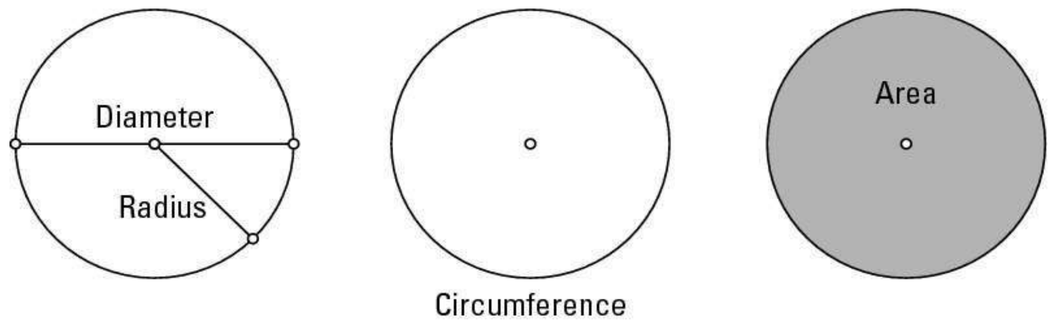
To find the median of a data set, arrange the observations in order from smallest to largest value. If there is an odd number of observations, the median is the middle value. If there is an even number of observations, the median is the average of the two middle values.

Circles

Area of a Circle:
$A = \pi r^2$

Circumference of a Circle:
$C = \pi d$ or $C = 2\pi r$

r = radius of a circle
d = diameter of a circle
π = 3.14 or 22/7



Converting Units	
Larger unit → smaller unit	*Multiply*
Smaller unit → Larger unit	*Divide*

Weight and Mass	
1 Ton (T)	2,000 pounds
1 pound (lb)	16 ounces (oz)

Linear Units	
12 inches (in)	1 foot (ft)
3 feet	1 yard (yd)
36 inches	1 yard
63,360 inches	1 mile (mi)
5,280 feet	1 mile
1,760 yards	1 mile

Time	
1 day	24 hours
1 hour (hr)	60 minutes (min)
1 minute	60 seconds (sec)
1 year (yr)	365.25 days
1 week	7 days
1 year	12 months (mon)
1440 minutes	1 day
3600 seconds	1 hour

Capacity	
8 fluid ounces	1 cup
2 cups	1 pint (pt)
2 pints	1 quart (qt)
4 quarts	1 gallon

Polygons

Shape	Number of Sides	Sum of Interior Angles
Triangle	3	180 degrees
Quadrilateral	4	360 degrees
Pentagon	5	540 degrees
Hexagon	6	720 degrees
Heptagon or Septagon	7	900 degrees
Octagon	8	1080 degrees
Any Polygon	n	S = 180(n - 2)

Multiplication Rules

The product and the quotient of one and any number is that number.

7 x 1 = 7

100 ÷ 1 = 100

Zero times any number equals zero.

0 × 2 = 0

858 x 0 = 0

Zero divided by any nonzero number is zero.

0 ÷ 3 = 0

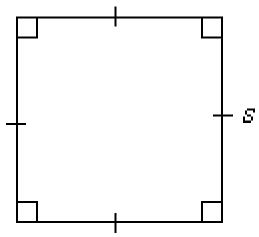
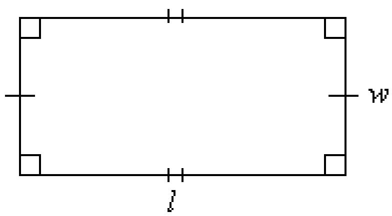
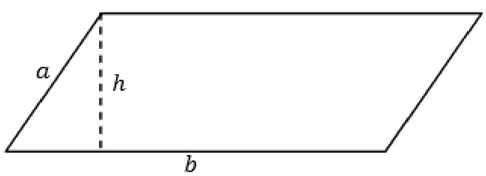
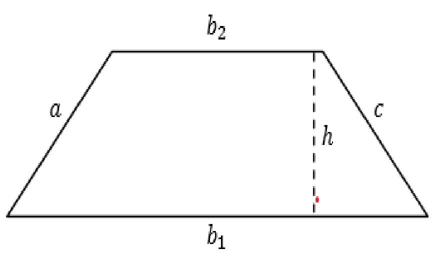
Dividing a number by zero is undefined.

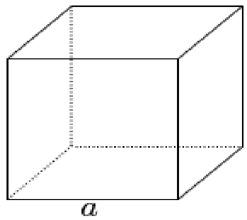
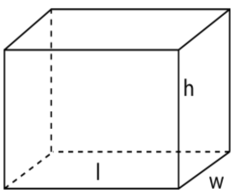
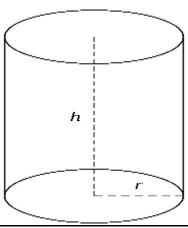
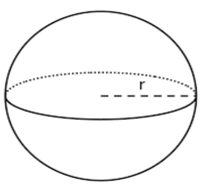
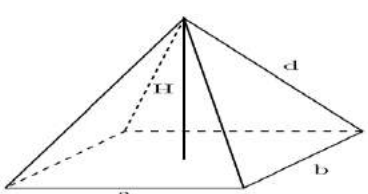
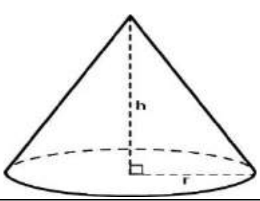
$$\frac{5}{0} = \text{undefined}$$

When multiplying or dividing with positives and negatives, use the signs charts.

Multiplication/Division Sign Chart

+	+	+
+	-	-
-	+	-
-	-	+

Quadrilaterals	
Square 	Perimeter: P = 4s Area: A = s^2 Note: To find the perimeter of any quadrilateral, you simply add up all of its sides.
Rectangle 	Perimeter: P = 2l + 2w Area: A = lw Note: To find the perimeter of any quadrilateral, you simply add up all of its sides.
Parallelogram 	Perimeter: P = 2a + 2b Area: A = bh Note: To find the perimeter of any quadrilateral, you simply add up all of its sides.
Trapezoid 	Perimeter: $P = a + b_1 + c + b_2$ Area: $A = \frac{1}{2}(b_1 + b_2) \cdot h$ Note: To find the perimeter of any quadrilateral, you simply add up all of its sides.

Formulas for Volume (V) and Surface Area (SA)	
Cube 	$V = a^3$ $SA = 6a^2$
Rectangular Solid 	$V = l \times w \times h$ $SA = 2(l \times w) + 2(w \times h) + 2(h \times l)$ l = length w = width h = height
Cylinder 	$V = \pi r^2 h$ $SA = 2\pi r h + 2\pi r^2$
Sphere 	$V = \frac{4}{3}\pi r^3$ $SA = 4\pi r^2$
Rectangular Pyramid 	$V = \frac{1}{3} abh$ Note: ab is the area of the base of the pyramid
Cone 	$V = \frac{1}{3} \pi r^2 h$

Basic Probability

1. For any event A: $0 \le P(A) \le 1$

2. P(impossible event) = 0.

3. P(sure event) = 1.

4. $P(A) = \frac{\text{Desired outcome}}{\text{Total number of outcomes}}$

5. P(not A) = 1 - P(A)

6. P(A and B) = P(A) x P(B) Independent (Replacement) vs. Dependent Events (No Replacement)

7. P(A or B) = P(A) + P(B) (Exclusive Events)

8. P(A or B) = P(A) + P(B) – P(A and B) (Non-Exclusive Events)

Prime Numbers

1	**2**	**3**	4	**5**	6	**7**	8	9	10
11	12	**13**	14	15	16	**17**	18	**19**	20
21	22	**23**	24	25	26	27	28	**29**	30
31	32	33	34	35	36	**37**	38	39	40
41	42	**43**	44	45	46	**47**	48	49	50
51	52	**53**	54	55	56	57	58	**59**	60
61	62	63	64	65	66	**67**	68	69	70
71	72	**73**	74	75	76	77	78	**79**	80
81	82	**83**	84	85	86	87	88	**89**	90
91	92	93	94	95	96	**97**	98	99	100

Times Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**1**	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	2	**4**	6	8	10	12	14	16	18	20	22	24	26	28	30
3	3	6	**9**	12	15	18	21	24	27	30	33	36	39	42	45
4	4	8	12	**16**	20	24	28	32	36	40	44	48	52	56	60
5	5	10	15	20	**25**	30	35	40	45	50	55	60	65	70	75
6	6	12	18	24	30	**36**	42	48	54	60	66	72	78	84	90
7	7	14	21	28	35	42	**49**	56	63	70	77	84	91	98	105
8	8	16	24	32	40	48	56	**64**	72	80	88	96	104	112	120
9	9	18	27	36	45	54	63	72	**81**	90	99	108	117	126	135
10	10	20	30	40	50	60	70	80	90	**100**	110	120	130	140	150
11	11	22	33	44	55	66	77	88	99	110	**121**	132	143	154	165
12	12	24	36	48	60	72	84	96	108	120	132	**144**	156	168	180
13	13	26	39	52	65	78	91	104	117	130	143	156	**169**	182	195
14	14	28	42	56	70	84	98	112	126	140	154	168	182	**196**	210
15	15	30	45	60	75	90	105	120	135	150	165	180	195	210	**225**

Perfect Squares

$1^2 = 1$	$6^2 = 36$	$11^2 = 121$	$16^2 = 256$
$2^2 = 4$	$7^2 = 49$	$12^2 = 144$	$17^2 = 289$
$3^2 = 9$	$8^2 = 64$	$13^2 = 169$	$18^2 = 324$
$4^2 = 16$	$9^2 = 81$	$14^2 = 196$	$19^2 = 361$
$5^2 = 25$	$10^2 = 100$	$15^2 = 225$	$20^2 = 400$

Laws of Exponents	
Zero-Exponent Rule $a^0 = 1$ Anything raised to the zero power is 1.	$3^0 = 1$ $(5x^3y^4)^0 = 1$
Power Rule $(a^m)^n = a^{mn}$ To raise a power to a power you need to multiply the exponents.	$(x^5)^4 = x^{20}$ $(2x^4y^2)^3 = 2^3x^{12}y^6 = 8x^{12}y^6$
Negative Exponent Rule $a^{-n} = \frac{1}{a^n}$ Negative exponents in the numerator get moved to the denominator and become positive exponents. Negative exponents in the denominator get moved to the numerator and become positive exponents.	$5^{-2} = \frac{1}{5^2} = \frac{1}{25}$ $4x^{-2} = \frac{4}{x^2}$ $\frac{x^{-3}}{y^{-7}} = \frac{y^7}{x^3}$
Product Rule $a^m \cdot a^n = a^{m+n}$ To multiply two exponents with the same base, you keep the base and add the powers.	$x \cdot x^5 = x^6$ $y^4 \cdot y^9 = y^{13}$
Quotient Rule $\frac{a^m}{a^n} = a^{m-n}$ To divide two exponents with the same base, you keep the base and subtract the powers.	$\frac{x^5}{x^3} = x^2$ $\frac{y^4}{y^9} = \frac{1}{y^5}$ $\frac{x^3y^2}{x^2y^5} = \frac{x}{y^3}$

Writing Equations of Lines
Given the following, you can write equations of lines using these steps:

1. **The slope of the line and the y-intercept**
   a. Slope = m
   b. Y-intercept = b
   c. Plug the m and b values into $y = mx + b$

2. **The slope of the line and a point that lies on the line**
   a. Slope = m
   b. Substitute the point (x, y) in for x and y in the equation $y = mx + b$ and solve for b.
   c. Plug the m and b values into $y = mx + b$

   OR

   a. Slope = m
   b. Substitute the slope and the point (x, y) in for x_1 and y_1 in the point-slope equation:
   $$y - y_1 = m(x - x_1)$$
   c. Solve the equation for y.

3. **Two points that lie on the line**
   a. Using the slope formula: m = $\frac{\text{change in y}}{\text{change in x}} = \frac{y_2 - y_1}{x_2 - x_1}$, find the slope.
   b. Substitute the slope and either point (x, y) in for x_1 and y_1 in the point-slope equation:
   $$y - y_1 = m(x - x_1)$$
   c. Solve the equation for y.

Fractions	
Adding and Subtracting Fractions	$\frac{a}{b} + \frac{c}{d} = \frac{(a \cdot d) + (c \cdot b)}{b \cdot d}$
Multiplying Fractions (Multiply straight across)	$\frac{a}{b} \cdot \frac{c}{d} = \frac{a \cdot c}{b \cdot d}$
Dividing Fractions (Keep, Change, Flip)	$\frac{a}{b} \div \frac{c}{d} = \frac{a \cdot d}{b \cdot c}$
Converting Mixed Numbers to Improper Fractions	$A\frac{b}{c} = \frac{(A \cdot c) + b}{c}$

Combined Rates & Work

Step 1: A problem involving combined rates or work can be solved using the formula:

$$\frac{T}{A}+\frac{T}{B}=1$$

T = time working together
A = the time it takes for one person or thing to complete the task by themselves
B = the time it takes for one person or thing to complete the task by themselves

Step 2: Adjust the formula in accordance with the problem and solve

Example: Walter and Helen are asked to paint a house. Walter can paint the house by himself in 12 hours and Helen can paint the house by herself in 16 hours. How long would it take to paint the house if they worked together?

Step 1: A problem involving work can be solved using the formula:

$$\frac{T}{A}+\frac{T}{B}=1$$

$$\frac{T}{12}+\frac{T}{16}=1$$

Step 2: Solve the equation created in the first step. This can be done by first multiplying the entire problem by the common denominator and then solving the resulting equation. In this case, the least common denominator is 48.

$$48\left(\frac{T}{12}+\frac{T}{16}=1\right)$$

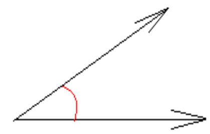
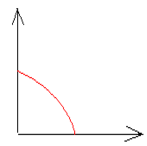
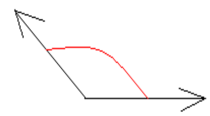
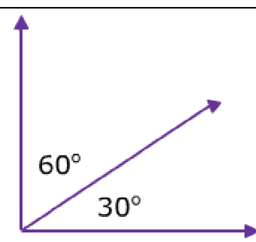
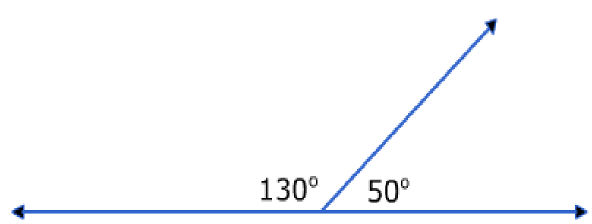
$$4T+3T=48$$

$$7T=48$$

$$T=\frac{48}{7}$$

Step 3: Answer the question asked of you in the problem and be sure to include units with your answer.

$$\text{Together } =\frac{48}{7}\approx 6.9 \text{ hours}$$

Angle Types & Special Angle Pairs	
Acute Angle: An angle whose measure is less than 90 degrees.	
Right angle: An angle whose measure is 90 degrees.	
Obtuse angle: An angle whose measure is bigger than 90 degrees but less than 180 degrees.	
Straight angle: An angle whose measure is 180 degrees. Thus, a straight angle look like a straight line.	
Complementary angles: Two angles that have a sum of 90 degrees. $\angle 1 + \angle 2 = 90°$	
Supplementary angles: Two angles that have a sum of 180 degrees. $\angle 1 + \angle 2 = 180°$	

Properties of Radicals

A. $a^{\frac{1}{n}} = \sqrt[n]{a}$ Example: $x^{\frac{1}{3}} = \sqrt[3]{x}$

B. $a^{\frac{m}{n}} = \sqrt[n]{a^m} = \left(\sqrt[n]{a}\right)^m$ Example: $x^{\frac{2}{3}} = \sqrt[3]{x^2} = \left(\sqrt[3]{x}\right)^2$

C. $\sqrt[n]{a^n} = a^{\frac{n}{n}} = a^1 = a$ Examples: $\sqrt{x^2} = x$ $\sqrt[5]{x^5} = x$

D. $\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$

Examples:

1. $\sqrt{36y^4} = \sqrt{36} \cdot \sqrt{y^4} = 6y^2$
2. $\sqrt{72y^5} = \sqrt{36y^4} \cdot \sqrt{2y} = 6y^2\sqrt{2y}$
3. $\sqrt[3]{48y^7} = \sqrt[3]{8y^6} \cdot \sqrt[3]{6y} = 2y^2\sqrt[3]{6y}$
4. $\sqrt[4]{64x^5y^8} = \sqrt[4]{16x^4y^8} \cdot \sqrt[4]{4x} = 2xy^2\sqrt[4]{4x}$
5. $\sqrt[5]{64x^5y^8} = \sqrt[5]{32x^5y^5} \cdot \sqrt[5]{2y^3} = 2xy\sqrt[5]{2y^5}$

E. $\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$ $b \neq 0$

Examples:

1. $\sqrt{\frac{9}{16}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$
2. $\sqrt{\frac{x^2}{4y^2}} = \frac{\sqrt{x^2}}{\sqrt{4y^2}} = \frac{x}{2y}$
3. $\sqrt[3]{\frac{8y^4}{27x^3}} = \frac{\sqrt[3]{8y^4}}{\sqrt[3]{27x^3}} = \frac{\sqrt[3]{8y^3} \cdot \sqrt[3]{y}}{\sqrt[3]{27x^3}} = \frac{2y\sqrt[3]{y}}{3x}$

FACTORING GUIDE

I. Check for GCF
II. Count the number of terms

Two Terms

1. Difference of 2 Squares

$A^2 - B^2 = (A - B)(A + B)$
$*$ *Note*: $A^2 + B^2$ *is prime and does* **NOT** *factor*

Example:
Since A = 2x and B = 5y
$4x^2 - 25y^2 = (2x - 5y)(2x + 5y)$

2. Sum or Difference of Cubes

$A^3 - B^3 = (A - B)(A^2 + AB + B^2)$
$A^3 + B^3 = (A + B)(A^2 - AB + B^2)$

Examples:
$x^3 - 8$ here A = x and B = 2
So $x^3 - 8 = (x - 2)(x^2 + 2x + 4)$

$27y^3 + 64z^3$ here A = 3y and B = 4z so
$27y^3 + 64z^3 = (3y + 4z)(9y^2 - 12yz + 16z^2)$

Three Terms

1. Leading Coefficient is 1

a) $x^2 + x - 42 = (x - 6)(x + 7)$
(find 2 numbers that multiply out to -42 and add up to 1)

b) $x^2 - 9x + 14$
$= (x - 7)(x - 2)$
(find 2 numbers that multiply to 14 and combine to - 9)

2. Leading Coefficient is NOT 1

a) Check to see if it is a perfect square trinomial
(use the sum or difference of the square root of the first and last terms)
$4x^2 - 20xy + 25y^2 = (2x - 5y)(2x - 5y)$
$= (2x - 5y)^2$

b) Use trial and error to factor the form $Ax^2 + Bx + C$
(If A and C are small or prime numbers, try different combinations to get the outer and inner terms to equal B.)

$2x^2 - 5x - 7 = (2x - 7)(x + 1)$ *not* $(2x + 1)(x - 7)$
not $(2x - 1)(x + 7)$
(outers = 2x, inners = - 7x, their sum is – 5x)
**Note: If $B^2 - 4AC$ is not a perfect square, the trinomial is prime.*

c) Use the AC (Australian) Method
1. Find the product of A times C and list pairs of factors. Select the pair of factors whose sum is B.
(If none match, then the trinomial is prime and cannot be factored.)
2. Rewrite the trinomial as four terms with the pair of factors as coefficients of the middle term.

$4x^2 - 13x + 10 \qquad AC = 40 \qquad B = -13$

	-2	-20	sum to -22
	-4	-10	sum to -14
use this pair →	-5	- 8	sum to -13

3. See factoring four terms **Two-by-Two Ex.1** below.

Four Terms — Factor by Grouping

Examples:

1. **Two by Two:**

1) $4x^2 - 8x - 5x + 10$
$= 4x(x - 2) - 5(x - 2) = (x - 2)(4x - 5)$

2) $x^3 - 3x^2 + 5x - 15$
$= x^2(x - 3) + 5(x - 3) = (x - 3)(x^2 + 5)$

2. **Three by One:** $x^2 - 6x + 9 - y^2 = (x - 3)^2 - y^2 = (x - 3 - y)(x - 3 + y)$

Factorials

$$n! = n \times (n-1) \times (n-2) \times \ldots \times 1$$

0! = 1
1! = 1
2! = 2 x 1 = 2
3! = 3 x 2 x 1 = 6
4! = 4 x 3 x 2 x 1 = 24
5! = 5 x 4 x 3 x 2 x 1 = 120
6! = 6 x 5 x 4 x 3 x 2 x 1 = 720
7! = 7 x 6 x 5 x 4 x 3 x 2 x 1 = 5,040

$$\frac{9!}{7!} = \frac{9\times8\times7\times6\times5\times4\times3\times2\times1}{7\times6\times5\times4\times3\times2\times1}$$
$$= \frac{9\times8\times\cancel{7}\times\cancel{6}\times\cancel{5}\times\cancel{4}\times\cancel{3}\times\cancel{2}\times\cancel{1}}{\cancel{7}\times\cancel{6}\times\cancel{5}\times\cancel{4}\times\cancel{3}\times\cancel{2}\times\cancel{1}}$$
$$= 9\times8$$
$$= 72 \checkmark$$

$$\frac{15!}{12!\,3!} = \frac{15\cdot14\cdot13\cdot12!}{12!\,3!}$$
$$= \frac{15\cdot14\cdot13\cdot\cancel{12!}}{\cancel{12!}\,3!}$$
$$= \frac{15\cdot14\cdot13}{3!}$$
$$= \frac{\overset{5}{\cancel{15}}\cdot\overset{7}{\cancel{14}}\cdot13}{\cancel{3}\cdot\cancel{2}\cdot1}$$
$$= 5\cdot7\cdot13$$
$$= 455 \checkmark$$

Prime Numbers & Divisibility Rules

A number is divisible by…	Divisible	Not Divisible
2 – if the last digit is even (0, 2, 4, 6, or 8).	3,978	4,975
3 – if the sum of the digits is divisible by 3.	315 = 3 + 1 + 5 = 9	139 = 1 + 3 + 9 = 13
4 – if the last two digits are divisible by 4.	8,512	7,511
5 – if the last digit is 0 or 5.	14,975	10,999
6 – if the number is divisible by both 2 and 3.	48	20
9 – if the sum of the digits is divisible by 9.	711 = 7 + 1 + 1 = 9	93 = 9 + 3 = 12
10 – if the last digit is 0.	15,990	10,536

Since a number is considered prime is if it is only divisible by one and itself, you can use these divisibility rules to quickly determine if a number is NOT prime. In other words, if a number is divisible by 2, 3, 4, 5, 6, 9, or 10, then it cannot be prime. For example:

1. 10,995 – this number is not prime because its last digit is 5, which means it is divisible by 5 (i.e., by something other than one and itself).

2. 988 – this number is not prime because its last digit is 8, an even number, which means it is divisible by 2 (i.e., by something other than one and itself).

3. 333 – this number is not prime because the sum of its digits (3 + 3 + 3 = 9) is divisible by 3, which means it is divisible by 3 (i.e., by something other than one and itself).

Reciprocals of Fractions, Whole Numbers, and Mixed Numbers

To find the reciprocal of a fraction, simply swap the numerator and denominator.

$$\frac{2}{5} \quad \frac{5}{2}$$

(The reciprocal of 2/5 is 5/2)

To find the reciprocal of a whole number, we rewrite whole number as a fraction by placing it over one and then swap the numerator and denominator.

$$5 = \frac{5}{1} \quad \frac{1}{5}$$

(The reciprocal of 5 is 1/5)

To find the reciprocal of a mixed number, we rewrite the mixed number as an improper fraction and then swap the numerator and denominator.

$$1\frac{2}{5} = \frac{7}{5} \quad \frac{5}{7}$$

(The reciprocal of 1 2/5 is 5/7)

Like Terms

Like terms have the <u>same letter variables</u> and are <u>raised to same powers</u>. Like terms can be combined into a single term.

Like Terms	Not Like Terms
2x and -5x	6x and 6y
$2a^2$ and $-5a^2$	y and $6y^2$
$-2xy^2$ and $8xy^2$	X and 7

Adding and Subtracting Polynomials

When **adding polynomials**, you simply combine **like terms**. For example:

$(x^2 – x + 5) + (6x^2 + 2x – 10)$

$$\begin{array}{rrrr} & x^2 & - \; x & + \; 5 \\ + & 6x^2 & + \; 2x & - \; 10 \\ \hline & 7x^2 & + \; x & - \; 5 \end{array}$$

When **subtracting polynomials**, you rewrite subtraction as addition by distributing the negative sign to every term in the second polynomial and then combine **like terms**. For example:

$(3x^2 – 8x + 7) – (2x^2 – 6x + 12)$

$= (3x^2 – 8x + 7) + (-2x^2 + 6x - 12)$

$$\begin{array}{rrrr} & 3x^2 & - \; 8x & + \; 7 \\ + & -2x^2 & + \; 6x & - \; 12 \\ \hline & x^2 & - \; 2x & - \; 5 \end{array}$$

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The Fundamental Counting Principle

The **Fundamental Counting Principle** is a way to quickly determine the total number of ways different events can occur.

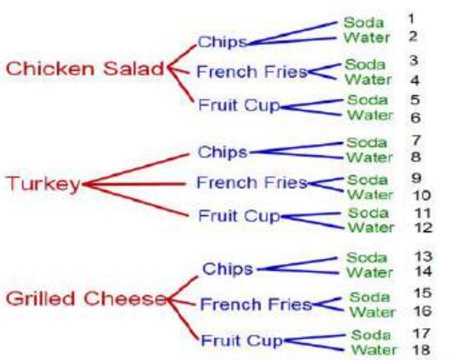
Event M can occur m number of ways
Event N can occur n number of ways

The total number of ways they can occur is:
m x n

For example:
A new restaurant opened, and it offers lunch combos for $5.00. With the combo meal, you get one choice of a sandwich, one choice of a side, and one choice of a drink. How many different combinations can you make for lunch? The choices are below.

Sandwiches: Chicken Salad, Turkey, Grilled Cheese
Sides: Chips, French Fries, Fruit Cup
Drinks: Soda, Water

Using a tree diagram to answer this question is slow and inefficient!



There are 18 total combinations

Applying **the Fundamental Counting Principle** to answer it takes 30 seconds or less:

3 choices of sandwiches x 3 choices of sides x 2 choices of drinks
3 x 3 x 2 = 18 possible combinations

Example 1
Sarah goes to a local deli, which offers a soup, salad, and sandwich lunch combo. There are 3 soups, 3 salads, and 6 sandwiches from which to choose. How many different lunches can be formed?
3 soups × 3 salads × 6 sandwiches = 54 different lunch combos

Example 2
A website offers 5 sizes, 8 colors, and 25 logos for their t-shirts. How many different t-shirts can be created, given these options?
5 sizes × 8 colors × 25 logos = 1,000 combinations of shirts

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Converting Celsius (C) to Fahrenheit (F) and Fahrenheit (F) to Celsius (C)

For the ASVAB, you generally do not have to memorize these formulas. Rather, you must understand that, algebraically, you can use either of these formulas to convert Celsius to Fahrenheit as well as Fahrenheit to Celsius.

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

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

For example: Convert 30 degrees Celsius to Fahrenheit using both formulas.

Using the First Formula	Using the Second Formula
$F = \frac{9}{5}C + 32, \quad C = 30$	$C = \frac{5}{9}(F - 32), \qquad C = 30$
$F = \frac{9}{5}(30) + 32$	$30 = \frac{5}{9}(F - 32)$
$F = \frac{9}{5} \cdot \frac{30}{1} + 32$	$\frac{9}{5} \cdot 30 = \frac{5}{9} \cdot \frac{9}{5}(F - 32)$
$F = \frac{270}{5} + 32$	$\frac{9}{5} \cdot \frac{30}{1} = \cancel{\frac{5}{9} \cdot \frac{9}{5}}(F - 32)$
$F = 54 + 32$	$\frac{270}{5} = F - 32$
$F = 86$	$54 = F - 32$ $54 + 32 = F$ $F = 86$

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