

## MULTIPLICATION TABLE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
7	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140
8	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
9	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180
10	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
11	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220
12	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240

## NUMBERS

**PRIME NUMBER**—A whole number that has only two factors, itself and 1.

*Examples:* 2, 5, 7, 11, 17.

**COMMON FACTOR**—A number that is a factor of two or more numbers.

*Examples:* 1, 2, and 4 are common factors of the numbers 12 and 16.

**GREATEST COMMON FACTOR**—The greatest number that is a factor of two or more numbers.

*Example:* 4 is the greatest common factor of the numbers 12 and 16.

**LEAST COMMON MULTIPLE**—The smallest number that is a multiple of two or more numbers.

*Example:* 12 is the least common multiple of the numbers 2, 3, 4, and 6.

**NUMERATOR**—The number above the line in a fraction.

**DENOMINATOR**—The number below the line in a fraction.

$$\frac{1}{2}$$

## ROMAN NUMERALS

**Roman Numerals**—Numerical symbols formed with the Roman letters I, V, X, L, C, D, and M, representing respectively the numbers 1, 5, 10, 50, 100, 500, and 1000. Once used by the ancient Romans, the system of numbering can still be found today in certain formal contexts.

1	I	19	XIX	100	C
2	II	20	XX	101	CI
3	III	21	XXI	200	CC
4	IV	22	XXII	300	CCC
5	V	23	XXIII	400	CD
6	VI	24	XXIV	500	D
7	VII	25	XXV	600	DC
8	VIII	26	XXVI	700	DCC
9	IX	27	XXVII	800	DCCC
10	X	28	XXVIII	900	CM
11	XI	29	XXIX	1000	M
12	XII	30	XXX	1001	MI
13	XIII	40	XL	2000	MM
14	XIV	50	L	2001	MMI
15	XV	60	LX	5000	MMMM or V̄
16	XVI	70	LXX	5001	MMMMMI or V̄I
17	XVII	80	LXXX	10,000	X̄ or MMMMMMMMMM
18	XVIII	90	LXXX		

## ENGLISH/METRIC CONVERSION

If you know— You can find— By multiplying by

<b>Length</b>	inches	millimeter	25
	feet	centimeters	30
	yards	meters	0.9
	miles	kilometers	1.6
<b>Area</b>	square inches	square centimeters	6.5
	square feet	square meters	0.09
	square yards	square meters	0.8
	square miles	square kilometers	2.6
<b>Mass</b>	ounces	grams	28
	pounds	kilograms	0.45
<b>Liquid Volume</b>	ounces	milliliters	30
	pints	liters	0.47
	quarts	liters	0.95
	gallons	liters	3.8
<b>Temperature</b>	degrees Fahrenheit	degrees Celsius	subtract 32 and multiply by $\frac{5}{9}$

## EQUIVALENT MEASUREMENTS

### English System

#### Area

1 acre = 4840 square (sq) yards  
 1 sq mile = 640 acres  
 1 sq foot = 144 sq inches  
 1 sq yard = 9 sq feet

#### Length/Distance

1 foot (ft) = 12 inches  
 1 yard (yd) = 3 feet  
 1 yard = 36 inches  
 1 mile (mi) = 1760 yards  
 1 mile = 5,280 feet  
 1 nautical mile = 1.15 miles  
 1 league = 3 miles

#### Volume

1 tablespoon (T) = 3 teaspoons (t)  
 1 cup (c) = 16 T

### Volume (Continued)

1 cup = 8 fluid oz (fl oz)  
 1 pint (pt) = 2 c  
 1 quart (qt) = 2 pt  
 1 quart = 4 c  
 1 quart = 32 fl oz  
 1 gallon (gal) = 4 qt

### Weight

1 pound (lb) = 16 oz  
 1 ton = 2000 lbs

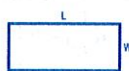
### Metric System

1 m<sup>2</sup> = 10,000 cm<sup>2</sup>  
 1 hectare (ha) = 10,000 m<sup>2</sup>  
 1 km<sup>2</sup> = 100 ha  
 1 metric ton (t) = 1000 kg

## PERIMETER AND CIRCUMFERENCE

**Perimeter**—The distance around an object. **Circumference**—The distance around a circle.

**Polygon**— $2(L + W)$

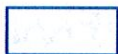


**Circle**— $\pi d$  or  $2\pi r$



**Area:** L = length; w = width; h = height; s = side; b = base; r = radius

**Rectangle**— $L \cdot w$



**Parallelogram**— $b \cdot h$



**Square**— $s^2$



**Circle**— $\pi r^2$



**Trapezoid**— $\frac{1}{2}(b_1 + b_2)h$



**Triangle**— $\frac{1}{2}b \cdot h$

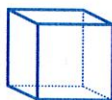


**Surface Area and Volume:** **Surface Area**—Find the area of each face and total. **Volume of Prisms**—Find the area of the base (b) and multiply by the height (h).

**Rectangular Prism**— $v = L \cdot w \cdot h$



**Cube**— $v = s^3$



**Cylinder Volume**— $v = \pi r^2 h$   
**Surface Area**— $sa = 2\pi r^2 + 2\pi rh$



**Cone**— $v = \frac{1}{3}\pi r^2 h$



**Sphere volume**— $v = \frac{4}{3}\pi r^3$   
**Surface Area**— $sa = 4\pi r^2$

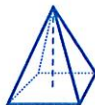


**Triangular Prism**— $v = b \cdot h$

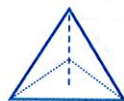


**Pyramid Volume**— Find the area of the base (b); multiply by the height (h); and divide by 3.

**Square Pyramid**— $v = \frac{1}{3}bh$



**Triangular Pyramid**— $v = \frac{1}{3}bh$



**Rectangular Pyramid**— $v = \frac{1}{3}bh$



## ALGEBRA

**Quadratic Equation**—If  $ax^2 + bx + c = 0$

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

**Equations of a Line**—( $m$  = slope;  $b$  =  $y$  intercept)

**Slope of a Line**—  $m = \frac{y_2 - y_1}{x_2 - x_1}$

**Slope Intercept Form**— $y = mx + b$

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

**Special Products**—

$$\begin{aligned} (a - b)^2 &= a^2 - 2ab + b^2 \\ (a - b)(a + b) &= a^2 - b^2 \\ (a + b)(c + d) &= ac + ad + bc + bd \\ (a + b)(a + c) &= a^2 + ac + ab + bc \\ (a + b)^2 &= a^2 + 2ab + b^2 \\ a(b + c) &= ab + ac \\ (a + b)^3 &= a^3 + 3a^2b + 3ab^2 + b^3 \\ (a - b)^3 &= a^3 - 3a^2b + 3ab^2 - b^3 \end{aligned}$$

**Logarithms**—

$$\begin{aligned} \log x^r &= r \log x \\ \log (xy) &= \log x + \log y \\ \log (x/y) &= \log x - \log y \\ \log x = n &\Leftrightarrow x = 10^n \text{ (common log)} \\ \log_a x = n &\Leftrightarrow x = a^n \text{ (log to the base } a) \\ \ln x = n &\Leftrightarrow x = e^n \text{ (natural log)} \\ \pi &\approx 3.14159265 \\ e &\approx 2.71828183 \end{aligned}$$

**Law of Exponents**—If  $a, b \in \mathbb{R}$ ,  $a, b \geq 0$ , and  $p, q, r, s \in \mathbb{Q}$  then:

- $a^r a^s = a^{r+s}$
- $a^r / a^s = a^{r-s}$
- $(a^r)^s = a^{rs}$
- $(ab)^r = a^r b^r$
- $(a/b)^r = a^r / b^r$  ( $b \neq 0$ )
- $a^0 = 1$  ( $a \neq 0$ )
- $a^{-r} = 1/a^r$  ( $a \neq 0$ )
- $a^{r/s} = \sqrt[s]{a^r} = (\sqrt[s]{a})^r$
- $a^{1/2} = \sqrt{a}$
- $a^{1/3} = \sqrt[3]{a}$

**Variation Models**—For variables  $x, y$ , and  $z$  where  $k$  is a positive constant called the constant of variation.

Direct Variation— $y = kx$  or  $y/x = k$

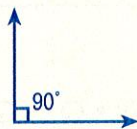
Inverse Variation— $y = k/x$  or  $xy = k$

Joint Variation— $z = kxy$

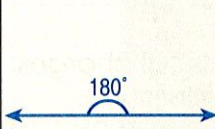
## GEOMETRY

**Angles and Triangles**—All angles of a triangle add up to  $180^\circ$

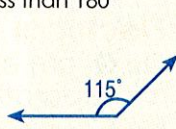
**Right angle:** equals  $90^\circ$



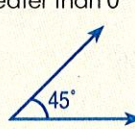
**Straight angle:** equals  $180^\circ$



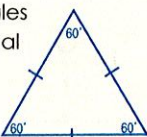
**Obtuse angle:** greater than  $90^\circ$  but less than  $180^\circ$



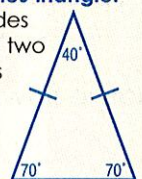
**Acute angle:** less than  $90^\circ$  but greater than  $0^\circ$



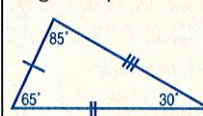
**Equilateral triangle:** all sides equal; all angles equal



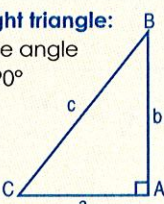
**Isosceles triangle:** two sides equal; two angles equal



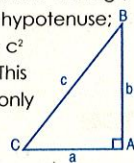
**Scalene triangle:** no sides equal; no angles equal



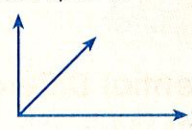
**Right triangle:** one angle is  $90^\circ$



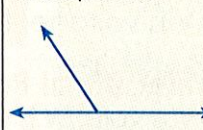
**Pythagorean Theorem:** sides  $a$  and  $b$  are legs; side  $c$  is hypotenuse;  $a^2 + b^2 = c^2$  angles. This applies only to right angles.



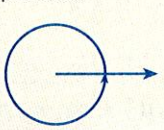
**Complementary angles:** two angles add up to  $90^\circ$



**Supplementary angles:** two angles add up to  $180^\circ$



**Complete angle rotation:** equals  $360^\circ$

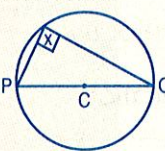


**Circle Theorems**

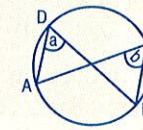
$C$  is the center of the circle



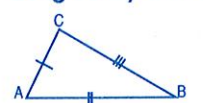
$\angle x = 90^\circ$   $PQ$  is a diameter



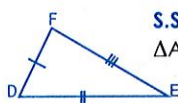
$a = b$  angles subtended on the same arc  $AB$



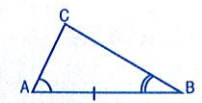
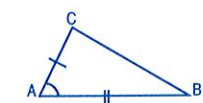
**Congruency Cases**



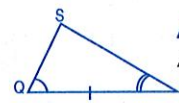
**S.S.S. (Side, Side, Side)**  
 $\triangle ABC \cong \triangle DEF$



**S.A.S. (Side, Angle, Side)**  
 $\triangle ABC \cong \triangle KLM$



**A.S.A. (Angle, Side, Angle)**  
 $\triangle ABC \cong \triangle QRS$



**H.S. (Hypotenuse, Side)**  
 $\triangle ABC \cong \triangle XYZ$

