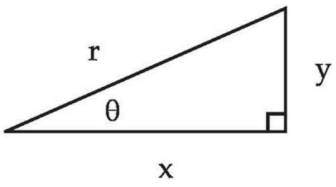
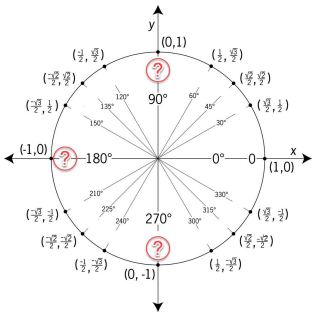
IMAGINARY NUMBERS $i^1 = ?$ $i^2 = ?$ $i^3 = ?$ $i^4 = ?$	ARC LENGTH Arc Length = _ · _
SOH-CAH-TOA ***on x-y plane*** sin Θ = _ / _ cos Θ = _ / _ tan Θ = _ / _  	THE NTH DIGIT How do you find the 5,009th digit in the repeating decimal $0.\overline{467129}$?
$\sin^2\Theta + \cos^2\Theta = ?$	SCIENTIFIC NOTATION What is $3.0 \times 10^8 \cdot 1.5 \times 10^{-6}$?
AREA OF A CIRCLE A = _ · _	UNIT CIRCLE 
AREA OF A TRAPEZOID A = _ (_ + _) · _	AREA OF A PARALLELOGRAM A = _ · _

ARC LENGTH

Arc Length = $r \cdot \Theta$

r = radius of the circle

Θ = angle measure **<u>in radians</u>**

IMAGINARY NUMBERS

$i^1 = i$ (or $\sqrt{-1}$) $\quad i^2 = -1$

$i^3 = -i \quad i^4 = 1$

THE NTH DIGIT

How do you find the 5,009th digit in the repeating decimal $0.\overline{46712}9$?

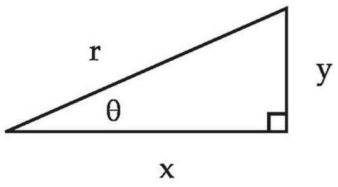
5,009 ÷ 6 = 834, **r.5**

Remainder 5 → 5th digit

SOH-CAH-TOA ***on x-y plane***

$\sin\Theta = y/r \quad \cos\Theta = x/r$

$\tan\Theta = y/x$



$3.0 \times 10^8 \cdot 1.5 \times 10^{-6}$

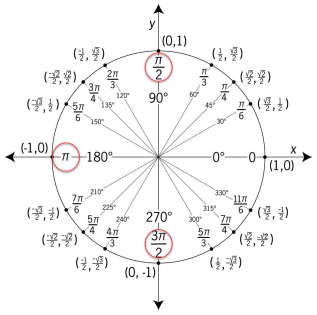
$= (3.0 \cdot 1.5) \times (10^8 \cdot 10^{-6})$

$= (4.5) \times (10^2)$

$=450$

$\sin^2\Theta + \cos^2\Theta = 1$

UNIT CIRCLE



AREA OF A CIRCLE

$A = \pi r^2$

AREA OF A PARALLELOGRAM

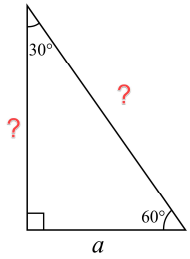
$A = b \cdot h$

AREA OF A TRAPEZOID

$A = \frac{1}{2}(b_2 + b_2) \cdot h$

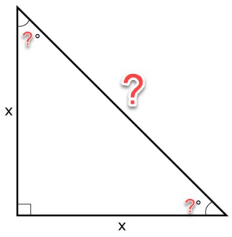
(*average of bases* · h)

SPECIAL RIGHT TRIANGLES



SPECIAL RIGHT TRIANGLES

Isosceles Right Triangle



CIRCLE EQUATION

$(\_ - \_)^2 + (\_ - \_)^2 = \_^2$

GEOMETRIC SEQUENCE

What is a geometric sequence?

ARITHMETIC SEQUENCE

What is an arithmetic sequence?

SOH-CAH-TOA

$\sin \Theta = \_ / \_ \quad \cos \Theta = \_ / \_$

$\tan \Theta = \_ / \_$

AMPLITUDE OF A PERIODIC FUNCTION

What is the amplitude of this periodic function (and what does it mean)?

$f(t) = -5/2 \sin(2t) + 3$

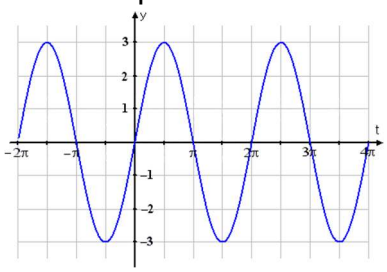
PERIOD OF A PERIODIC FUNCTION

What is the period of this periodic function (and what does it mean)?

$f(t) = -5/2 \sin(2t) + 3$

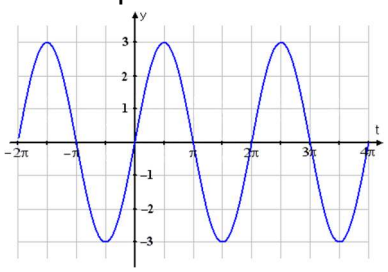
AMPLITUDE

What is the amplitude of this function?

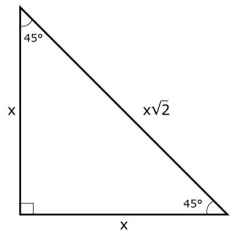


PERIOD

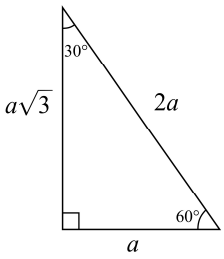
What is the period of this function?



SPECIAL RIGHT TRIANGLES
Isosceles Right Triangle



SPECIAL RIGHT TRIANGLES



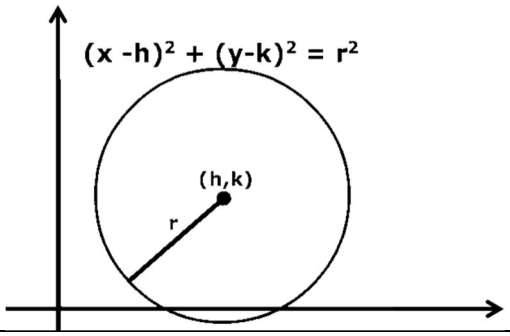
GEOMETRIC SEQUENCE

A sequence formed by **multiplying** by the same factor

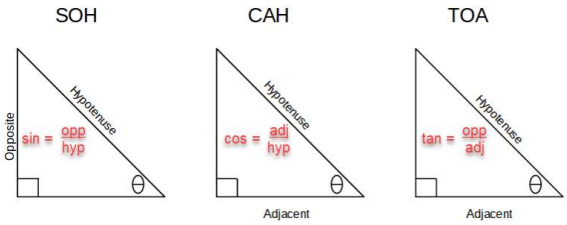
Example 1: 2, -4, 8, -16, 32

Example 2: x, x^2y, x^3y^2, x^4y^3, x^5y^4

CIRCLE EQUATION



SOH-CAH-TOA



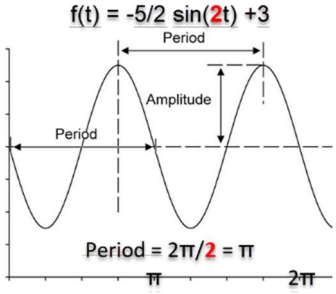
ARITHMETIC SEQUENCE

A sequence formed by **adding** the same factor

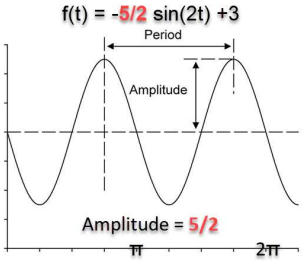
Example 1: 2, 4, 6, 8, 10

Example 2: x, 2x+y, 3x+2y, 4x+5y

PERIOD

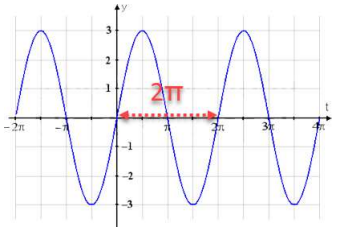


AMPLITUDE



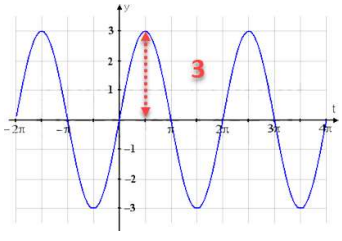
PERIOD

What is the period of this function?



AMPLITUDE

What is the amplitude of this function?



---BONUS---
VERTICAL ASYMPTOTE

Find the vertical asymptote(s):

$$f(x) = \frac{1}{x^2 - 5x + 6}$$

---BONUS---
HOLES

Find the hole(s) in this function:

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

---BONUS---
HORIZONTAL ASYMPTOTE

Find the horizontal asymptote(s):

$$f(x) = \frac{2x^3 - 2}{3x^3 - 6}$$

---BONUS---
OBLIQUE (SLANT) ASYMPTOTE

Find the oblique asymptote(s):

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

---BONUS---
HORIZONTAL ASYMPTOTE

Find the horizontal asymptote(s):

$$f(x) = \frac{2x^3 - 2}{3x^5 - 6x^3}$$

---BONUS---
PERMUTATIONS

In a race of 10 people, how many possible gold, silver, and bronze medalist outcomes are there?

---BONUS---
COMBINATIONS

A committee of 5 men and 5 women will be formed from a group of 18 men and 12 women. Express this as a combination.

---BONUS---
STANDARD DEVIATION

Calculate the standard deviation of 9, 2, 5, 4, 12, and 7.

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

---BONUS---
VERTICAL SHIFT

What is the vertical shift of this periodic function (and what does it mean)?

$f(t) = 4\cos(2t - \frac{1}{4}\pi) + 3$

---BONUS---
PHASE SHIFT

What is the phase shift of this periodic function (and what does it mean)?

$f(t) = 4\cos(2t - \frac{1}{4}\pi) + 3$

---BONUS---
HOLES

$f(x) = \frac{\cancel{(x-2)}(x+1)}{\cancel{(x-2)}}$, so $x \neq 2$ (Den $\neq 0$)

$f(2) = 2 + 1 = 3$

Hole at (2,3)

---BONUS---
VERTICAL ASYMPTOTE

$f(x) = \frac{1}{(x-3)(x-2)}$

Asymptotes where Denominator = 0

$\therefore$ Vertical Asymptotes @ x=3 & x=2

---BONUS---
OBLIQUE (SLANT) ASYMPTOTE

$$x-1\overline{)-3x^2+0x+2}\quad -3x-3$$
$$-3x^2+3x$$
$$-3x+2$$
$$-3x+3$$
$$-1$$

---BONUS---
HORIZONTAL ASYMPTOTE

If polynomial degrees are equal top & bottom, coefficients of the highest-degree polynomial

$f(x) = \frac{2x^3 - 2}{3x^3 - 6}$

Horizontal Asymptote @ y = **2/3**

---BONUS---
PERMUTATIONS
(Order matters)

$P(n,r) = {}^nP_r = {}_nP_r = \frac{n!}{(n-r)!}$

${}_{10}P_3 = 10!/(10 - 3)! = 10!/7!$

$= 10 \cdot 9 \cdot 8 = 720$

---BONUS---
HORIZONTAL ASYMPTOTE

If the degree of the denominator > that of the numerator, the horizontal asymptote is y=0.

$f(x) = \frac{2x^3 - 2}{3x^5 - 6x^3}$

Horizontal Asymptote @ y = 0

---BONUS---
STANDARD DEVIATION

Average of 9, 2, 5, 4, 12, and 7 = 6.5

$(9 - 6.5)^2 = 6.25$, $(2 - 6.5)^2 = 20.25$,
$(5 - 6.5)^2 = 2.25$, $(4 - 6.5)^2 = 6.25$,
$(12 - 6.5)^2 = 30.25$, $(7 - 6.5)^2 = 0.25$

Sum of Red Numbers = 65.5

65.5 / (N-1) = 65.5 / 5 = 13.1

$\sqrt{13.1}$ = **3.62**

---BONUS---
COMBINATIONS
(Order does not matter)

$C(n,r) = {}^nC_r = {}_nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$

$({}_{18}C_5) \cdot ({}_{12}C_5)$

---BONUS---
PHASE SHIFT
(move left or right)

$f(t) = 4\cos(2t - \frac{1}{4}\pi) + 3$

(Entire function shifted right $\frac{1}{4}\pi$)

+ Left, - Right

---BONUS---
VERTICAL SHIFT
(move up or down)

$f(t) = 4\cos(2t - \frac{1}{4}\pi) + 3$

(Entire function shifted up 3)

LEAST COMMON MULTIPLE What is a least common multiple?	★ PEMDAS Can you solve a problem like the below? $-\|9 - 2\| - \|3 - (5 - 4)\| + (18 \div 2 - 2)^2$
★ PEMDAS Can you solve a problem like the below? What is $200(1.5)^{0.5t}$ when t = 4?	★ SLOPE How do you find the slope of line given by the equation 2x + 9y = -18?
★ SLOPE How do you find the slope of a line that passes through two points? Example: (1 , 4) and (3 , 8)	★ Y INTERCEPT How do you find the y Intercept of a line given by the equation 3x + 2y = 12?
★ MIDPOINT FORMULA What is the formula used to find the midpoint between two points?	★ DISTANCE FORMULA What is the formula used to find the distance between two points?
f(g(x)) If you are given two functions, f(x) = x + 3 and $g(x) = x^2 + 1$, how do you find f(g(1))?	★ f(x) If you are given the function f(x) = x + 3, how do you find f(x+2)?

PEMDAS

$-|9 - 2| - |3 - (5 - 4)| + (18 \div 2 - 2)^2$

$-|7| - |3 - 1| + (9 - 2)^2$

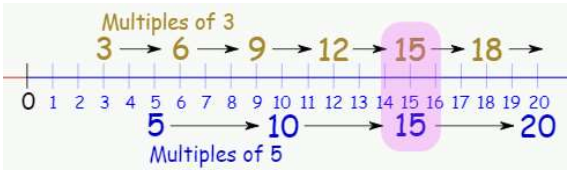
$-|7| - |3 - 1| + 7^2$

$-7 - 2 + 49$

40

LEAST COMMON MULTIPLE

The Least Common Multiple is the smallest positive number that is the multiple of two or more numbers.



SLOPE

$2x + 9y = -18$

$9y = -2x - 18$

$y = -(2/9)x - 2$

$y = mx \pm b$

$m = -2/9$

PEMDAS

$200(1.5)^{(0.5)(4)}$

$200(1.5)^2$

$200(2.25)$

450

Y INTERCEPT

$3x + 2y = 12$

$2y = -3x + 12$

$y = -3/2x + 6$

$y = mx \pm b$

$b = 6$

SLOPE

"Rise over run":

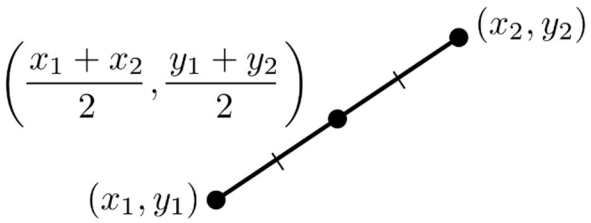
$$\frac{(y_2 - y_1)}{(x_2 - x_1)}$$

$$\frac{(8 - 4)}{(3 - 1)}$$

DISTANCE FORMULA

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

MIDPOINT FORMULA



$f(x) \rightarrow f(x+2)$

Replace each x with (x+2):

$x + 3 \rightarrow (x+2) + 3$

$f(g(x))$

$f(x) = x + 3$ and $g(x) = x^2 + 1$

Work inside to outside:

Find g(1) first: $g(1) = 1^2 + 1 = 2$

$f(g(1)) = f(2) = 2 + 3 = 5$

INEQUALITIES

Solve for x:

$-3x + 8 > 14$

DOMAIN

Given the function below, what is the domain of f(x)?

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

EXPONENT RULES

$x^a \cdot x^b =$

$\frac{x^a}{x^b} =$

$(x^a)^b =$

$x^{-a} =$

$x^0 =$

LOGARITHM RULES

$\log(ab) =$

$\log\left(\frac{a}{b}\right) =$

$\log(a^b) =$

$\log_x 1 =$

LOGARITHM TO EXPONENTIAL

Express $\log_2 8 = x$ as an exponential

IMAGINARY NUMBERS

If n is a positive integer, what is:

i^{4n}? $i^{(4n+1)}$?

IMAGINARY NUMBERS

What is $i^{10,000}$?

$i^{10,001}$?

$i^{10,002}$?

$i^{10,003}$?

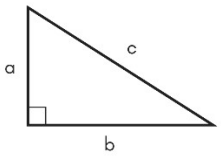
DOUBLE INCREASE

If the average price of a car increases 5% each year, and the average price in 2020 was $40,000, what will the average price be in 2022?

DOUBLE DECREASE

If a $100 dress was marked down 50% in March then marked down an additional 25% in April, what is the price of the dress?

PYTHAGOREAN THEOREM



_ + _ = _

DOMAIN

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

x > 3

(Denominator must be >0)

INEQUALITIES

-3x + 8 > 14

-3x > 6

x < -2

If you multiply or divide by a negative, flip the sign!

LOGARITHM RULES

$$\log(ab) = \log(a) + \log(b)$$

$$\log\left(\frac{a}{b}\right) = \log(a) - \log(b)$$

$$\log(a^b) = b \cdot \log(a)$$

$$\log_x 1 = 0$$

EXPONENT RULES

$$x^a \cdot x^b = x^{a+b}$$

$$\frac{x^a}{x^b} = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

$$x^{-a} = \frac{1}{x^a}$$

$$x^0 = 1$$

IMAGINARY NUMBERS

$i^{4n} = (i^4)^n = 1^n = 1$ $i^{(4n+1)}$?

$i^{(4n+1)} = i^{4n} \cdot i^1 = (1 \cdot i) = i$

LOGARITHM TO EXPONENTIAL

$\log_2 8 = x$

$2^x = 8$

DOUBLE INCREASE

($40,000 * 1.05) * (1.05)

$42,000 * 1.05

$44,100

IMAGINARY NUMBERS

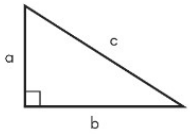
$i^{10,000} = (i^4)^{2,500} = 1^{2,500} = 1$

$i^{10,001} = (i^{10,000}) \cdot (i^1) = i$

$i^{10,002} = (i^{10,000}) \cdot (i^2) = -1$

$i^{10,003} = (i^{10,000}) \cdot (i^3) = -i$

PYTHAGOREAN THEOREM



For right triangles, $a^2 + b^2 = c^2$

(For acute triangles, $a^2 + b^2 > c^2$)

(For obtuse triangles, $a^2 + b^2 < c^2$)

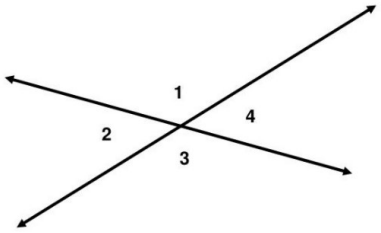
DOUBLE DECREASE

$100 - ($100 · 0.50) = $100 - $50 = $50

$50 - ($50 · 0.25) = $50 - $12.50 = $37.50

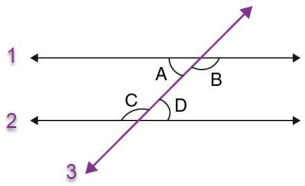
VERTICAL ANGLES

What are vertical angles?



ALTERNATE INTERIOR ANGLES

If lines 1 and 2 are parallel, which angles are equal?



ANGLES IN A POLYGON

What is the formula for calculating the total degrees inside a polygon with n sides?

(_ - _) * _

FACTORING

How do you factor $x^3 + 64$?

FACTORING

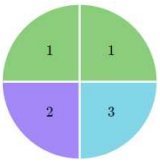
How do you factor $4x^2 - 144$?

What is a rational number?

---BONUS---

EXPECTED VALUE

In a board game with a spinner, the probability is ½ that a player moves forward 1 space, and ¼ that a plater moves forward 2 or 3 spaces. What is the expected value for the number of spaces the player will move?



---BONUS---

DETERMINANT OF A MATRIX

How do you calculate the determinant of a 2 x 2 matrix?

---BONUS---

AREA OF AN ELLIPSE

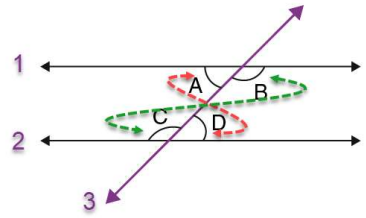
A = _ · _ · _

---BONUS---

EQUATION OF AN ELLIPSE

ALTERNATE INTERIOR ANGLES

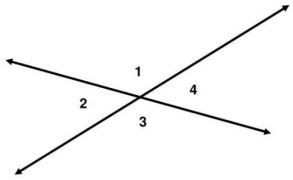
$\angle A = \angle D$, $\angle B = \angle C$



VERTICAL ANGLES

Vertical angles: the **angles** opposite each other when two lines intersect. They are ***always*** equal.

$\angle 1 = \angle 3$, $\angle 2 = \angle 4$



FACTORING

$a^3 + b^3 \rightarrow (a + b)(a^2 - ab + b^2)$

So, $x^3 + 64$ would factor into:

$(x + 4)(16 - 4x + x^2)$

NOTE: $a^3 - b^3 \rightarrow (a - b)(a^2 + ab + b^2)$

ANGLES IN A POLYGON

For a polygon with n sides, the total degrees inside the polygon equal

$(n - 2) * 180$

(Example: 9 sides: $(9 - 2)*180° = 1{,}260°$)

A rational number is any number that can be expressed as a fraction with integers in the numerator and denominator.

1/3 is rational

Π is irrational

FACTORING

$a^2 - b^2 \rightarrow (a + b)(a - b)$

So, $4x^2 - 144$ would factor into:

$(2x + 12)(2x - 12)$

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad |A| = ad - bc$$

Determinant of 2x2 matrix

Expected value is calculated by summing the products of each probability and value:

$(½ * 1) + (¼ * 2) + (¼ * 3) =$

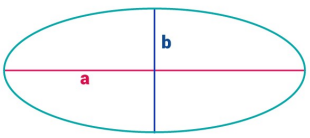
$½ + ½ + ¾ = 1\ ¾$

---BONUS---
EQUATION OF AN ELLIPSE

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

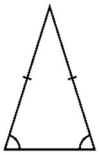
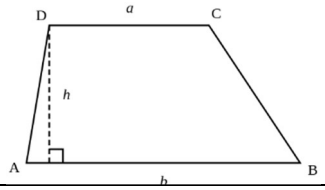
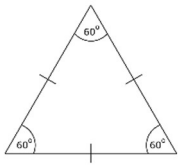
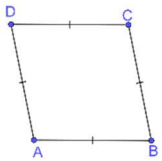
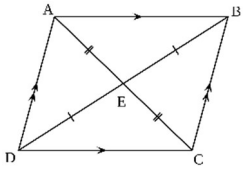
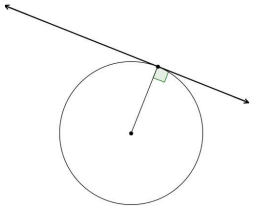
---BONUS---
AREA OF AN ELLIPSE

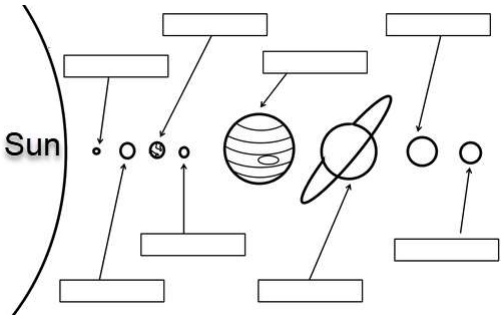
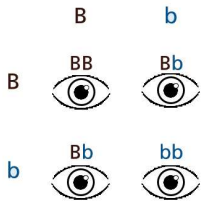
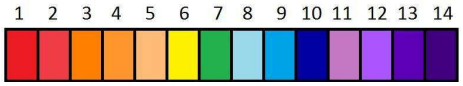
$A = \pi ab$

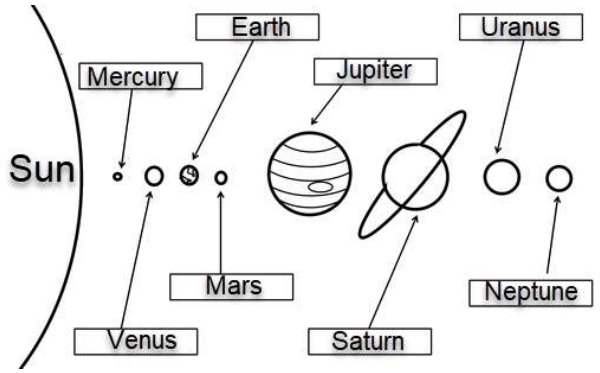


Ellipse

Quadratic Equation What is the quadratic equation?	Isosceles Triangle What is an isosceles triangle?
Equilateral Triangle What is an equilateral triangle?	Trapezoid What is a trapezoid?
Parallelogram What is a parallelogram?	Rhombus What is a rhombus?
Circumference Formula $C = \_ \cdot \_ \cdot \_$	Tangent (Geometry) What does it mean for a line to be tangent to a circle?

Isosceles Triangle Triangle with 2 equal sides and 2 equal angles 	Quadratic Equation $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Trapezoid A trapezoid is a quadrilateral with 2 parallel sides. 	Equilateral Triangle Triangle with 3 equal sides and 3 equal (60°) angles 
Rhombus A rhombus is a quadrilateral whose four sides all have the same length. 	Parallelogram A parallelogram is a quadrilateral with two pairs of parallel sides. 
If a line is tangent to a circle, it intersects only one point and is always perpendicular to the radius. 	Circumference Formula C = 2πr (or πd)

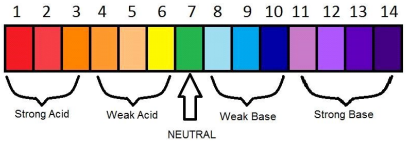
Balancing Chemical Equations Insert the correct coefficients to balance the equation below: $\_H_2 + \_O_2 \rightarrow \_H_2O$	Solar System 
Dominant / Recessive What is the eye color of each of the below eyes?  	pH Scale Label acid, base, and neutral THE PH SCALE 
Density How do you calculate density?	Subatomic Particles Give the charges for protons, neutrons, and electrons.
Potential / Kinetic Energy What is the formula for gravitational potential energy? What is the formula for kinetic energy?	Potential / Kinetic Energy Describe potential and kinetic energy.
States of Matter If a material's temperature is above its melting point but below its boiling point, what state is it in? Above its boiling point?	Subatomic Particles What two subatomic particles are located withing the nucleus of an atom?

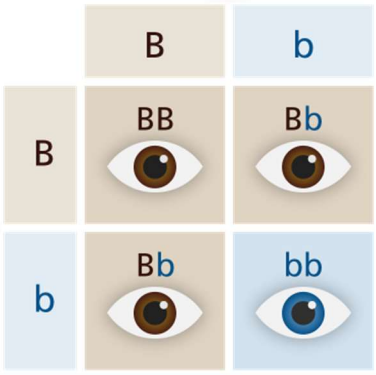


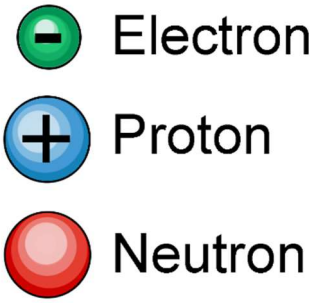
Balancing Chemical Equations

$2H_2 + O_2 \rightarrow 2H_2O$

THE PH SCALE







$$p = \frac{m}{v}$$

mass

density

volume

Potential energy is stored energy (e.g. a roller coaster at the top of the hill).

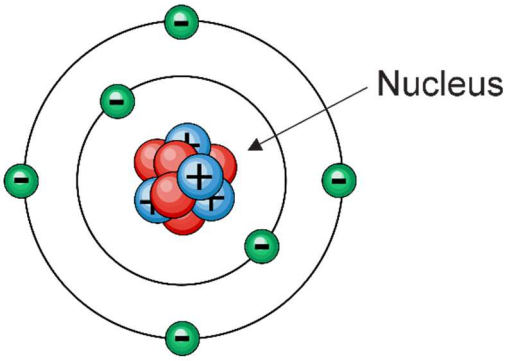
Kinetic energy is energy of motion (e.g. a roller coaster racing along at the bottom of the hill).

PE = mgh

So, increasing mass or height increases PE.

KE = ½ m v^2

So, increasing mass or velocity increases KE.



States of Matter

Liquid.

Gas.