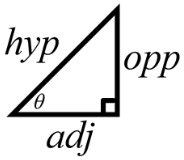
Formula Sheet

TI PROFESSIONAL DEVELOPMENT

Formula Favorites – *These types are used at least once per test.*

SohCahToa



$\sin(\theta) = \frac{opp}{hyp}$

$\cos(\theta) = \frac{adj}{hyp}$

$\tan(\theta) = \frac{opp}{adj}$

Slope

+ / \ −

$m \perp =$ opposite reciprocal

$m \parallel =$ same

$m = 0$ (horizontal)

$m = undefined$ (vertical)

Slope-Intercept form

$y = m \cdot x + b$ (m: slope, b: y-int)

Slope Formula

$m = \frac{y_2 - y_1}{x_2 - x_1}$

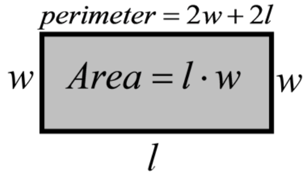
Standard Form

$ax + by = c$

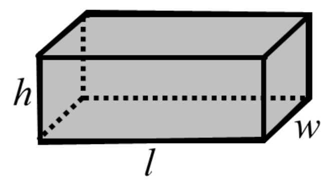
$m = \frac{-a}{b}$

Rectangles

$perimeter = 2w + 2l$



$Volume = l \cdot w \cdot h$



Mean (average)

1. Add up the terms
2. Divide by the # of terms

Median

1. Order the terms
2. Find the middle term

Mode

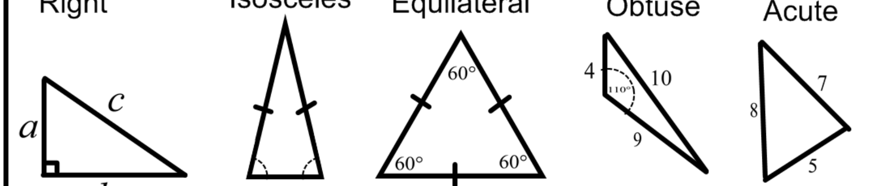
1. Most common term

Exponent Rules

1. $x^2 \cdot x^3 = x^{2+3}$
2. $\left(x^2\right)^3 = x^{2\cdot3}$
3. $\frac{x^7}{x^4} = x^{7-4}$
4. $x^0 = 1, x \neq 0$
5. $x^{-2} = \frac{1}{x^2}$
6. $(x)^{2/3} = \sqrt[3]{x^2}$

Triangles

Right | Isosceles | Equilateral | Scalene Obtuse | Scalene Acute



Pythagorean Th.

$a^2 + b^2 = c^2$

Obtuse

$a^2 + b^2 < c^2$

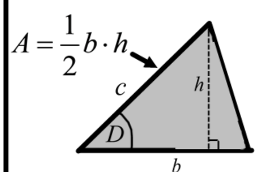
$4^2 + 9^2 < 10^2$

Acute

$a^2 + b^2 > c^2$

$5^2 + 7^2 > 8^2$

$A = \frac{1}{2} b \cdot h$

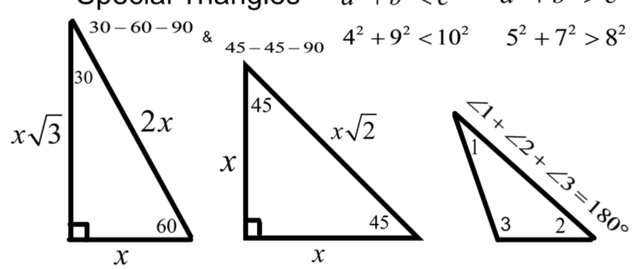


SAS Area formula

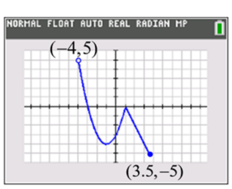
$A = \frac{1}{2} \cdot b \cdot c \cdot \sin(D)$

Special Triangles

$30-60-90$ & $45-45-90$



Domain($x - values$) & Range($y - values$)

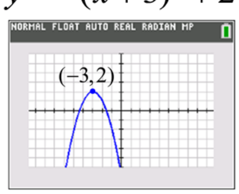


$domain: -4 < x \leq 3.5$

$range: -5 \leq y < 5$

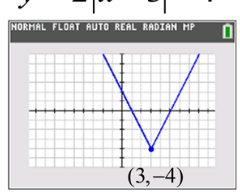
Transformations

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



reflect through x-axis, shift left 3, shift up 2

$y = 2|x-3| - 4$



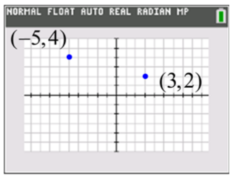
vertical stretch, shift right 3, shift down 4

If (x, y) maps to (kx, ky) and $(2,5)$ maps to $(8,20)$. Then, $(3,7)$ maps to ?

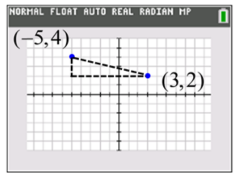
$answer: (12,28)$

Somewhat Common Formulas – *These types are seen on over half of the tests.*

Distance



or



Distance Formula

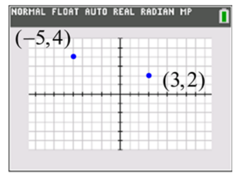
$$d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$$
$$d=\sqrt{(3-(-5))^2+(2-4)^2}$$
$$d=\sqrt{64+4}$$
$$d=\sqrt{68}$$
$$d=2\sqrt{17}$$

or

Pythagorean Th.

$$a^2+b^2=c^2$$
$$8^2+2^2=d^2$$
$$68=d^2$$
$$d=\sqrt{68}$$
$$d=2\sqrt{17}$$

Midpoint



Midpoint is just the (*average* x, *average* y)

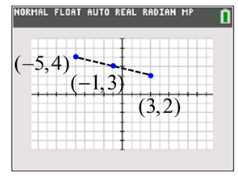
Midpoint Formula

$$(x,y)=\left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2}\right)$$
$$=\left(\frac{-5+3}{2},\frac{4+2}{2}\right)$$
$$=(-1,3)$$

See the linear pattern?

$x:-5,-1,3$

$y:4,3,2$



Imaginary Numbers

$i=\sqrt{-1}$ and $i^2=-1$

Simplify $(x+i)^2$

$$(x+i)(x+i)$$
$$x^2+xi+xi+i^2$$
$$x^2+2xi-1$$

Powers of i

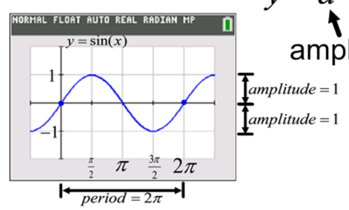
$$i^1=i^5=i^9=i$$
$$i^2=i^6=i^{10}=-1$$
$$i^3=i^7=i^{11}=-i$$
$$i^4=i^8=i^{12}=1$$
$$i^{\text{multiple of 4}}=1$$

Example: $i^{27}=\left(i^{24}\right)\left(i^3\right)$
$=(1)(-i)=-i$

Trigonometry

$y=a\cdot\sin(b(x-c))+d$

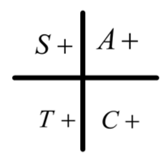
amplitude



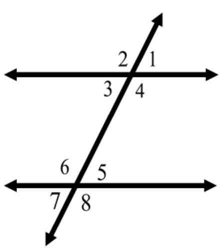
$$period=\frac{2\pi}{|b|}$$

$$\sin^2(x)+\cos^2(x)=1$$

$$180°=\pi\ \ radians$$



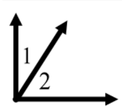
Angles



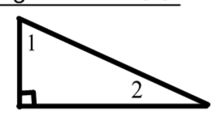
Parallel Lines cut by a Transversal

- **Alternate Interior**
  $\angle 3\cong\angle 5$ and $\angle 4\cong\angle 6$
- **Same Side Interior**
  $\angle 4+\angle 5=180°$ and $\angle 3+\angle 6=180°$
- **Alternate Exterior**
  $\angle 2\cong\angle 8$ and $\angle 1\cong\angle 7$
- **Corresponding**
  $\angle 4\cong\angle 8$ and $\angle 3\cong\angle 7$

Complementary Angles add to 90°

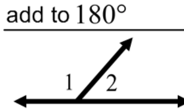


$\angle 1+\angle 2=90°$



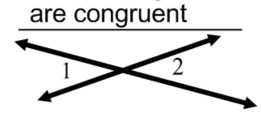
$\angle 1+\angle 2=90°$

Supplementary Angles add to 180°



$\angle 1+\angle 2=180°$

Vertical angles are congruent



$\angle 1\cong\angle 2$

Logarithm Rules

Log form	Exponential form
$\log_3(9)=x$	$3^x=9$

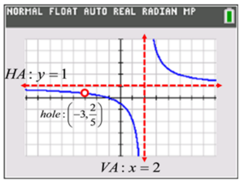
1. $\log_5(2)+\log_5(3)=\log_5(2\cdot 3)$
2. $\log_5\left(2^3\right)=3\cdot\log_5(2)$
3. $\log_5\left(\frac{2}{3}\right)=\log_5(2)-\log_5(3)$
4. $\log_5(1)=0$
5. $\log_5(5)=1$
6. $\log_5\left(5^3\right)=3$
7. $5^{\log_5(3)}=3$

Formula Sheet

TI PROFESSIONAL DEVELOPMENT

Less Common Formulas – *These types are seen on about 1 in every 2 or 3 tests.*

Asymptotes



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

Vertical Asymptote (VA)

To find VA, set the denominator = zero and solve for x

Hole

If a factor cancels, it causes a hole instead of a VA

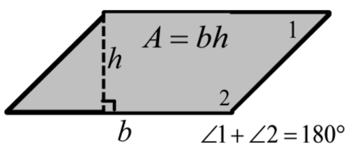
Horizontal Asymptote (HA)

1. If *bottomheavy* degree, then HA at $y=0$
2. If *topheavy* degree, then there is no HA ↗
3. If *same* degree then divide the leading coefficients

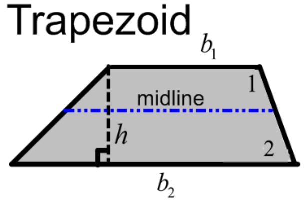
Slant Asymptote

If the degree in the numerator is one more than the denominator, use long division to find the slant asymptote

Parallelogram



Trapezoid

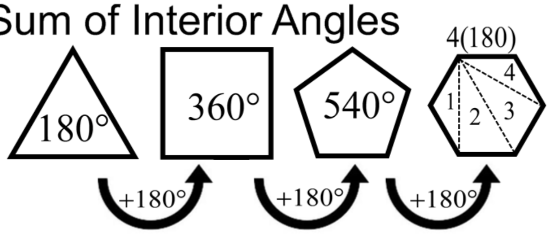


$$Area=\frac{1}{2}(b_1+b_2)\cdot h=\text{(avg. base)}\cdot h$$

$$midline=\frac{b_1+b_2}{2}=\text{(avg. base)}$$

$\angle 1+\angle 2=180°$

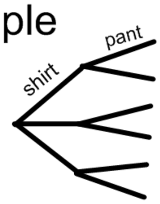
Sum of Interior Angles



Counting Principle

Jamie has 3 shirts and 2 pairs of pants.

How many different outfits can Jamie wear?



Draw a tree diagram or use the *counting principle*: (3)(2)=6

Matrices

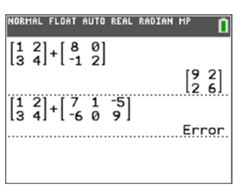
Dimensions
row × column

3×2

$$\begin{bmatrix}1 & 8\\ -2 & 0\\ 3 & 5\end{bmatrix}$$

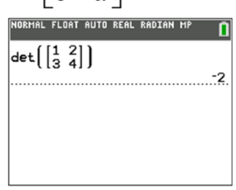
Adding Matrices

- must have the same dimensions



Determinants

$$\det\begin{bmatrix}a & b\\ c & d\end{bmatrix}=ad-cb$$



Multiplying Matrices

- *inner* dimensions must match

3×2 2×4 Yes!

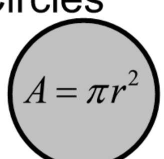
2×4 3×2 No! (not possible)

Augmented Matrices

$$2x-3y=10$$
$$-x+8y=-5$$

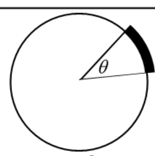
$$\left[\begin{array}{cc|c}2 & -3 & 10\\ -1 & 8 & -5\end{array}\right]$$

Circles



$c=2\pi r$

$$(x-h)^2+(y-k)^2=r^2$$

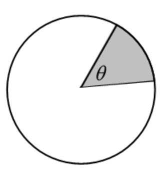


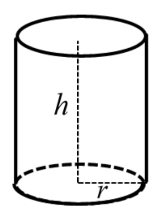
$$\text{arc length}=\frac{\theta}{360}(circ.)$$

$c=2\pi r$

$$\text{sector area}=\frac{\theta}{360}(area)$$

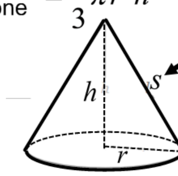
$A=\pi r^2$





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

$$\text{Volume Cone}=\frac{1}{3}\pi r^2 h$$

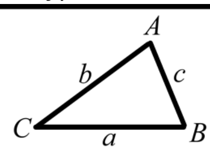


$$\text{Surface Area Cone}=\pi r^2+\pi r\cdot s$$

Uncommon Formulas – *These types are seen on about 1 in every 4 tests.*

Law of Sines

$$\frac{\sin(A)}{a}=\frac{\sin(B)}{b}=\frac{\sin(C)}{c}$$



Law of Cosines

$$c^2=a^2+b^2-2ab\cdot\cos(C)$$

Difference of Cubes

$$a^3-b^3=(a-b)\left(a^2+ab+b^2\right)$$

Sum of Cubes

$$a^3+b^3=(a+b)\left(a^2-ab+b^2\right)$$

Compound Interest

$$A=P\left(1+\frac{r}{n}\right)^{nt}$$

Discriminant

discriminant $=b^2-4ac$

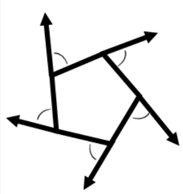
1. If $b^2-4ac>0$, then 2 real solutions
2. If $b^2-4ac<0$, then <u>no</u> real solutions
3. If $b^2-4ac=0$, then 1 real solution

Triangle Inequality Theorem

The sum of the lengths of any two sides of a triangle is greater than the length of the third side

A. 2,5,8 — NO, $2+5<8$
B. 4,5,6 — YES
C. 5,7,12 — NO, $5+7=12$

Sum of Exterior Angles



The sum of the exterior angles of any polygon is always $360°$

Expected Value (on average)

What is the expected value for the sum of 2 dice rolls?

sum of 2 dice (x)	2	3	4	5	6	7	8	9	10	11	12
P(x)	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

Expected Value $=p_1x_1+p_2x_2+p_3x_3+\ldots$

answer=7

Standard Deviation

Typical distance from the mean

Example: Which list has a larger standard deviation?

$A:\{1,3,5,7,9,11\}$

$B:\{2,2,2,10,10,10\}$

Answer: B, mean=6 for both, but list B is more spread out

Permutations & Combinations

(order matters) (order doesn't matter)

Example: There are 5 runners in a race.

a. How many ways can you give out a gold, silver, and bronze medal? *answer:* ${}_nP_r(5,3)$

b. How many different combinations of people could have a medal at the end of the race? *answer:* ${}_nC_r(5,3)$

Sequences

Arithmetic Sequences

16 13 10 7 4 ...

$d=-3$ -3 -3 -3

$$a_n=a_1+(n-1)d$$

Geometric Sequences

3 -6 12 -24 48 ...

$r=-2$ -2 -2 -2

$$a_n=a_1\cdot(r)^{n-1}$$

Recursive Sequences

$a_n=\left(a_{n-1}\right)+5$ where $a_1=6$

(↑ Previous Term)

6	11	16	21	26 ...
a_1	a_2	a_3	a_4	a_5

Miscellaneous topics: distance in complex plane, joint variation, multiplicity, tangent lines, simplifying using the conjugate, independent events, polar, vectors, prime numbers.