

## ARITHMETIC PROPERTIES

- ASSOCIATIVE  $a(bc) = (ab)c$   
 COMMUTATIVE  $a + b = b + a$  and  $ab = ba$   
 DISTRIBUTIVE  $a(b + c) = ab + ac$

## ARITHMETIC OPERATIONS EXAMPLES

$$ab + ac = a(b + c)$$

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

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

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

$$\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$$

$$\frac{a}{b} - \frac{c}{d} = \frac{ad - bc}{bd}$$

$$\frac{a - b}{c - d} = \frac{b - a}{d - c}$$

$$\frac{a + b}{c} = \frac{a}{c} + \frac{b}{c}$$

$$\frac{ab + ac}{a} = b + c, a \neq 0$$

$$\frac{\left(\frac{a}{b}\right)}{\left(\frac{c}{d}\right)} = \frac{ad}{bc}$$

## QUADRATIC EQUATION

For the equation  $ax^2 + bx + c = 0$

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

## RADICAL PROPERTIES

$a, b \geq 0$  for even  $n$

$$\sqrt[n]{a} = a^{\frac{1}{n}}$$

$$\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$$

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

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$\sqrt[n]{a^n} = a$ , if  $n$  is odd  
 $\sqrt[n]{a^n} = |a|$ , if  $n$  is even

## LOGARITHM PROPERTIES

if  $y = \log_b x$  then  $b^y = x$   
 $\log_b b = 1$  and  $\log_b 1 = 0$   
 $\log_b b^x = x$   
 $b^{\log_b x} = x$   
 $\log_a x = \frac{\log_b x}{\log_b a}$   
 $\log_b(x^r) = r \log_b x$   
 $\log_b(xy) = \log_b x + \log_b y$   
 $\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$

## EXPONENT PROPERTIES

$$a^n a^m = a^{n+m}$$

$$(a^n)^m = a^{nm}$$

$$(ab)^n = a^n b^n$$

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

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

$$\frac{a^n}{a^m} = a^{n-m} = \frac{1}{a^{m-n}}$$

$$a^0 = 1, a \neq 0$$

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

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

$$a^{\frac{n}{m}} = \left(a^{\frac{1}{m}}\right)^n = (a^n)^{\frac{1}{m}}$$

## PROPERTIES OF INEQUALITIES

If  $a < b$  then  $a + c < b + c$  and  $a - c < b - c$   
 If  $a < b$  and  $c > 0$  then  $ac < bc$  and  $a/c < b/c$   
 If  $a < b$  and  $c < 0$  then  $ac > bc$  and  $a/c > b/c$

## PROPERTIES OF COMPLEX NUMBERS

$$i = \sqrt{-1}$$

$$i^2 = -1$$

$$\sqrt{-a} = i\sqrt{a}, \quad a \geq 0$$

$$(a + bi) + (c + di) = a + c + (b + d)i$$

$$(a + bi) - (c + di) = a - c + (b - d)i$$

$$(a + bi)(c + di) = ac - bd + (ad + bc)i$$

$$(a + bi)(a - bi) = a^2 + b^2$$

$$|a + bi| = \sqrt{a^2 + b^2}$$

$$\overline{(a + bi)} = a - bi$$

$$\overline{(a + bi)}(a + bi) = |a + bi|^2$$

$$\frac{1}{(a + bi)} = \frac{(a - bi)}{(a + bi)(a - bi)} = \frac{a - bi}{a^2 + b^2}$$

## COMMON FACTORING EXAMPLES

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

$$x^2 + 2ax + a^2 = (x + a)^2$$

$$x^2 - 2ax + a^2 = (x - a)^2$$

$$x^2 + (a + b)x + ab = (x + a)(x + b)$$

$$x^3 + 3ax^2 + 3a^2x + a^3 = (x + a)^3$$

$$x^3 + a^3 = (x + a)(x^2 - ax + a^2)$$

$$x^3 - a^3 = (x - a)(x^2 + ax + a^2)$$

$$x^{2n} - a^{2n} = (x^n - a^n)(x^n + a^n)$$

## ABSOLUTE VALUE

$$|a| = \begin{cases} a, & \text{if } a \geq 0 \\ -a, & \text{if } a < 0 \end{cases}$$

$$|a| = |-a|$$

$$|a| \geq 0$$

$$|ab| = |a||b|$$

$$\left|\frac{a}{b}\right| = \frac{|a|}{|b|}$$

$$|a + b| \leq |a| + |b|$$

## COMPLETING THE SQUARE

$$ax^2 + bx + c = a(\dots)^2 + \text{constant}$$

1. Divide by the coefficient  $a$ .
2. Move the constant to the other side.
3. Take half of the coefficient  $b/a$ , square it and add it to both sides.
4. Factor the left side of the equation.
5. Use the square root property.
6. Solve for  $x$ .

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## Electrical Engineering Community

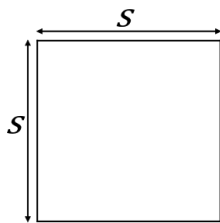
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# GEOMETRY SHAPES AND SOLIDS

## SQUARE

$$P = 4s$$

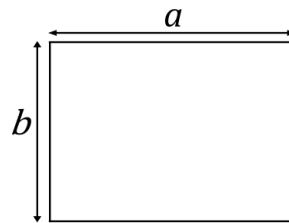
$$A = s^2$$



## RECTANGLE

$$P = 2a + 2b$$

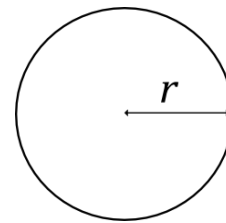
$$A = ab$$



## CIRCLE

$$P = 2\pi r$$

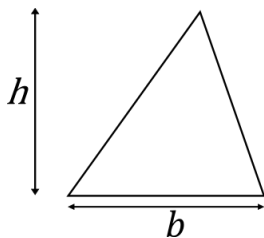
$$A = \pi r^2$$



## TRIANGLE

$$P = a + b + c$$

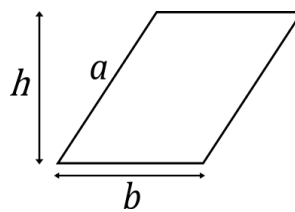
$$A = \frac{1}{2}bh$$



## PARALLELOGRAM

$$P = 2a + 2b$$

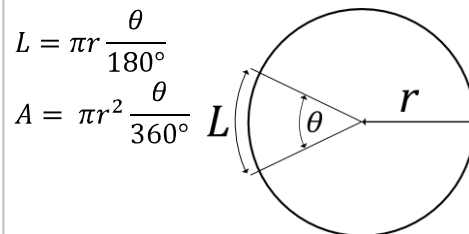
$$A = bh$$



## CIRCULAR SECTOR

$$L = \pi r \frac{\theta}{180^\circ}$$

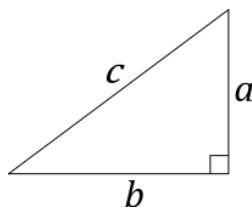
$$A = \pi r^2 \frac{\theta}{360^\circ}$$



## PYTHAGOREAN THEOREM

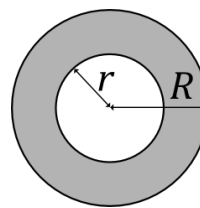
$$a^2 + b^2 = c^2$$

$$c = \sqrt{a^2 + b^2}$$



## CIRCULAR RING

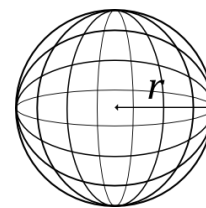
$$A = \pi(R^2 - r^2)$$



## SPHERE

$$S = 4\pi r^2$$

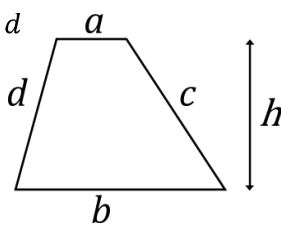
$$V = \frac{4\pi r^3}{3}$$



## TRAPEZOID

$$P = a + b + c + d$$

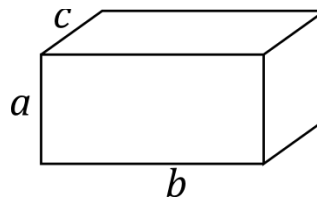
$$A = h \frac{a+b}{2}$$



## RECTANGULAR BOX

$$A = 2ab + 2ac + 2bc$$

$$V = abc$$

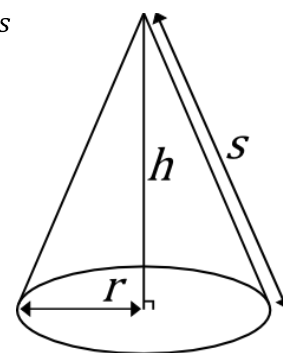


## RIGHT CIRCULAR CONE

$$A = \pi r^2 + \pi rs$$

$$s = \sqrt{r^2 + h^2}$$

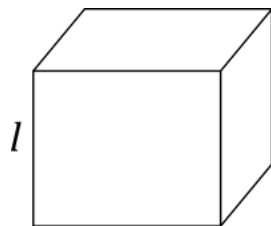
$$V = \frac{1}{3}\pi r^2 h$$



## CUBE

$$A = 6l^2$$

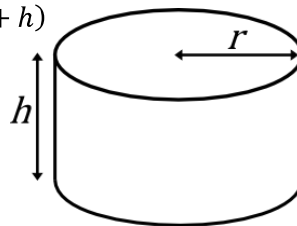
$$V = l^3$$



## CYLINDER

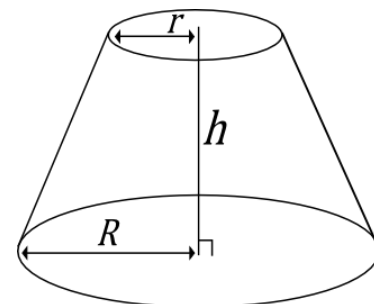
$$A = 2\pi r(r + h)$$

$$V = \pi r^2 h$$



## FRUSTUM OF A CONE

$$V = \frac{1}{3}\pi h(r^2 + rR + R^2)$$



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