

# GMAT Prep Now Quantitative Reasoning Flashcards

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# GMAT Prep Now Quantitative Reasoning Flashcards

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# Arithmetic Flashcards

(watch [video](#))

**Real number:** any number that can be shown on the number line

$$a + b = b + a$$

$$a \times b = b \times a$$

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

$$(a \times b) \times c = a \times (b \times c)$$

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

$$1 \times a = a$$

$$a \div 1 = a$$

$$a \times 0 = 0$$

$$a + 0 = a$$

$$a \div a = 1 \quad (\text{as long } a \neq 0)$$

# Arithmetic Flashcards

(watch [video](#))

## Adding a positive number

- Move right along the number line

## Subtracting a positive number

- Move left along the number line

## Adding a negative number

- Same as subtracting a positive number  $a + (-b) = a - b$

## Subtracting a negative number

- Same as adding a positive number  $a - (-b) = a + b$

# Arithmetic Flashcards

(watch [video](#))

(positive)  $\times$  or  $\div$  (positive) = positive  
(negative)  $\times$  or  $\div$  (positive) = negative  
(positive)  $\times$  or  $\div$  (negative) = negative  
(negative)  $\times$  or  $\div$  (negative) = positive

2 like signs produce a positive number  
2 different signs produce a negative number

# Arithmetic Flashcards

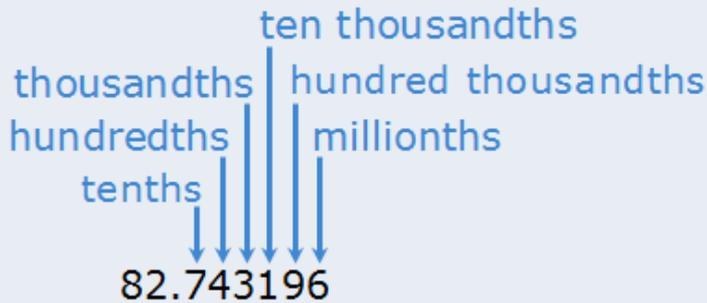
(watch [video](#))

Parentheses  
Exponents  
Multiplication  
Division  
Addition  
Subtraction

Brackets  
Exponents  
Division  
Multiplication  
Addition  
Subtraction

**absolute value:** a number's distance from zero on the number line

# Arithmetic Flashcards



(watch [video](#))

Next digit is 0, 1, 2, 3 or 4 ➡ round down  
Next digit is 5, 6, 7, 8 or 9 ➡ round up

## Adding and subtracting decimals

- Line up the decimals
- Add additional zeros (or assume there are zeros)

## Multiplying decimals

- Find the total number of digits to the right of each decimal
- Ignore the decimals and find the product
- Take product and move the decimal place to the left

## Dividing decimals

- Move both decimals until the divisor becomes an integer
- Divide, keeping the decimal in the same location

# Arithmetic Flashcards

(watch [video](#))

## Multiplying by powers of 10

- Move the decimal 1 space right for each zero

## Dividing by powers of 10

- Move the decimal 1 space left for each zero

# Arithmetic Flashcards

(watch [video](#))

## Equivalent fractions

$$\frac{1}{2} = \frac{5}{10}$$

$$\frac{7}{9} = \frac{14}{18}$$

$$\frac{3}{5} = \frac{30}{50}$$

- Create equivalent fractions by multiplying/dividing the numerator and denominator by the same number

$$\frac{2}{3} = \frac{2 \times 5}{3 \times 5} = \frac{10}{15}$$

$$\frac{24}{36} = \frac{24 \div 4}{36 \div 4} = \frac{6}{9}$$

$$\frac{10}{11} = \frac{10 \times 7}{11 \times 7} = \frac{70}{77}$$

$$\frac{35}{45} = \frac{35 \div 5}{45 \div 5} = \frac{7}{9}$$

# Arithmetic Flashcards

(watch [video](#))

## Converting entire fractions into mixed numbers

$$\frac{7}{2} = 3\frac{1}{2}$$

entire fraction      mixed number

- Determine how many times the denominator divides into the numerator (this becomes the whole number portion)
- The remainder becomes the numerator of the new fraction
- The denominator remains the same

# Arithmetic Flashcards

(watch [video](#))

## Converting mixed numbers into entire fractions

- Multiply the whole number by the denominator, and add the product to the numerator
- The result becomes the new numerator and the denominator remains the same

$$6\frac{1}{3} = \frac{19}{3}$$

$$11\frac{2}{7} = \frac{79}{7}$$

# Arithmetic Flashcards

## Converting fractions to decimals

(watch [video](#))

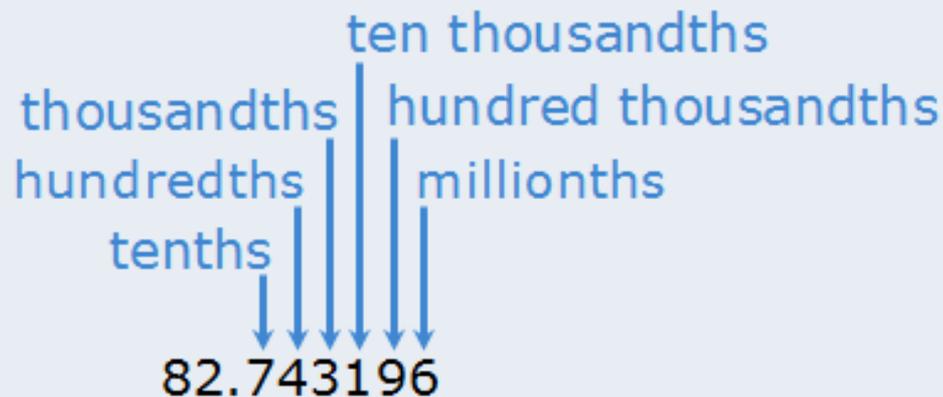
$\frac{1}{2}$	0.5
$\frac{1}{3}$	~ 0.333
$\frac{1}{4}$	0.25
$\frac{1}{5}$	0.2
$\frac{1}{6}$	~ 0.166
$\frac{1}{7}$	~ 0.14
$\frac{1}{8}$	0.125
$\frac{1}{9}$	~ 0.11

# Arithmetic Flashcards

## Converting decimals to fractions

(watch [video](#))

- Find the place value of the last digit
- Write a fraction with that place value as the denominator



## Arithmetic Flashcards

(watch [video](#))

$$n = \frac{n}{1}$$

$\frac{n}{0}$  is undefined

$$\frac{n}{n} = 1 \quad (\text{as long as } n \neq 0)$$

$$\frac{1}{\frac{a}{b}} = \frac{b}{a} \quad (\text{as long as } a \neq 0 \text{ and } b \neq 0)$$

$$\frac{a}{b} \times \frac{b}{a} = 1 \quad (\text{as long as } a \neq 0 \text{ and } b \neq 0)$$

The reciprocal of  $\frac{a}{b}$  is  $\frac{b}{a}$

# Arithmetic Flashcards

(watch [video](#))

- Bigger numerator  $\rightarrow$  bigger value
- Smaller numerator  $\rightarrow$  smaller value
- Bigger denominator  $\rightarrow$  smaller value
- Smaller denominator  $\rightarrow$  bigger value

Increase numerator and denominator by same amount  $\rightarrow$  fraction approaches 1

# Arithmetic Flashcards

(watch [video](#))

## Adding and subtracting fractions

- Create equivalent fractions with the same denominator
- Add/subtract the numerators
- Keep the denominator the same

## Multiplying fractions

- Multiply numerators, and multiply denominators
- Convert to entire fractions before multiplying
- When possible, simplify fractions before multiplying
- When possible, “cross simplify” before multiplying

## Dividing fractions

- Multiply by the reciprocal of the divisor

## Arithmetic Flashcards

$$\frac{abc}{def} = \frac{a}{d} \times \frac{b}{e} \times \frac{c}{f}$$

$$\frac{a+b+c}{d+e+f} \neq \frac{a}{d} + \frac{b}{e} + \frac{c}{f}$$

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

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

(watch [video](#))

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

$$\frac{a}{b} \times b = a \quad (\text{as long as } b \neq 0)$$

$$\text{If } \frac{a}{b} = \frac{c}{d} \text{ then } ad = bc$$

## Arithmetic Flashcards

$\frac{1}{2}$	0.5	50%
$\frac{1}{3}$	~ 0.333	~ 33.3%
$\frac{1}{4}$	0.25	25%
$\frac{1}{5}$	0.2	20%
$\frac{1}{6}$	~ 0.166	~ 16.6%
$\frac{1}{7}$	~ 0.14	~ 14%
$\frac{1}{8}$	0.125	12.5%
$\frac{1}{9}$	~ 0.11	~ 11.1%

(watch [video](#))

### Conversions (decimal to percent)

- Move decimal two places to the right

### Conversions (percent to decimal)

- Move decimal two places to the left

## Arithmetic Flashcards

(watch [video](#))

The **part** is **some percent** of the **whole**

$$\frac{\text{part}}{\text{whole}} = \frac{\text{percent}}{100}$$

$$\text{If } \frac{a}{b} = \frac{c}{d} \text{ then } ad = bc$$

$$p \text{ percent of } x \text{ is } y \rightarrow \left(\frac{p}{100}\right)(x) = y$$

## Arithmetic Flashcards

(watch [video](#))

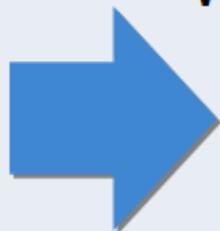
10 percent of  $y$

- move decimal 1 space to the left

1 percent of  $y$

- move decimal 2 spaces to the left

What is 15 percent of 62?



$$\begin{array}{r} 10\% \text{ of } 62 = 6.2 \\ + \quad 5\% \text{ of } 62 = 3.1 \\ \hline 15\% \text{ of } 62 = 9.3 \end{array}$$

# Arithmetic Flashcards

(watch [video](#))

$$\% \text{ change} = \frac{\text{change}}{\text{original value}} \rightarrow \text{(then rewrite as a percent)}$$

$$\% \text{ change} = \frac{\text{change} \times 100}{\text{original value}}$$

$$\text{new} = \left( 1 \pm \frac{\text{percent change}}{100} \right) \times \text{original}$$

# Arithmetic Flashcards

## Compound interest

$$\text{final} = P \left( 1 + \frac{r}{c} \right)^{nc}$$

$P$  = principal

$r$  = annual interest rate (as a decimal)

$c$  = number of "compoundings" per year

$n$  = number of years

(watch [video](#))

## simple interest

$$\text{interest} = (\text{principal})(\text{rate})(\text{time})$$

- For short time periods, consider incremental calculations

e.g.,

$$\begin{array}{r} \$40,000 \\ \text{after 1 month} \rightarrow + \quad \$400 \\ \hline \$40,400 \\ \text{after 2 months} \rightarrow + \quad \$404 \\ \hline \$40,804 \end{array}$$

# Arithmetic Flashcards

(watch [video](#))

“For every  $x$  there are  $y$  . . .” ➡ ratio question

## Equivalent ratios

$$\text{If } \frac{a}{b} = \frac{c}{d} \text{ then } ad = bc$$

## Portioning into ratios

- Add the terms in the ratio and let the sum =  $T$
- Divide the total quantity into  $T$  equal parts
- Divide the  $T$  equal parts into the target ratio

(watch [video](#))

## Combining Ratios

### Strategy 1

- Find equivalent ratios until there are matching terms
- Combine

### Strategy 2

- Solve one ratio
- Apply results to the other ratio

## Arithmetic Flashcards

(watch [video](#))

- Ratios can be used to solve simple rate questions

# Powers & Roots Flashcards

base  $\rightarrow$   $2^5$   $\leftarrow$  exponent

(watch [video](#))

1 raised to any power is equal to 1

0 raised to any nonzero power is equal to 0

Any nonzero number raised to the power of 0 is equal to 1

Any number,  $x$ , raised to the power of 1 is equal to  $x$

An odd exponent preserves the sign of the base

An even exponent always yields a positive result

\* as long as the base  $\neq 0$

# Powers & Roots Flashcards

(watch [video](#))

## Exponential Growth

### Positive bases

If  $x > 1$ , then the value of  $x^n$  increases as  $n$  increases

If  $0 < x < 1$ , then the value of  $x^n$  approaches zero as  $n$  increases

### Negative bases

If  $x < -1$ , then the magnitude of  $x^n$  increases as  $n$  increases, but the sign oscillates

If  $-1 < x < 0$ , then the magnitude of  $x^n$  decreases as  $n$  increases

# Powers & Roots Flashcards

(watch [video](#))

## Squaring Integers Ending in 5

$$\begin{array}{r} 7 \times 8 = 56 \\ \uparrow \quad \downarrow \\ 75^2 = 5625 \end{array}$$

$$\begin{array}{r} 10 \times 11 = 110 \\ \uparrow \quad \downarrow \\ 105^2 = 11025 \end{array}$$

### Technique

- Let  $n$  be the number before the 5
- Write the product of  $n$  and  $n+1$ , followed by 25

# Powers & Roots Flashcards

(watch [video](#))

Quotient law

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

Product law

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

Power of a power law

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

# Powers & Roots Flashcards

(watch [video](#))

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

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

# Powers & Roots Flashcards

(watch [video](#))

Power of a product law

$$(x^a y^b)^n = x^{an} y^{bn}$$

Power of a quotient law

$$\left(\frac{x^a}{y^b}\right)^n = \frac{x^{an}}{y^{bn}}$$

Combining bases law

$$x^n y^n = (xy)^n$$

Combining bases law

$$\frac{x^n}{y^n} = \left(\frac{x}{y}\right)^n$$

# Powers & Roots Flashcards

What is the units digit of  $53^{35}$  ?

(watch [video](#))

$$53^1 = 53$$

$$53^2 = \text{---}9$$

$$53^3 = \text{---}7$$

$$53^4 = \text{---}1$$

$$53^5 = \text{---}3$$

$$53^6 = \text{---}9$$

$$53^7 = \text{---}7$$

$$53^8 = \text{---}1$$

.

.

.

$$53^{35} =$$

} cycle = 4 → When  $n$  is divisible by 4, the units digit of  $53^n$  is 1

$$53^{32} = \text{---}1$$

$$53^{33} = \text{---}3$$

$$53^{34} = \text{---}9$$

$$53^{35} = \text{---}7$$

# Powers & Roots Flashcards

$\sqrt{n}$  = a number (greater than or equal to zero) that, when squared, equals  $n$

(watch [video](#))

## Properties

- If  $n < 0$ ,  $\sqrt{n}$  has no real value
- If  $n \geq 0$ , then  $\sqrt{n} \geq 0$

$$\sqrt{x^2} = |x|$$

If  $0 < x < 1$  then  $\sqrt{x} > x$

If  $x > 1$  then  $\sqrt{x} < x$

## Powers & Roots Flashcards

(watch [video](#))

$\sqrt[r]{n}$  = a number that, when raised to the power of  $r$ , equals  $n$

A root will have, at most, 1 value

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

# Powers & Roots Flashcards

(watch [video](#))

$$\left(\sqrt[n]{x}\right)\left(\sqrt[n]{y}\right) = \sqrt[n]{xy}$$

$$\frac{\sqrt[n]{x}}{\sqrt[n]{y}} = \sqrt[n]{\frac{x}{y}}$$

# Powers & Roots Flashcards

## Simplifying Square Roots

(watch [video](#))

4, 9, 16, 25, 36, 49, 64, 81, 100, 121, . . .

$$\sqrt{700} = \sqrt{100 \times 7}$$

$$= \sqrt{100} \times \sqrt{7}$$

$$= 10\sqrt{7}$$

- Rewrite the number inside the root as the product of a perfect square and some other number
- Rewrite the root as the product of 2 roots
- Simplify the root of the perfect square

# Powers & Roots Flashcards

(watch [video](#))

## Operations with Roots

Multiply the parts  
outside the root and  
multiply the parts  
inside the root

Divide the parts  
outside the root, and  
divide the parts  
inside the root

$$\sqrt{a} + \sqrt{b} = \sqrt{a + b} \quad \times$$

$$n\sqrt{a + b} = \sqrt{na + nb} \quad \times$$

## Powers & Roots Flashcards

(watch [video](#))

$$x^{\frac{a}{b}} = \sqrt[b]{x^a} \quad \rightarrow \quad 32^{\frac{3}{5}} = \sqrt[5]{32^3}$$

$$x^{\frac{a}{b}} = \left(\sqrt[b]{x}\right)^a \quad \rightarrow \quad 32^{\frac{3}{5}} = \left(\sqrt[5]{32}\right)^3 = (2)^3 = 8$$

$$x^{\frac{a}{b}} = \left(\sqrt[b]{x}\right)^a \quad 81^{\frac{3}{4}} = \left(\sqrt[4]{81}\right)^3 = 3^3 = 27$$

# Powers & Roots Flashcards

(watch [video](#))

## Equations with Exponents

- 1) Rewrite with equal bases
- 2) Apply following rule
- 3) Solve resulting equation

$$\text{If } b^x = b^y \text{ then } x = y \\ (b \neq 0, 1, -1)$$

# Powers & Roots Flashcards

(watch [video](#))

## “Fixing” the Denominator

$$\frac{6\sqrt{3}}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$$

Multiply top and bottom by the root in the denominator

$$\frac{\sqrt{3} + \sqrt{5}}{\sqrt{3} - 2\sqrt{5}} \times \frac{\sqrt{3} + 2\sqrt{5}}{\sqrt{3} + 2\sqrt{5}}$$

Multiply top and bottom by the conjugate of the denominator

# Algebra & Equation-Solving Flashcards

## Definitions

(watch [video](#))

*expression*: collection of one or more terms combined using addition and/or subtraction

*examples* :  $w^3 - 3x^2 + 5y$

$$x - 1$$

$$\frac{2x^4}{5} + \frac{1}{y^3} - 5x^2y + x - 3y + 9$$

*monomial*: expression with 1 term

*examples* :  $14, 5x, 8xy^3, \frac{jk}{5m^3}$

*binomial*: expression with 2 terms

*examples* :  $x^2 + 3y$   
 $w - 8$

*polynomial*: expression with 1 or more terms

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Simplifying Expressions

- Like terms can be combined (added/subtracted)

*e.g.*,  $2x + 7x = 9x$

- To add expressions in parentheses, remove the parentheses

*e.g.*,  $(3x - 2y) + (x - 7y) = 3x - 2y + x - 7y$

- To subtract expressions in parentheses, add the "opposites"

*e.g.*,  $(3x - 2y) - (x - 7y) = (3x - 2y) + (-x + 7y)$

# Algebra & Equation-Solving Flashcards

(watch [video](#))

Multiply members of the same "family"

e.g.,  $(5y^3)(4y^4) = 20y^7$

Multiply each term in the parentheses by the term in front

e.g.,  $3(2x + 5) = 6x + 15$

# Algebra & Equation-Solving Flashcards

## Multiplying two binomials

(watch [video](#))

First  $(x + 2)(x + 7) = x^2 + 7x + 2x + 14$

Outer  $= x^2 + 9x + 14$

Inner

Last  $(3y - 4)(2y - 5) = 6y^2 - 15y - 8y + 20$   
 $= 6y^2 - 23y + 20$

$$(2x + y)(x - 7y) = 2x^2 - 14xy + xy - 7y^2$$
$$= 2x^2 - 13xy - 7y^2$$

# Algebra & Equation-Solving Flashcards

## Multiplying two binomials

(watch [video](#))

First

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

Outer

$$= a^2 + ab + ab + b^2$$

Inner

$$= a^2 + 2ab + b^2$$

Last

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

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

$$= a^2 - ab - ab + b^2$$

$$= a^2 - 2ab + b^2$$

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

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Greatest Common Factor Factoring

- Find the greatest common factor (divisor) of all terms
- Place the greatest common factor in front of the parentheses
- Determine which terms must be inside the parentheses to get the desired product

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Difference of Squares Factoring

- Watch out for **differences** of squares

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

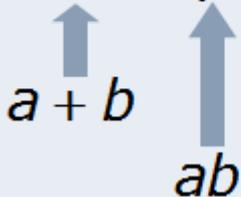
# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Quadratic Polynomial Factoring

$$x^2 + nx + p = (x + a)(x + b)$$

$a + b$        $ab$



## Factoring – Putting it all Together

(watch [video](#))

1. Factor out the greatest common factor
2. Factor further (if possible)

$$\begin{aligned}\text{Example: } 2x^6 - 2x^2 &= 2x^2(x^4 - 1) \\ &= 2x^2(x^2 + 1)(x^2 - 1) \\ &= 2x^2(x^2 + 1)(x + 1)(x - 1)\end{aligned}$$

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Simplifying Rational Expressions

$$\begin{aligned}\frac{x^3 + 4x^2 + 3x}{x^3 + 2x^2 - 3x} &= \frac{x(x^2 + 4x + 3)}{x(x^2 + 2x - 3)} \\ &= \frac{x(x+3)(x+1)}{x(x+3)(x-1)} \\ &= \frac{x+1}{x-1}\end{aligned}$$

→  $\frac{x^3 + 4x^2 + 3x}{x^3 + 2x^2 - 3x} = \frac{x+1}{x-1}$  for all values of  $x$  for which both expressions are defined

(watch [video](#))

## Golden Rule of Equation Solving

What you do to one side of the equation,  
you must do to the other side

- Isolate the variable by performing the same operations to both sides
- "solution" = "root"

## Algebra & Equation-Solving Flashcards

(watch [video](#))

$$\frac{x}{10} + \frac{4}{5} = \frac{x}{12} + 1$$

$$\frac{60}{1} \left( \frac{x}{10} + \frac{4}{5} \right) = \frac{60}{1} \left( \frac{x}{12} + 1 \right)$$

Multiply both sides by the least common multiple of the denominators

$$\frac{60x}{10} + \frac{240}{5} = \frac{60x}{12} + \frac{60}{1}$$

$$6x + 48 = 5x + 60$$

$$x + 48 = 60$$

$$x = 12$$

# Algebra & Equation-Solving Flashcards

(watch [video](#))

$$\frac{7}{6x-6} = \frac{3}{2x+2}$$

$$\text{If } \frac{a}{b} = \frac{c}{d} \text{ then } ad = bc$$

$$7(2x+2) = 3(6x-6)$$

$$14x + 14 = 18x - 18$$

$$14 = 4x - 18$$

$$32 = 4x$$

$$8 = x$$

# Algebra & Equation-Solving Flashcards

(watch [video](#))

$$ax^2 + bx + c = 0 \quad (a \neq 0)$$

- Most (all) quadratic equations can be solved by factoring
- Solvable quadratic equations will have 1 or 2 unique solutions (roots)

Quadratic formula

$$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$(b^2 - 4ac) < 0 \Rightarrow$  no solution exists

$(b^2 - 4ac) \geq 0 \Rightarrow$  solution exists

(watch [video](#))

## 2 Equations with 2 Unknowns

### Substitution Method

- 1) Solve one equation for one variable
- 2) Take the other equation and replace the chosen variable with its equivalent expression from the first equation
- 3) Solve for the variable
- 4) Plug the solution into any equation to solve for the other variable

(watch [video](#))

## 2 Equations with 2 Unknowns

### Elimination Method

- 1) Manipulate equations until you have matching coefficients for one variable
- 2) Add or subtract the 2 equations to eliminate one variable
- 3) Solve for the remaining variable
- 4) Plug the solution into any equation to solve for the other variable

(watch [video](#))

## Number of Solutions

- Solve as usual
  - find solution ➡ 1 solution
  - identical equations ➡ infinite solutions
  - $0x + 0y = \text{nonzero value}$  ➡ zero solutions

(watch [video](#))

## Solving 3 Equations with 3 Unknowns

- 1) Solve one equation for one variable
- 2) Take the other two equations and replace the chosen variable with its equivalent expression from the first equation
- 3) Solve for the two remaining variables
- 4) Plug the solution into any equation to solve for the third variable

or

- 1) Solve using the elimination method

(watch [video](#))

## Equations with Square Roots

### Square root

- 1) Eliminate square root by squaring both sides
- 2) Solve for variable
- 3) Check for extraneous roots

### $n^{\text{th}}$ root

- 1) Raise both sides by power of  $n$
- 2) Solve for variable
- 3) If  $n$  is even, check for extraneous roots

(watch [video](#))

## Equations with Exponents

- 1) Rewrite with equal bases
- 2) Apply following rule
- 3) Solve resulting equation

$$\text{If } b^x = b^y \text{ then } x = y \\ (b \neq 0, 1, -1)$$

(watch [video](#))

## Equations with Absolute Value

- 1) Apply rule  $|x| = a \rightarrow \begin{cases} x = a \\ x = -a \end{cases}$
- 2) Solve resulting equations
- 3) Check for extraneous roots

(watch [video](#))

## Strange Operators

- Use the “recipe” to evaluate

(watch [video](#))

## Solving Inequalities

- Adding and subtracting to/from both sides does not affect the inequality
- Multiplying and dividing both sides by a positive number does not affect the inequality
- Multiplying and dividing both sides by a **negative** number **reverses** the inequality

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## combining inequalities

$$w < x$$

$$x < y$$

$$w < x < y \rightarrow w < y$$

Rewrite inequalities facing the same direction before trying to combine

# Algebra & Equation-Solving Flashcards

(watch [video](#))

adding inequalities

$$\begin{array}{r} A < B \\ + \quad C < D \\ \hline A + C < B + D \end{array}$$

$$\begin{array}{r} \text{Al} < \$15 \\ + \quad \text{Bob} < \$10 \\ \hline \text{Al} + \text{Bob} < \$25 \end{array}$$

The inequality signs must face the same direction before adding

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## subtracting inequalities

$$\begin{array}{r} 10 < 17 \\ - 9 < 10 \\ \hline 1 < 7 \end{array}$$

~~$$\begin{array}{r} 10 < 11 \\ - 4 < 8 \\ \hline 6 < 3 \end{array}$$~~

Do not subtract inequalities

Do not multiply inequalities

Do not divide inequalities

# Algebra & Equation-Solving Flashcards

(watch [video](#))

$$|x| < a \Rightarrow -a < x < a \text{ (where } a \text{ is positive)}$$

$$|x| > a \Rightarrow x > a \text{ or } x < -a \text{ (where } a \text{ is positive)}$$

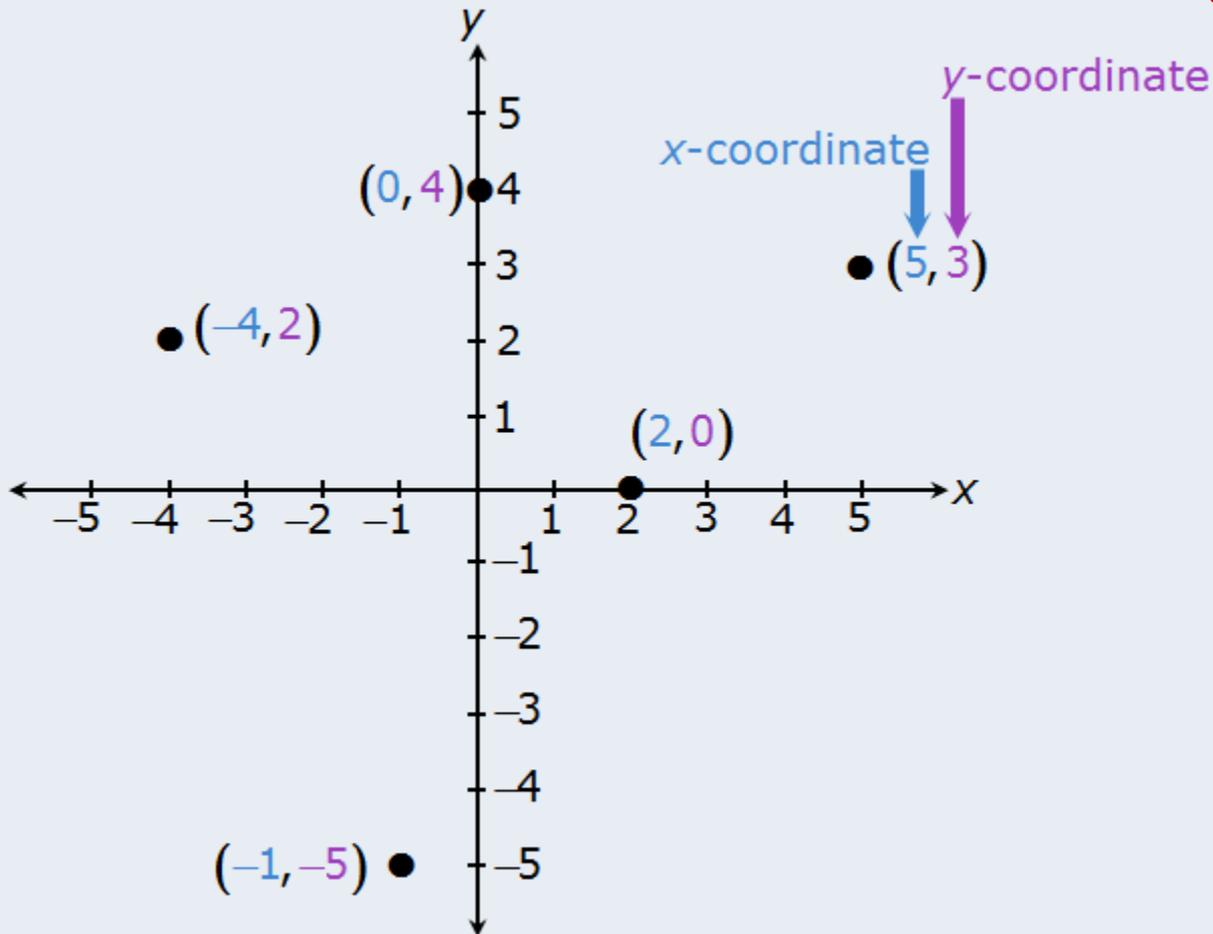
(watch [video](#))

## Quadratic Inequalities

- Set the expression to equal zero
- Find solutions and record on number line
- Test number from each region
- Solve the inequality

# Algebra & Equation-Solving Flashcards

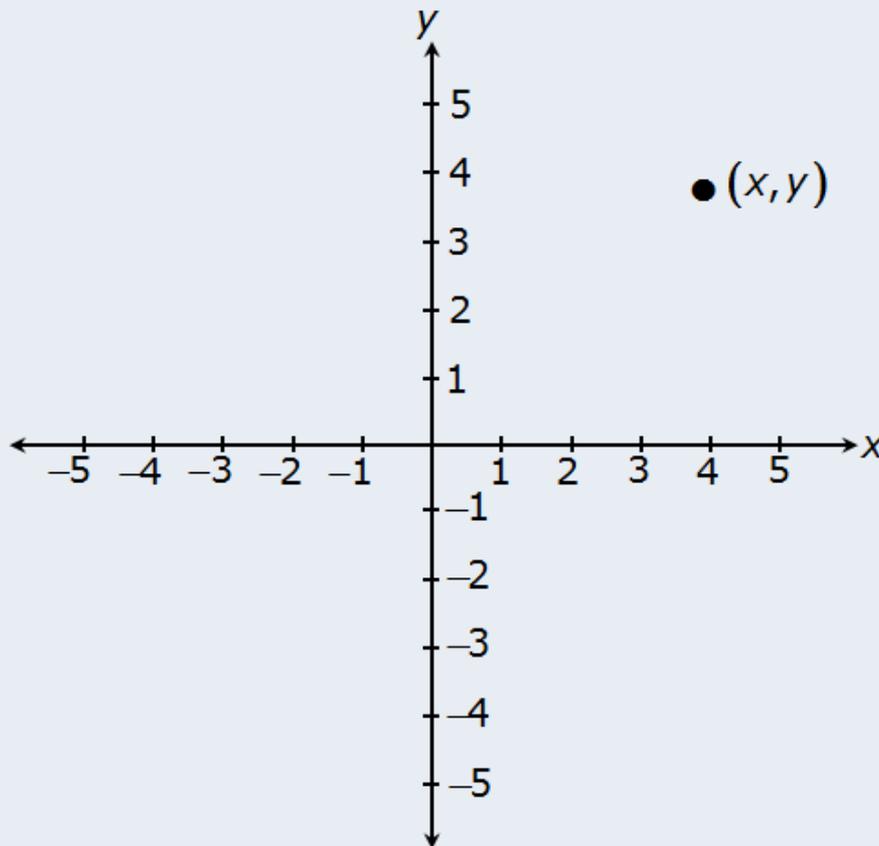
(watch [video](#))



# Algebra & Equation-Solving Flashcards

(watch [video](#))

- Every point in the coordinate plane is defined by a unique ordered pair of numbers  $(x, y)$



# Algebra & Equation-Solving Flashcards

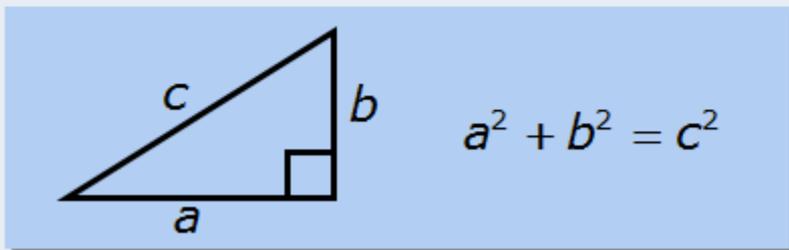
(watch [video](#))

## Distance Between Two Points

- Apply formula

Distance between points  $(x_1, y_1)$  and  $(x_2, y_2)$  is  $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

- Sketch and use Pythagorean Theorem



# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Graphing Lines

- In the coordinate plane, a line is a set of points such the coordinates of each point satisfy the given equation
- If the coordinates of a point satisfy the equation, then that point will lie on the line
- If the coordinates of a point **do not** satisfy the equation, then that point will **not** lie on the line

## Algebra & Equation-Solving Flashcards

(watch [video](#))

- The graph of the line  $x=k$  will be a **vertical** line where all of the points have  $x$ -coordinates equal to  $k$
- The graph of the line  $y=k$  will be a **horizontal** line where all of the points have  $y$ -coordinates equal to  $k$

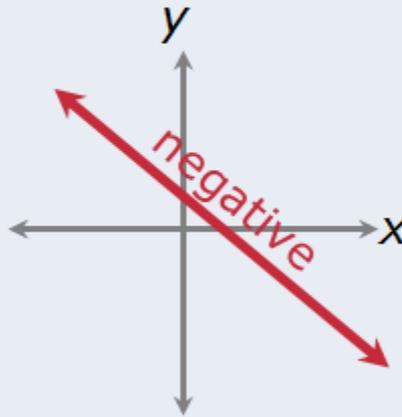
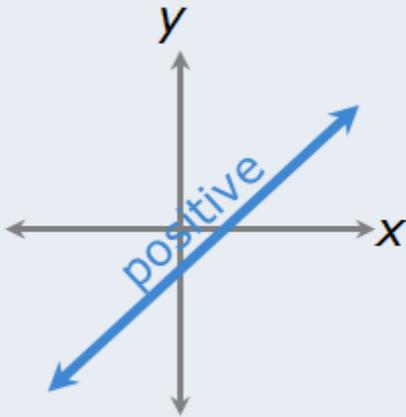
# Algebra & Equation-Solving Flashcards

(watch [video](#))

Given  $(x_1, y_1)$  and  $(x_2, y_2)$

$$\text{slope} = \frac{y_1 - y_2}{x_1 - x_2}$$

$$\text{slope} = \frac{\text{rise}}{\text{run}}$$



As the magnitude of the slope increases, the line gets steeper

# Algebra & Equation-Solving Flashcards

(watch [video](#))

$x$ -intercept:  $x$ -coordinate of point where the line intersects the  $x$ -axis

- To find the  $x$ -intercept, plug  $y = 0$  into the equation

$y$ -intercept:  $y$ -coordinate of point where the line intersects the  $y$ -axis

- To find the  $y$ -intercept, plug  $x = 0$  into the equation

# Algebra & Equation-Solving Flashcards

(watch [video](#))

## Slope y-intercept form

$$y = mX + b$$

slope  $\nearrow$   $\nwarrow$  y-intercept

# Algebra & Equation-Solving Flashcards

Writing equations from two given points

(watch [video](#))

$$y = mx + b$$

- 1) Find the slope ( $m$ ) of the line
- 2) Plug the value of  $m$  into the slope  $y$ -intercept equation
- 3) Plug the coordinates of one point into the equation
- 4) Solve for  $b$
- 5) Write the equation in slope  $y$ -intercept form

Practice

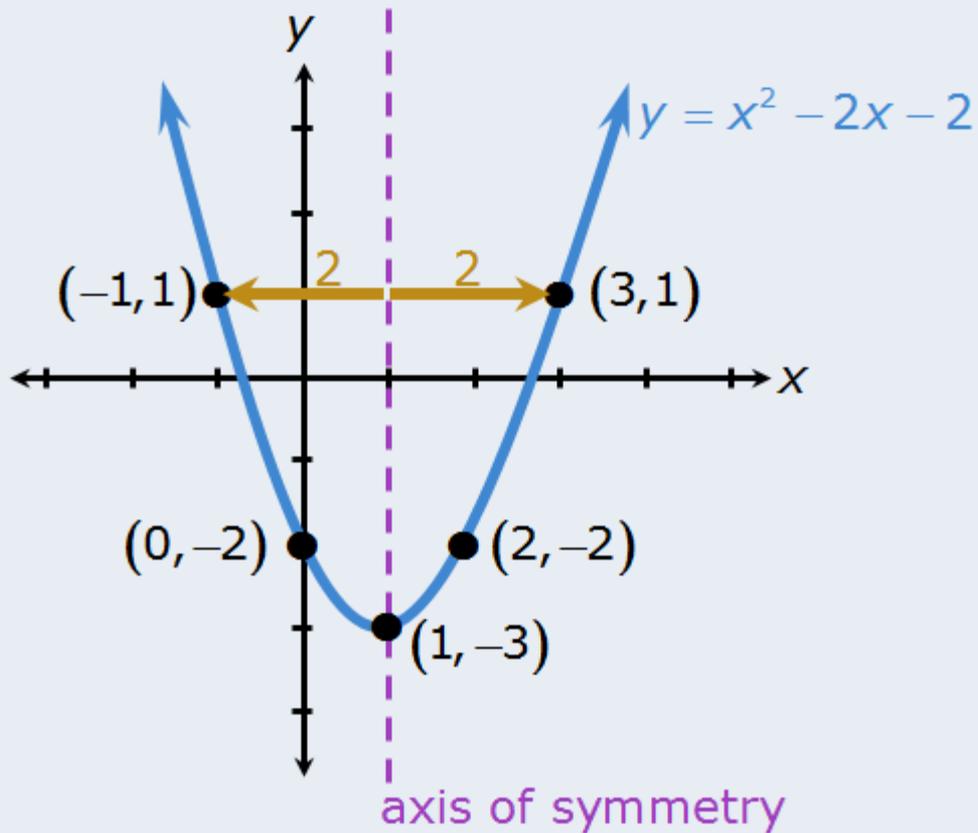
$$(1, -2) \text{ and } (4, 7) \Rightarrow y = 3x - 5$$

$$(4, -9.5) \text{ and } (-2, 5.5) \Rightarrow y = -\frac{5}{2}x + \frac{1}{2}$$

# Algebra & Equation-Solving Flashcards

(watch [video](#))

$$y = ax^2 + bx + c$$



# Word Problems Flashcards

(watch [video](#))

## Introduction to Word Problems

1. Understand the question and any restrictions
2. Consider testing the answer choices
3. Assign variables
4. Create an equation
5. Solve the equation (if necessary)
6. Reread question and confirm required value

(watch [video](#))

## Strategy for Testing Answer Choices

- Test answer choices, beginning with C
- Eliminate impossible answer choices

(watch [video](#))

## Assigning Variables

- Consider assigning the variable to the target value
- Consider writing a “word equation”
- It is often best to assign the variable to the smallest value
- Assign descriptive variables
- Look for relationships

(watch [video](#))

## Writing Equations

- Write a “word equation”
- Replace with algebraic expressions
- Solve for variable
- Reread the question and confirm required value

$\text{profit} = \text{revenue} - \text{cost}$

$\text{total cost} = \text{price per item} \times \text{quantity purchased}$

$\text{total earnings} = \text{pay rate} \times \text{time worked}$

(watch [video](#))

## Using More than 1 Variable

- Begin with one variable, but change to more variables if there are complex relationships between the unknown values
- $n$  variables requires  $n$  equations

(watch [video](#))

## Past & Future Age Questions

- Create table with given times
- Create equation(s)
- Ensure that you have obtained the required information

# Word Problems Flashcards

(watch [video](#))

$$\text{distance} = \text{rate} \times \text{time}$$

$$\text{rate} = \frac{\text{distance}}{\text{time}}$$

$$\text{time} = \frac{\text{distance}}{\text{rate}}$$

$$\frac{(\text{Distance})}{(\text{Rate})(\text{Time})}$$

$$\frac{D}{RT}$$

$$\text{distance} = \text{rate} \times \text{time}$$

The time units must match before multiplying

$$\text{time} = \frac{\text{distance}}{\text{rate}}$$

The distance units must match before dividing

# Word Problems Flashcards

(watch [video](#))

$$\text{average speed} = \frac{\text{total distance traveled}}{\text{total time}}$$

- Assign variables if necessary

(watch [video](#))

## Multiple Trips and/or Multiple Travelers

- Consider possible word equations
- Use the equation with favorable variables

(watch [video](#))

## **Shrinking/Expanding Gaps**

- Observe the outcome after 1 unit of time
- Determine shrink/expansion rate
- Apply the rate to the question

# Word Problems Flashcards

(watch [video](#))

## Work Questions

$$\text{output} = \text{rate} \times \text{time}$$

$$\text{rate} = \frac{\text{output}}{\text{time}}$$

$$\text{time} = \frac{\text{output}}{\text{rate}}$$

$$\frac{(\text{Output})}{(\text{Rate})(\text{Time})}$$

$$\frac{O}{RT}$$

Find the output rates

- Add rates when there are two or more contributors (machines, workers, etc.)

# Word Problems Flashcards

(watch [video](#))

## Double Matrix Method - Example

In a shipment of 40 toys, each toy is either blue or green, and each toy is either large or small. In total, there are 30 small toys, and there are 14 blue toys. If the shipment contains 22 toys that are both small and green, how many toys are both large and blue?

A) 4

**B) 6**

C) 10

D) 12

E) 14

	(40) blue	green	
small	8	22	→ sum = 30
large	6*	4	→ sum = 10
	↓ sum = 14	↓ 26	

(watch [video](#))

## 3-Criteria Venn Diagrams

- Draw 3 overlapping sets
- Fill in regions from the middle outwards

## Word Problems Flashcards

(watch [video](#))

- **Recursive definitions** of sequences typically require us to start at the beginning of the sequence

## Word Problems Flashcards

(watch [video](#))

$$1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

The number of integers from  
 $x$  to  $y$  inclusive =  $y - x + 1$

(watch [video](#))

## Growth Tables

- For incremental growth or decline draw a table
- Note changes for every time period

(watch [video](#))

## Mixture Questions

- Sketch the solution(s) with the parts separated
- Combine like parts

# Word Problems Flashcards

(watch [video](#))

## Variables in the Answer Choices

### Algebraic approach

- Translate the information into an expression

### Input-output approach

- Choose **value(s)** for the given variable(s)
- Use those **values** to calculate the required **output**
- Use the same **values** to evaluate each answer choice, and look for a matching **output**

Both strategies usually work

The algebraic approach is typically faster

(watch [video](#))

## Tips for the Algebraic Approach

- Use real numbers to determine the required operations to reach a certain goal
- Apply those operations to the given variables
- Try writing the expression in different ways

(watch [video](#))

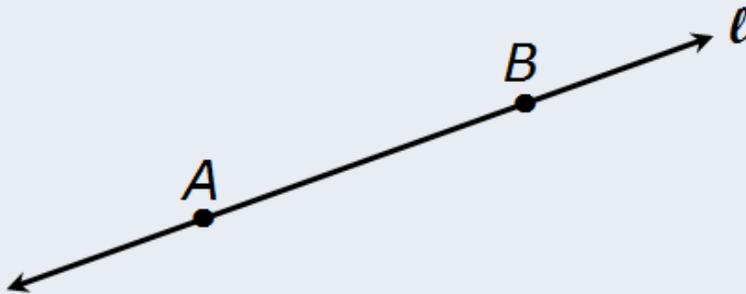
## Tips for the Input-Output Approach

- Use small numbers and prime numbers
- Use different numbers
- In most cases, avoid using 0 and 1
- Avoid numbers that appear in the question
- Some numbers allow us to quickly eliminate answer choices

# Geometry Flashcards

(watch [video](#))

**line:** a straight path that extends without end in both directions



$AB$ : line segment

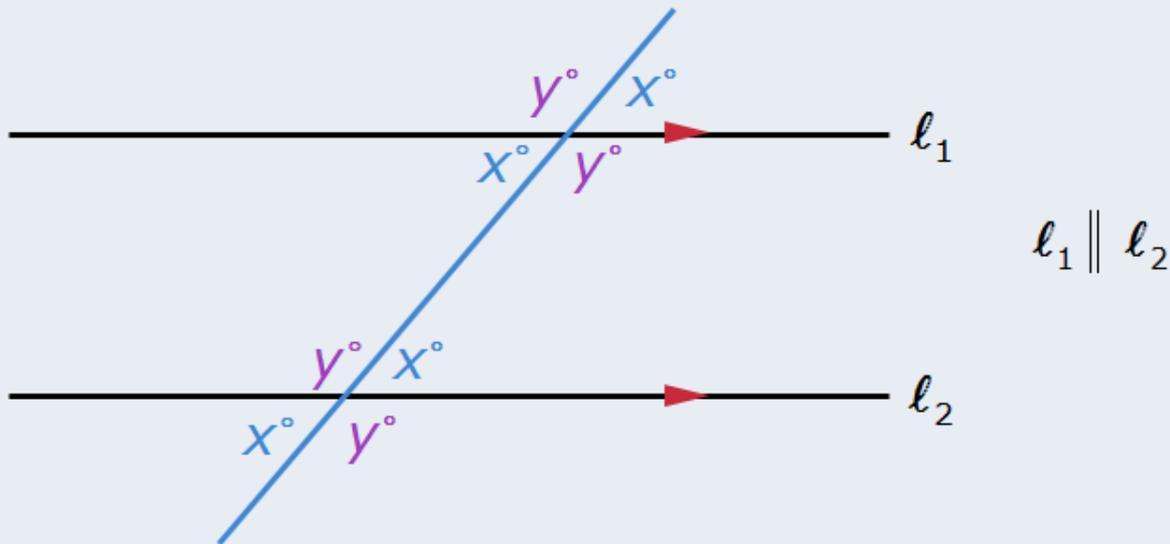
$AB$ : length of line segment  $AB$  (e.g.,  $DE=7$ )

# Geometry Flashcards

(watch [video](#))

Angles on a line add to  $180^\circ$

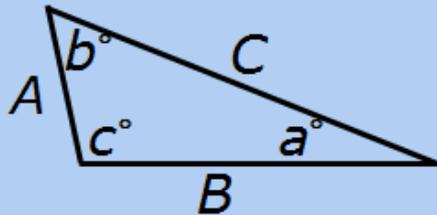
Opposite angles are equal



# Geometry Flashcards

(watch [video](#))

Angles in a triangle add to  $180^\circ$



If  $a < b < c$  then  $A < B < C$

The sum of the lengths of any two sides of a triangle must be greater than the third side.

Given lengths of sides  $A$  and  $B$

$$|A - B| < 3^{\text{rd}} \text{ side} < A + B$$

(watch [video](#))

## **Assumptions about Geometric Figures**

- Lines that appear straight can be assumed to be straight
- Angles are greater than zero degrees
- Do not make assumptions about angle measurements
- Do not make assumptions about parallelism
- Use visual estimation sparingly

# Geometry Flashcards

(watch [video](#))

- An isosceles triangle has 2 equal sides and 2 equal angles
- An equilateral triangle has 3 equal sides and 3 equal angles (60° each)

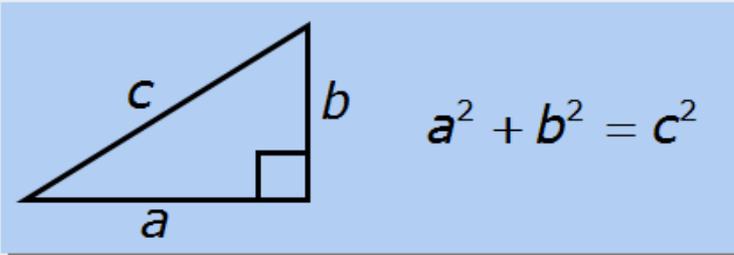
$$\text{Area} = \frac{\text{base} \times \text{height}}{2}$$

$$\text{Area} = \frac{\sqrt{3} \times (\text{side})^2}{4}$$

- The altitudes of isosceles triangles and equilateral triangles bisect the base

# Geometry Flashcards

(watch [video](#))



- Watch out for Pythagorean triples (and their multiples)

3-4-5

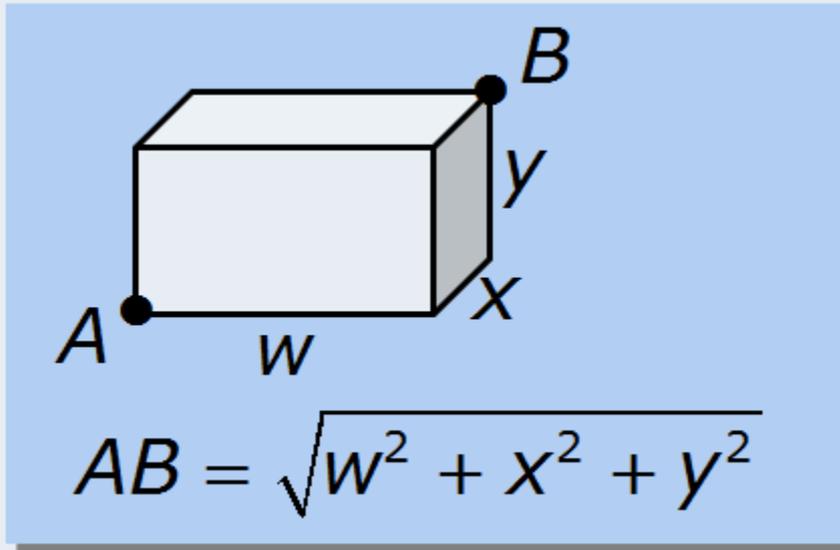
5-12-13

8-15-17

7-24-25

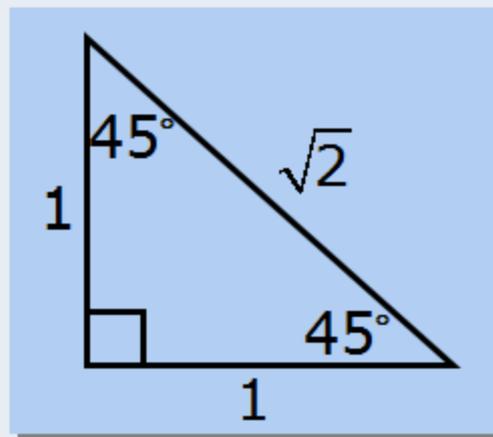
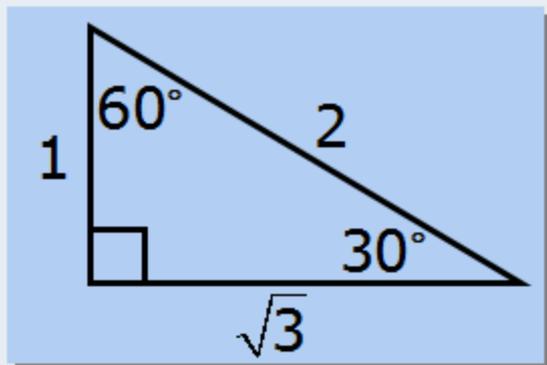
# Geometry Flashcards

(watch [video](#))



# Geometry Flashcards

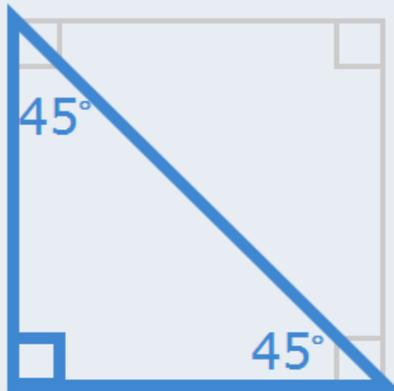
(watch [video](#))



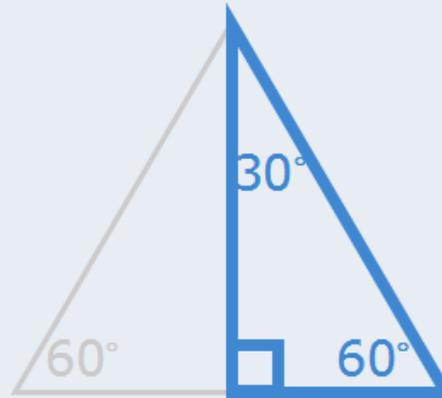
# Geometry Flashcards

(watch [video](#))

Square



Equilateral Triangle

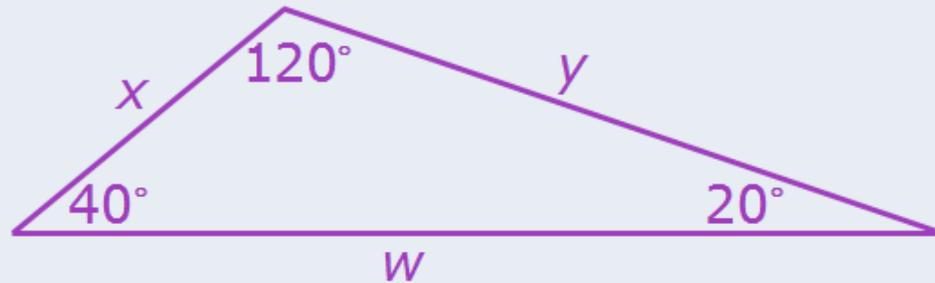
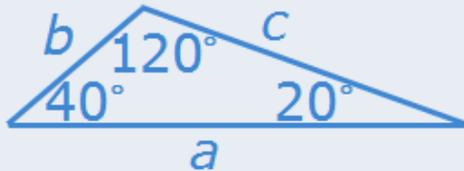


Watch out for special right triangles "hiding" in squares and equilateral triangles

# Geometry Flashcards

(watch [video](#))

Similar triangles have the same 3 angles in common



$$\frac{a}{w} = \frac{b}{x} = \frac{c}{y}$$

With similar triangles, the ratio of any pair of corresponding sides is the same

# Geometry Flashcards

(watch [video](#))

parallelogram

- opposite sides parallel



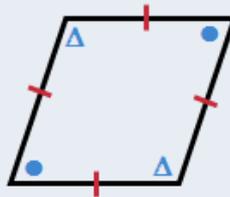
rectangle

- opposite sides parallel
- all angles are  $90^\circ$



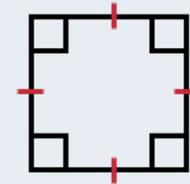
rhombus

- opposite sides parallel
- all sides are equal



square

- opposite sides parallel

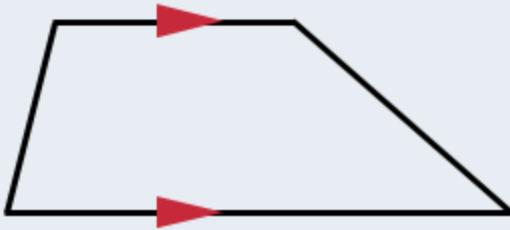


# Geometry Flashcards

(watch [video](#))

trapezoid

- 2 sides parallel

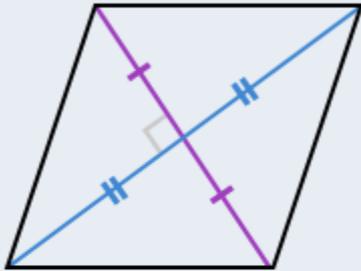


# Geometry Flashcards

(watch [video](#))

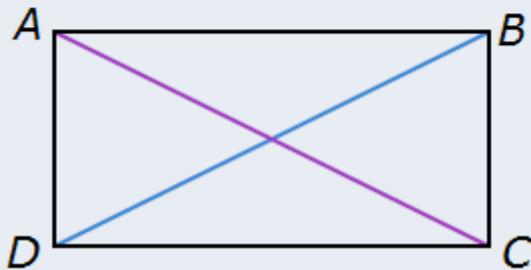
Rhombus (and square)

- diagonals are perpendicular bisectors



Rectangle (and square)

- diagonals are equal length



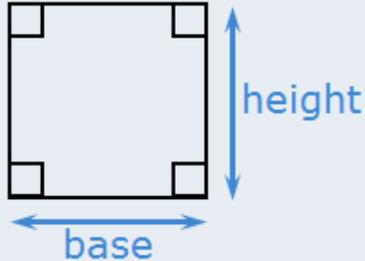
$$AC = BD$$

# Geometry Flashcards

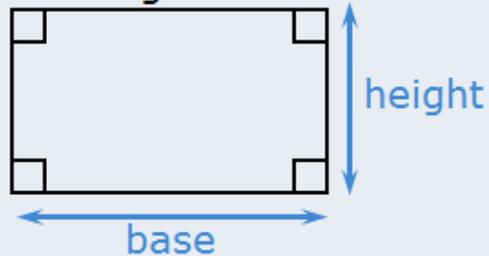
$$\text{area} = \text{base} \times \text{height}$$

(watch [video](#))

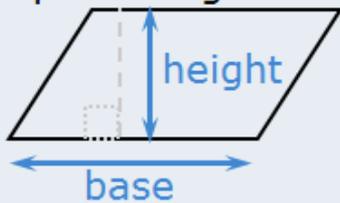
square



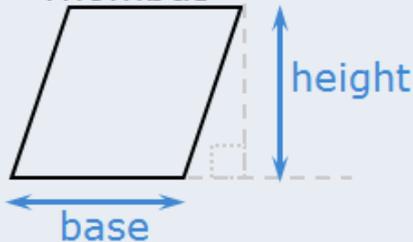
rectangle



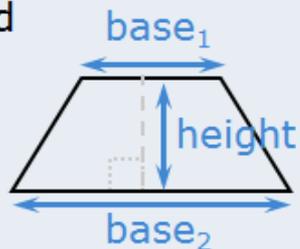
parallelogram



rhombus



trapezoid

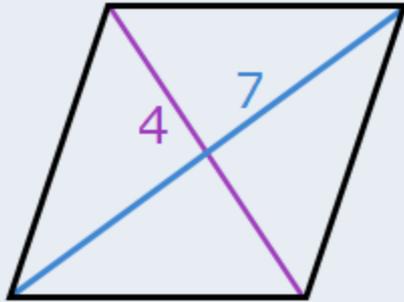


$$\begin{aligned} \text{area} &= \left( \frac{\text{base}_1 + \text{base}_2}{2} \right) \times \text{height} \\ &= \text{average of bases} \times \text{height} \end{aligned}$$

# Geometry Flashcards

(watch [video](#))

rhombus



$$\text{area} = \frac{\text{diagonal}_1 \times \text{diagonal}_2}{2}$$

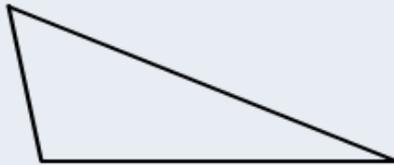
$$\begin{aligned}\text{area} &= \frac{4 \times 7}{2} \\ &= \frac{28}{2} \\ &= 14\end{aligned}$$

# Geometry Flashcards

(watch [video](#))

- Polygon: Closed figure formed by 3 or more line segments
- "polygon" ➔ "convex polygon" (all interior angles less than  $180^\circ$ )
- Regular polygon: equal sides and equal angles

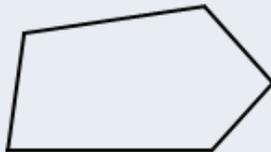
Triangle



Quadrilateral



Pentagon



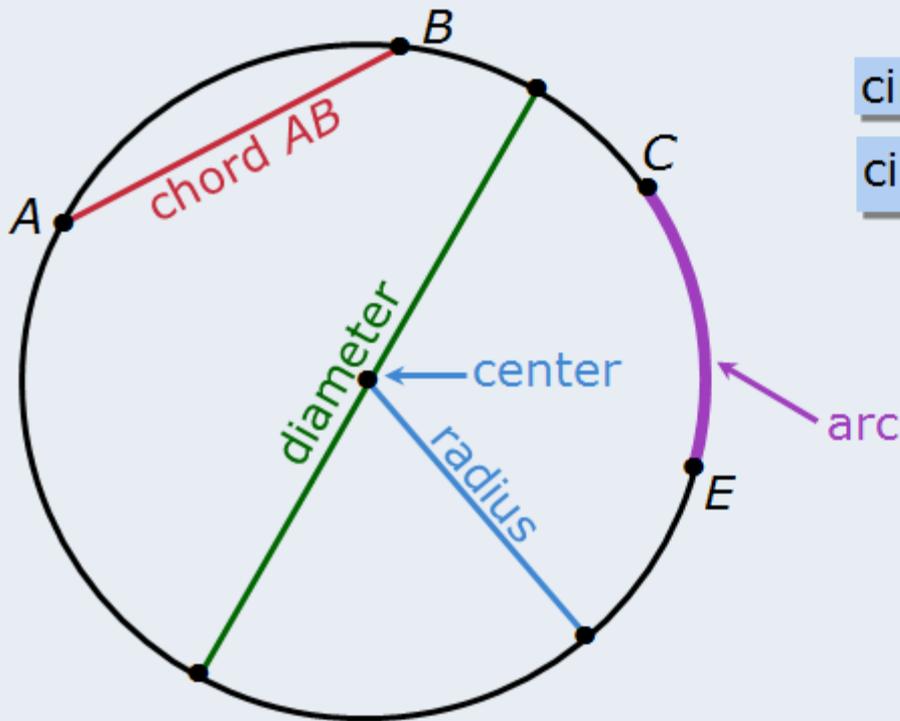
Hexagon



The sum of the interior angles in an  $N$ -sided polygon is equal to  $180^\circ (N - 2)$

# Geometry Flashcards

(watch [video](#))



$$\text{circumference} = \pi \times \text{diameter}$$

$$\text{circumference} = \pi \times (2 \times \text{radius})$$

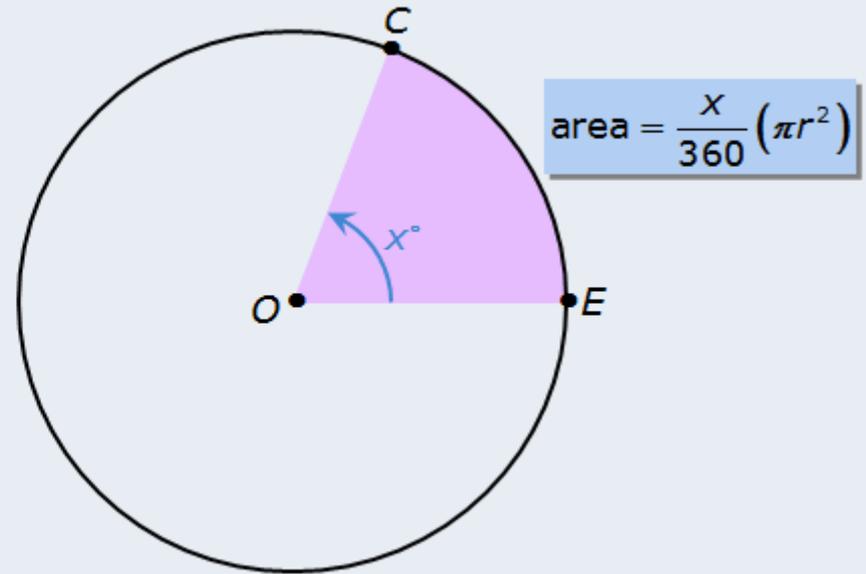
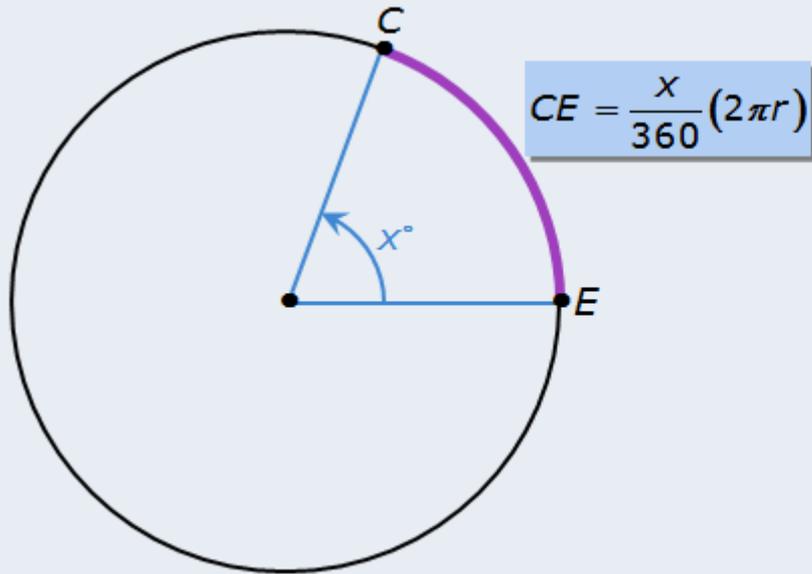
$$\text{area} = \pi r^2$$

$$\pi \approx 3.14$$

$$\approx 3$$

# Geometry Flashcards

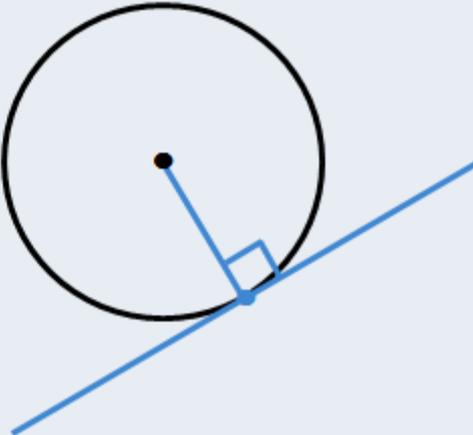
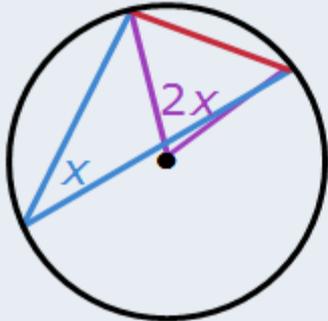
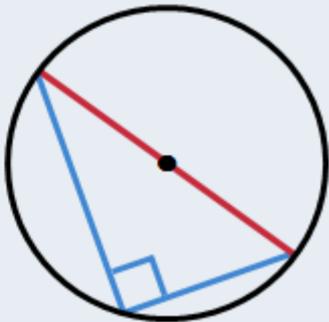
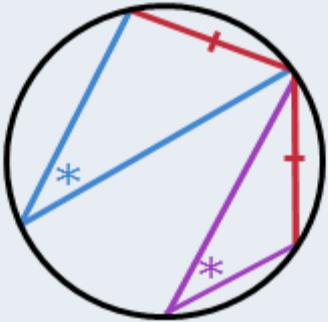
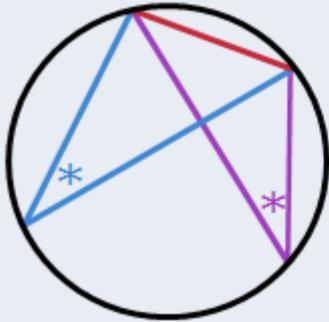
(watch [video](#))



# Geometry Flashcards

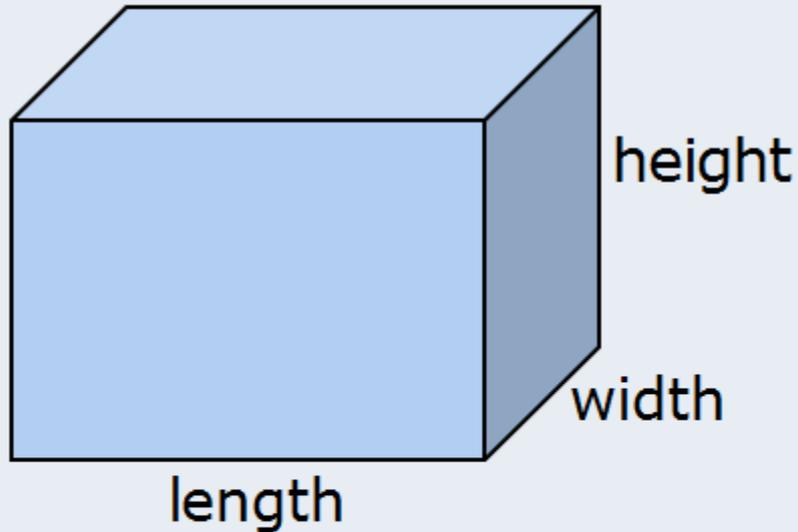
## Circle Properties

(watch [video](#))



# Geometry Flashcards

(watch [video](#))

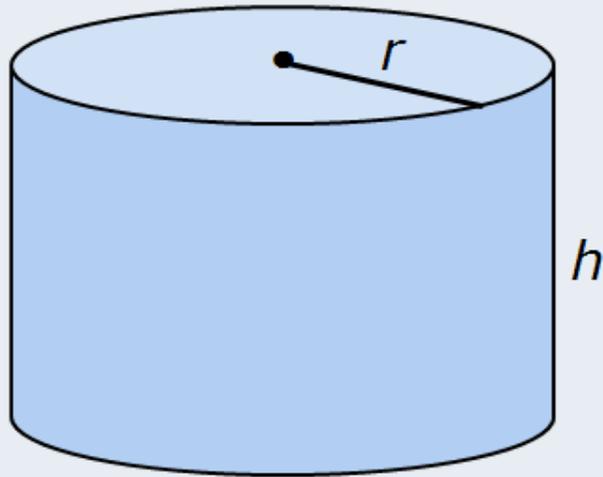


volume = length  $\times$  width  $\times$  height

surface area = sum of areas of all 6 sides

# Geometry Flashcards

(watch [video](#))



$$\text{volume} = \pi r^2 h$$

$$\begin{aligned}\text{surface area} &= \pi r^2 + \pi r^2 + 2\pi r h \\ &= 2\pi r^2 + 2\pi r h \\ &= 2\pi r (r + h)\end{aligned}$$

# Geometry Flashcards

(watch [video](#))

## Conversions

- If conversion is required, relationship will be given
  - e.g., (1 kilometer = 1000 meters)
  - e.g., (1 mile = 5280 feet)
- Note: Relationships **not** given for units of time
  - e.g., (1 hour = 60 minutes)
  - e.g., (1 day = 24 hours)

(watch [video](#))

## Geometry Data Sufficiency Questions

- Do not estimate lengths and angles
- To find one length, requires at least one other length
- Sketch diagram and add information
- Mentally grab and move points and lines

# Geometry Flashcards

(watch [video](#))

## Geometry Strategies

- Redraw figures
- Add all given information
- Add any information that can be deduced
- Add/extend lines
- Assign variables and use algebra
- Problem solving questions drawn to scale:
  - estimate to confirm calculations and guide guesses
- Two or more triangles and length required
  - look for similar triangles
- Right triangle:
  - use Pythagorean Theorem to relate sides
  - watch for Pythagorean Triples and special triangles
- Circle:
  - beware of circle properties (inscribed/central angles, tangent lines)
  - look for isosceles triangles
- Break areas/volumes into manageable pieces

# Integer Properties Flashcards

(watch [video](#))

If  $x$  and  $y$  are integers then:

" $x$  is **divisible** by  $y$ " = "when  $x$  is divided by  $y$  the **remainder is 0**"  
= " $y$  is a **divisor** of  $x$ "  
= " $y$  is a **factor** of  $x$ "  
= " $x$  **equals**  $ky$  for some integer  $k$ "  
= " $x$  is a **multiple** of  $y$ "

GMAT questions typically focus  
on **positive** divisors/factors

# Integer Properties Flashcards

(watch [video](#))

## Divisibility Rules

### Divisible by

### Characteristic

2	Units digit is 0, 2, 4, 6, or 8
3	Sum of digits is divisible by 3
4	2-digit # at the end is divisible by 4
5	Units digit is 0 or 5
6	The number is divisible by 2 AND by 3
9	Sum of digits is divisible by 9
10	Units digit is 0

# Integer Properties Flashcards

(watch [video](#))

## Prime Number

A positive integer with exactly 2 positive divisors.

Primes: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41,  
43, 47, 53, 59, . . .

Note:

- 1 is not prime (only 1 positive divisor)
- 2 is the **only** even prime number

# Integer Properties Flashcards

(watch [video](#))

" $x$  is divisible by  $y$ " = "when  $x$  is divided by  $y$  the remainder is 0"  
= " $y$  is a divisor of  $x$ "  
= " $y$  is a factor of  $x$ "  
= " $x$  equals  $ky$  for some integer  $k$ "  
= " $x$  is a multiple of  $y$ "  
= " $y$  is 'hiding' in the prime factorization of  $x$ "

6 is a divisor of  $W$   $\Rightarrow W = 6 \times ? \times ? \times ? \times \dots$   
 $= 2 \times 3 \times ? \times ? \times ? \times \dots$

$R$  is divisible by 88  $\Rightarrow R = 88 \times ? \times ? \times ? \times \dots$   
 $= 2 \times 2 \times 2 \times 11 \times ? \times ? \times ? \times \dots$

# Integer Properties Flashcards

(watch [video](#))

- The **prime factorization** of each number is unique
- Prime factorization can help determine whether numbers are divisors
- If some number,  $k$ , is “hiding” in the prime factorization of a number, then  $k$  is a divisor of that number

# Integer Properties Flashcards

(watch [video](#))

## Counting Divisors of Large Numbers

If  $N = p^a \times q^b \times r^c \times \dots$ , where  $p, q, r$  (etc) are prime numbers, then the total number of positive divisors of  $N$  is  $(a + 1)(b + 1)(c + 1) \dots$

# Integer Properties Flashcards

(watch [video](#))

## Squares of Integers

- The prime factorization of a perfect square will have an even number of each prime.
- A perfect square will have an odd number of positive divisors

# Integer Properties Flashcards

(watch [video](#))

## Divisor Rules

Given:  $j, k, M$  and  $N$  are integers:

- If  $k$  is a divisor of  $N$ , then  $k$  is a divisor of  $NM$
- If  $jk$  is a divisor of  $N$ , then  $j$  is a divisor of  $N$ , and  $k$  is a divisor of  $N$
- If  $k$  is not a divisor of  $N$ , then  $jk$  is not a divisor of  $N$
- If  $k$  is a divisor of both  $N$  and  $M$ , then  $k$  is a divisor of  $N+M$  (and  $N-M$  and  $M-N$ )
- If  $k$  is a divisor  $N$ , but  $k$  is not a divisor of  $M$ , then  $k$  is not a divisor of  $N+M$  (or  $N-M$  or  $M-N$ )

# Integer Properties Flashcards

## Greatest Common Divisor

(watch [video](#))

Find the greatest common divisor of 56 and 70:

$$\begin{aligned} 56 &= 2 \times 2 \times 2 \times 7 \\ 70 &= 2 \times 5 \times 7 \\ \text{GCD} &= 2 \times 7 \\ &= 14 \end{aligned}$$

Find the greatest common divisor of 132, 198 and 330:

$$\begin{aligned} 132 &= 2 \times 2 \times 3 \times 11 \\ 198 &= 2 \times 3 \times 3 \times 11 \\ 330 &= 2 \times 3 \times 5 \times 11 \\ \text{GCD} &= 2 \times 3 \times 11 \\ &= 66 \end{aligned}$$

# Integer Properties Flashcards

(watch [video](#))

## Least Common Multiple

Find the least common multiple of 12 and 56:

$$\begin{array}{l} 12 = 2 \times 2 \times 3 \\ 56 = 2 \times 2 \times 2 \times 7 \\ \downarrow \quad \downarrow \\ \text{LCM} = 2 \times 2 \times 3 \times 2 \times 7 \\ = 168 \end{array}$$

Find the least common multiple of 18 and 42:

$$\begin{array}{l} 18 = 2 \times 3 \times 3 \\ 42 = 2 \times 3 \times 7 \\ \downarrow \quad \downarrow \\ \text{LCM} = 2 \times 3 \times 3 \times 7 \\ = 126 \end{array}$$

## Integer Properties Flashcards

(watch [video](#))

$$(\text{GCD of } x \text{ and } y)(\text{LCM of } x \text{ and } y) = xy$$

# Integer Properties Flashcards

(watch [video](#))

$\text{odd} \pm \text{odd} = \text{even}$   
 $\text{odd} \pm \text{even} = \text{odd}$   
 $\text{even} \pm \text{even} = \text{even}$

$\text{odd} \times \text{odd} = \text{odd}$   
 $\text{odd} \times \text{even} = \text{even}$   
 $\text{even} \times \text{even} = \text{even}$

$\frac{\text{even}}{\text{even}}$  can be a non-integer, even or odd

If  $\frac{\text{even}}{\text{odd}}$  is an integer, it will be even

$\frac{\text{odd}}{\text{even}}$  cannot be an integer

If  $\frac{\text{odd}}{\text{odd}}$  is an integer, it will be odd

# Integer Properties Flashcards

(watch [video](#))

- Create a table to **test cases**
  - Use "E" and "O" and even/odd rules
  - Plug in values and evaluate
- Draw conclusions based on outcomes

# Integer Properties Flashcards

(watch [video](#))

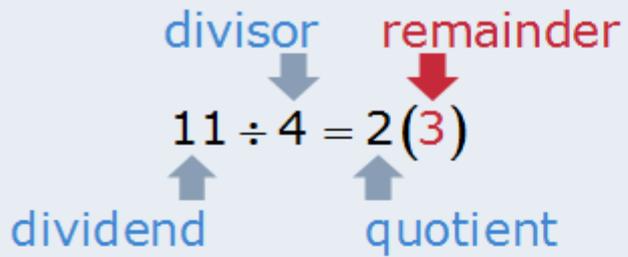
... -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, ...

Every  $n^{\text{th}}$  integer is divisible by  $n$

$n$  consecutive integers  $\Rightarrow$  1 number must be divisible by  $n$

# Integer Properties Flashcards

(watch [video](#))



$$0 \leq \text{remainder} < \text{divisor}$$

remainder  
↓  
If  $N \div D = Q(R)$ , then the possible values of  $N$  are:  $R, R + D, R + 2D, R + 3D, \dots$

$$\text{If } N \div D = Q(R) \Rightarrow Q \times D + R = N$$

↑  
remainder

# Statistics Flashcards

(watch [video](#))

$$\text{average} = \text{mean} = \frac{\text{sum of } n \text{ numbers}}{n}$$

$$\text{sum of } n \text{ numbers} = (\text{mean})(n)$$

median: the middlemost value when the numbers are arranged in ascending order

$n$  is odd: median = middle number

$n$  is even: median = average of the 2 middle numbers

mode: the number that occurs most frequently

## Statistics Flashcards

(watch [video](#))

If the numbers in a set are evenly spaced, then the mean and median of that set are equal

If the mean and median of a set are equal, then the numbers in that set **may or may not** be evenly spaced

# Statistics Flashcards

(watch [video](#))

$$\text{Weighted average} = (\text{proportion}) \left( \begin{array}{c} \text{group} \\ \text{A} \\ \text{average} \end{array} \right) + (\text{proportion}) \left( \begin{array}{c} \text{group} \\ \text{B} \\ \text{average} \end{array} \right) + \dots$$

Group A average =  $a$

Group B average =  $b$

case 1) population A = population B

➔ average of combined group =  $\frac{a+b}{2}$

case 2) population A is greater than population B

➔ average of combined group is closer to  $a$

case 3) population B is greater than population A

➔ average of combined group is closer to  $b$

# Statistics Flashcards

(watch [video](#))

range = greatest value – least value

Standard Deviation of  $x_1, x_2, x_3, x_4, \dots, x_n$

$m$  = mean

$n$  = number of values

$$SD = \sqrt{\frac{(x_1 - m)^2 + (x_2 - m)^2 + (x_3 - m)^2 + \dots + (x_n - m)^2}{n}}$$

Informal definition

**Standard deviation** is the average distance the data values are away from the mean.

# Statistics Flashcards

(watch [video](#))

$$\text{variance} = (\text{standard deviation})^2$$

units of standard deviation

If the standard deviation of a set of numbers is  $k$ ,  
then  $k = 1$  *unit of standard deviation*

# Counting Flashcards

(watch [video](#))

**When tackling counting questions, consider listing and counting.**

# Counting Flashcards

(watch [video](#))

## Fundamental Counting Principle

If a task is comprised of stages, where  
one stage can be accomplished in **A** ways,  
another stage can be accomplished in **B** ways,  
another stage can be accomplished in **C** ways,  
and so on,

then the total number of ways to accomplish the task is  
 $A \times B \times C \times \dots$

Can I take the task of “building” possible outcomes and break it into individual stages?

(watch [video](#))

## Arranging $n$ Unique Objects

$n$  unique objects can be arranged in  $n!$  ways

### Factorial Notation

$$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$$

$$5! = 5 \times 4 \times 3 \times 2 \times 1$$

$$n! = n \times (n - 1) \times (n - 2) \times \dots \times 3 \times 2 \times 1$$

$$0! = 1$$

# Counting Flashcards

(watch [video](#))

- Counting question with **restrictions**
  - Adhere to the restriction
  - Apply the Restrictions Rule

## Restrictions Rule

# of ways  
to follow a  
restriction

=

# of ways  
to ignore  
restriction

−

# of ways  
to break  
restriction

- Restrictions Rule is useful for questions involving “at least” and “at most”

(watch [video](#))

## MISSISSIPPI Rule

- When arranging objects, determine whether the objects are unique

### Arranging Objects When Some are Alike

Given  $n$  objects where  $A$  are alike, another  $B$  are alike, another  $C$  are alike and so on, the number of ways to arrange the  $n$  objects is

$$\frac{n!}{(A!)(B!)(C!) \cdots}$$

# Counting Flashcards

(watch [video](#))

**Combination:** A selection from a set of unique objects where the order of the selected objects does not matter.

- Choosing committee members is a popular theme

## Combination Formula

$r$  objects can be selected from a set of  $n$  unique objects in  ${}_n C_r$  ways, where:

$${}_n C_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

(watch [video](#))

## When to use Combinations

### General Strategy

- If possible, break the required task into stages
- “Does the outcome of each stage differ from the outcomes of other stages?”
  - No ➔ Combination
  - Yes ➔ Fundamental Counting Principle or other strategy

(watch [video](#))

## Calculating Combinations Shortcut

$r$  objects can be selected from a set of  $n$  unique objects in  ${}_n C_r$  ways

$${}_n C_r = \frac{\text{first } r \text{ values of } n!}{r!}$$

# Counting Flashcards

(watch [video](#))

## Counting Strategies

1. List outcomes
2. If restrictions exist, consider applying the Restrictions Rule
3. If possible, break the required task into stages
4. Ask, "Do the outcomes of each stage differ from the outcomes of other stages?"
  - No ➔ combination
  - Yes ➔ continue below
5. Determine the number of ways to accomplish each stage, **beginning with the most restrictive stage(s)**
6. Apply the Fundamental Counting Principle
7. Arranging objects that are not unique may require the MISSISSIPPI Rule

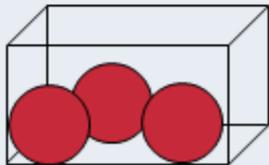
# Probability Flashcards

(watch [video](#))

- The **probability** of an event = the **likelihood** that the event will occur
- $0 \leq \text{probability of an event} \leq 1$

$P(\text{Event A}) = 0 \Rightarrow$  Event A will not occur

$P(\text{Event A}) = 1 \Rightarrow$  Event A will definitely occur



$P(\text{selected ball is green}) = 0$

$P(\text{selected ball is red}) = 1$

# Probability Flashcards

(watch [video](#))

## Probability of an Event

In an experiment where each outcome is equally likely, the probability that event A will occur is:

$$P(A) = \frac{\text{number of outcomes where A occurs}}{\text{total number of possible outcomes}}$$

Calculating the denominator first will often help you gain insight into a question

# Probability Flashcards

(watch [video](#))

## Complement

$$P(\text{event happens}) = 1 - P(\text{event DOES NOT happen})$$

### Possible Uses

- When calculating  $P(\text{event DOES NOT happen})$  is easier
- Questions with “at least” and “at most”

# Probability Flashcards

## Mutually Exclusive Events

Two events are mutually exclusive if both events cannot occur together.

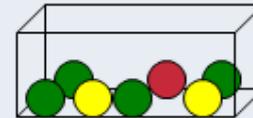
(watch [video](#))

### Example

A ball is randomly selected from the box

Event A: The ball is red

Event B: The ball is yellow



Can both events occur together?

- No → The events are mutually exclusive
- $P(A \text{ and } B) = 0$

# Probability Flashcards

(watch [video](#))

## "or" Probabilities

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

If events A and B are mutually exclusive, then  $P(A \text{ and } B) = 0$

Events A and B are mutually exclusive

$$\Rightarrow P(A \text{ or } B) = P(A) + P(B)$$

## Probability Flashcards

(watch [video](#))

$$P(A \text{ AND } B) = P(A) \times P(B|A)$$

$P(B|A)$  = probability of event B given  
that event A has occurred

# Probability Flashcards

(watch [video](#))

Events A and B are **dependent** if the occurrence of one event affects the probability of the other. If Events A and B are dependent, then:

$$P(A \text{ and } B) = P(A) \times P(B|A)$$

Events A and B are **independent** if the occurrence of one event does not affect the probability of the other. If Events A and B are independent, then:

$$P(A \text{ and } B) = P(A) \times P(B)$$

# Probability Flashcards

(watch [video](#))

## Rewriting Questions

### "or" Probabilities

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

### Dependent Events

$$P(A \text{ and } B) = P(A) \times P(B|A)$$

### Complement

$$P(A) = 1 - P(\text{NOT } A)$$

### Independent Events

$$P(A \text{ and } B) = P(A) \times P(B)$$

## Questions

- What must occur to get this outcome?
- Will it be faster to use the complement?
- Are the events mutually exclusive?
- Are the events independent?

# Probability Flashcards

(watch [video](#))

## General Probability Strategies

- Consider using the complement
- Determine the general approach
  - Basic probability formula
  - Probability rules
- Basic probability formula
  - Equally likely outcomes?
  - List or use counting techniques
- Probability rules
  - Rewrite question by asking, "What must occur?"
  - "or" probability ➡ test for mutually exclusivity
  - "and" probability ➡ test for independence

(watch [video](#))

## Guessing Strategies

- Use your instincts
- For questions that may involve the complement, eliminate any answer choice that does not combine with another answer choice to add to 1