

# Maths Crucial Knowledge Year 10-11 [Foundation]

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# Chapter 1 - Number

Place Value									
• The 'column values' of numbers									
....	Thousands	Hundreds	Tens	Units	Decimal Point	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	....

**4 Operators**  
 Addition (or **Sum**) +  
 Subtraction (or **Difference**) -  
 Multiplication (or **Product**) x  
 Division ÷

**Negative Numbers**  
 + and + = +  
 + and - = -  
 - and + = -  
 - and - = +

**Multiplying and Dividing by 10, 100, 1000**

- When we multiply a number by 10, we move every digit one place value to the left.
- When we multiply a number by 100, we move every digit 2 place values to the left.
- When we multiply a number by 1000, we move every digit 3 places to the left.
- We move each digit the same number of places to the left as there are zeros.
- Remember to fill in any blank spaces with 0 place holders.
- For dividing, we follow the same method but move every digit to the right

**Ordering Decimals**

- Set up a table with the decimal point in the same place for each number.
- Put in each number.
- Fill in the empty squares with zeros.
- Compare using the first column on the left.
- If the digits are equal move to the next column to the right until one number is higher.
- This number is the bigger one.

Know More, Remember More, Understand and Apply



## Crucial Knowledge Directed Numbers



Crucial Knowledge		Remember More	
<p><b>Adding a positive number / Subtracting a negative number</b></p> <p>Count along the number line to the right.</p>	<p>Start at -3 and ADD 10 <math>-3 + 10 = 7</math></p>		
<p><b>Subtracting a positive number / Adding a negative number</b></p> <p>Count along the number line to the left.</p>	<p>Start at -3 and SUBTRACT 6 <math>-3 - 6 = -9</math></p>		
Understand and Apply			
$-8 + 5 =$	$8 - 5 =$	$8 - - 5 =$	$8 + - 5 =$
$-12 + 19 =$	$12 - 19 =$	$12 - - 19 =$	$12 + - 19 =$
$-23 + 16 =$	$-23 - 16 =$	$23 - - 16 =$	$-23 + - 16 =$





## Crucial Knowledge

### Rounding



Crucial Knowledge	Remember More
<p>If the digit to the right of the place <u>value</u> you are rounding to is...</p> <ul style="list-style-type: none"> <li>➤ 5 or more: round up</li> <li>➤ Less than 5: round down</li> </ul>	<p>To the nearest hundred...</p> <p style="text-align: center;">Th H T U 73<u>8</u>4 = 7400</p> <p style="text-align: center;">Th H T U 73<u>4</u>4 = 7300</p>
<u>Understand and Apply</u>	
<p>1. Round to the nearest hundred:</p> <p>a) 7354                      b) 882                      c) 94</p> <p>2. Round to the nearest ten:</p> <p>a) 664                      b) 3078                      c) 13</p>	

## Measures, Area, Perimeter

### Chapter 2 – Measures, Perimeter, Area

Length	Area	Capacity and Volume	Mass	Time
1 cm = 10 mm	1 cm <sup>2</sup> = 100 mm <sup>2</sup>	1 cl = 10 ml	1 kg = 1000 g	1 minute = 60 seconds
1 m = 100 cm	1 m <sup>2</sup> = 10 000 cm <sup>2</sup>	1 litre = 100 cl	1 tonne = 1000 kg	1 hour = 60 minutes
1 km = 1000 m	1 ha = 10 000 m <sup>2</sup>	1 litre = 1000 ml		1 day = 24 hours
	1 km <sup>2</sup> = 1 000 000 m <sup>2</sup>	1 litre = 1000 cm <sup>3</sup>		1 week = 7 days
		1 ml = 1 cm <sup>3</sup>		1 year = 365 days

#### Area and perimeter

Perimeter is distance around shape  
 Area is space inside a shape (2D), measure in square units  
 Rectangle Area = *base x height*  
 Parallelogram Area = *base x height*  
 Triangle Area =  $\frac{1}{2} (\text{base} \times \text{height})$   
 Trapezium Area =  $\frac{1}{2} (a+b) \times \text{height}$   
 Circle Area =  $\pi \times \text{radius}^2$   
 Circumference is the perimeter of a circle  
 Circumference =  $2\pi \times \text{radius}$

#### Terminology of Shape

Height – Perpendicular height  
 Perpendicular – lines meet at 90 degrees  
 Parallel – always the same distance apart  
 Edge – Where 2 faces meet on a 3D shape  
 Vertices – The point where edges meet (corner) on a 3D shape  
 Face – side of a 3D shape  
 Compound Shapes – two or more shapes together  
 Quadrilateral – a 4-sided polygon  
 Polygon – a 2d shape with straight sides

#### Surface Area

The total of the area of all the faces

#### Volume

Volume is the space inside a 3D shape  
 Volume of a prism = cross sectional area x length

# Chapter 3 - Expressions

## Algebra terminology

We don't use the multiplication sign in algebra. When multiplying letters and numbers they are placed next to each other.  
We don't use the divide sign in algebra. When dividing letters and numbers they are written as a fraction.

## Simplifying – Adding and Subtracting

We can only bring 'like terms' together to simplify the expression  
Rewrite to get your 'like terms together'

## Simplifying – Multiplying and Dividing

Multiply or divide the numbers.  
If letters are different, put them together.  
If the letters are the same use power laws.

## Indices

If we multiply the indices, we add the powers.  
 $y^3 \times y^4 = y^{(3+4)} = y^7$   
If we divide the indices, we subtract the powers.  
 $y^{10} \div y^6 = y^{(10-6)} = y^4$   
If we have indices raised to a power, we multiply.  
 $(y^2)^3 = y^{(2 \times 3)} = y^6$   
Anything to the power zero is always 1

## Expanding

Remove the brackets by multiplying.

## Factorising

Opposite to expanding. Put back into brackets by dividing by the highest common factor.

## Substitution

We can replace letters with numbers to create an answer.  
You are told  $E = \frac{1}{2} mv^2$   
Calculate E when  $m = 10$  and  $v = 2.5$   
 $E = \frac{1}{2} \times 10 \times 2.5^2$   
 $E = 31.25$

Know More, Remember More, Understand and Apply



## Crucial Knowledge

### Factorising Single Brackets [Positive Terms Only]



Crucial Knowledge	Remember More
Factorise means to put into brackets. Take the highest common factor of each term out of the expression and put outside of the brackets. Divide terms by the highest common factor and write these inside of the brackets.	$4x + 16$ Highest Common Factor = 4 $4(\quad)$ $4x + 16$ $\begin{array}{cc} \div 4 \downarrow & \downarrow \div 4 \\ 4(x + 4) \end{array}$
Understand and Apply	
Factorise the following: a) $3x + 12$ b) $4x + 12$ c) $3x + 15$	



## Crucial Knowledge

### Factorising Single Brackets [Negative Terms]



Crucial Knowledge	Remember More
<p>Factorise means to put into brackets.</p> <p>Take the highest common factor of each term out of the expression and put outside of the brackets.</p> <p>Divide terms by the HCF and write these inside of the brackets.</p> <p style="color: red; font-size: small;">A negative divided by a positive is a negative. A negative divided by a negative is a positive.</p>	$4x - 16$ <p>Highest Common Factor = 4</p> $4(\quad)$ $\begin{array}{r} 4x - 16 \\ \div 4 \quad \downarrow \quad \downarrow \div 4 \\ x - 4 \end{array}$ $4(x - 4)$
<u>Understand and Apply</u>	
<p>Factorise the following:</p> <p style="text-align: center;">a) <math>5x + 20</math>                      b) <math>5x - 20</math>                      c) <math>-5x - 20</math></p>	

#### *2 - Factorising Single Brackets [Negative Terms]*



## Crucial Knowledge

### Factorising Single Brackets [Multiple Letters/Squared Terms]



Crucial Knowledge	Remember More
<p>Factorise means to put into brackets.</p> <p>Take the highest common factor of each term out of the expression and put outside of the brackets. Sometimes this highest common factor can be or include a letter.</p> <p>Divide terms by the HCF and write these inside of the brackets.</p>	$3xy + 9x$ <p>Highest Common Factor = 3 AND x</p> $3x(\quad)$ $\begin{array}{r} 3xy + 9x \\ \div 3x \quad \downarrow \quad \downarrow \div 3x \\ y + 3 \end{array}$ $3x(y + 3)$
<u>Understand and Apply</u>	
<p>Factorise the following:</p> <p style="text-align: center;">a) <math>xy + 2x</math>                      b) <math>2xy + 4y</math>                      c) <math>2x^2 + 6x</math></p>	

#### *3 - Factorising Single Brackets [Multiple Letters/Squared Terms]*



## Crucial Knowledge Expanding Single Brackets (Positives)



Crucial Knowledge	Remember More	
Remove the brackets by multiplying Multiply the term on the outside of the bracket by the first term inside the bracket	$\overbrace{3(x+4)} \quad 3 \times x = 3x$	
Multiply the term on the outside of the bracket by the second term in the bracket	$\overbrace{3(x+4)} \quad 3 \times 4 = +12$	
Bring the two multiplied terms together	$3x + 12$	
Understand and Apply		
Expand the following brackets:		
$5(x+7)$	$x(x+4)$	$3x(x+2)$
$7(2+y)$	$y(3+y)$	$2y(3+4y)$
$2(z+5)$	$z(z+6)$	$z^2(z+6z)$

*4 - Expanding Single Brackets [Positive Terms]*



## Crucial Knowledge Expanding Single Brackets (Negatives)



Crucial Knowledge	Remember More	
Remove the brackets by multiplying Multiply the term on the outside of the bracket by the first term inside the bracket	$\overbrace{3(x-4)} \quad 3 \times -x = -3x$	
Multiply the term on the outside of the bracket by the second term in the bracket	$\overbrace{3(x-4)} \quad 3 \times -4 = -12$	
Bring the two multiplied terms together	$3x - 12$	
Understand and Apply		
Expand the following brackets:		
$5(x-7)$	$x(x-4)$	$3x(x-2)$
$7(2-y)$	$y(3-y)$	$2y(3-4y)$
$2(z-5)$	$z(z-6)$	$z^2(z-6z)$

*5 - Expanding Single Brackets [Negative Terms]*

# Chapter 4 – Fractions, Decimals, Percentages

## Fractions

- Bottom term is the denominator
- Top term is the numerator

## Fractions of a quantity

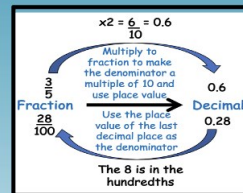
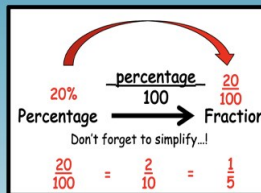
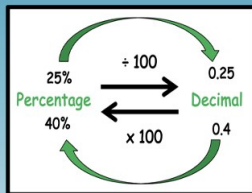
- Divide by the denominator
- Multiply by the numerator

## Percentages

- An amount out of 100
- **With a calculator:**  
What is 40% of £50  
**Percentage ÷ 100 x amount**
- **Without a calculator:**  
**1% = divide by 100**  
**10% = divide by 10**  
**25% = divide by 4**  
**50% = divide by 2**

## Fraction Arithmetic

- Multiplying** – Multiply top by top and bottom by bottom.
- Dividing** - 'Keep Change Flip'.
- Addition or Subtraction** – You need same bottom number (**denominator**). Add or subtract the numerator, keep the denominator the same.



## Improper and Mixed Fractions

Improper to mixed:

$$\frac{5}{3} = 5 \div 3 = 1 \text{ R}2$$

Mixed to improper:

$$2\frac{3}{4} = \frac{(4 \times 2) + 3}{4} = \frac{11}{4}$$

## Recurring Decimals

- A decimal with repeating values
- We indicate the repeating numbers with a dot above
- $0.\dot{6} = 0.666666 \dots$
- $0.\dot{6}\dot{5} = 0.65656565 \dots$

Know More, Remember More, Understand and Apply



## Crucial Knowledge Decimals and Percentages



Crucial Knowledge	Remember More
Decimals to Percentages: $\times 100$ Move every digit 2 places to the <u>left</u>	Express 0.23 as a percentage. $0.23 \times 100 = 23\%$
Percentages to Decimals: $\div 100$ Move every digit 2 places to the <u>right</u>	Express 85% as a decimal. $85 \div 100 = 0.85$
Understand and Apply	
How do you change a decimal to a percentage? How do you change a percentage to a decimal?	
Express the following decimals as percentages: 1) 0.72 2) 0.8 3) 0.04	Express the following percentages as decimals: 1) 64% 2) 20% 3) 9%



## Crucial Knowledge Decimals and Fractions



Crucial Knowledge								Remember More	
Thousands	Hundreds	Tens	Units	Decimal Point	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$		
<p><b>Decimals to Fractions:</b> → The denominator is the place value column</p> <p><b>Fractions to Decimals:</b> → Numerator ÷ denominator</p> <p><b>Fractions to Decimals:</b> → Multiply the fraction to make the denominator a multiple of ten then use the place value</p>								<p>Express 0.24 as a fraction. <math>\frac{24}{100} = \frac{6}{25}</math> The last digit is in the hundredth's column</p> <p>Express <math>\frac{2}{5}</math> as a decimal. <math>2 \div 5 = 0.4</math></p> <p>Express <math>\frac{3}{10}</math> as a decimal. This means there is a 3 in the tenth's column. 0.3</p>	
<b>Understand and Apply</b>									
<p>How do you change a decimal to a fraction? How do you change a fraction to a decimal?</p> <p>Express the following decimals as fractions:</p> <p>1) 0.72 2) 0.8</p>					<p>Express the following fractions as decimals:</p> <p>1) <math>\frac{3}{5}</math>                      2) <math>\frac{14}{100}</math></p>				

### *7 - Converting Decimals and Fractions*



## Crucial Knowledge Fractions and Percentages



Crucial Knowledge								Remember More	
<p><b>Fractions to Percentages:</b> → Multiply to make the denominator 100. The numerator is the percentage</p> <p><b>Percentages to Fractions:</b> → Write the percentage as the numerator. The denominator is 100. Simplify if possible.</p>								<p>Express <math>\frac{7}{50}</math> as a percentage. Multiply the fraction by <math>2 = \frac{14}{100} = 14\%</math></p> <p>Express 85% as a fraction. <math>\frac{85}{100} = \frac{17}{20}</math></p>	
<b>Understand and Apply</b>									
<p>How do you change a fraction to a percentage? How do you change a percentage to a fraction?</p> <p>Express the following fractions as percentages:</p> <p>1) <math>\frac{14}{100}</math>                      2) <math>\frac{3}{50}</math></p>					<p>Express the following percentages as fractions:</p> <p>1) 64% 2) 20% 3) 9%</p>				

### *8 - Converting Fractions and Percentages*



## Crucial Knowledge Fractions of an amount



Crucial Knowledge	Remember More
Divide the amount by the denominator	$\frac{1}{3}$ of 21 = $21 \div 3 = 7$
Multiply by the numerator	$\frac{2}{3}$ of 21 = $21 \div 3 = 7, 7 \times 2 = 14$
Understand and Apply	
Which part of the fraction do you divide by?	Find:
$\frac{1}{4}$ of 24	$\frac{2}{3}$ of 18
Which part of the fraction do you multiply by?	Find:
$\frac{1}{5}$ of 35	$\frac{3}{5}$ of 45
$\frac{1}{7}$ of 42	$\frac{4}{7}$ of 49

*9 - Fractions of Amounts*



## Crucial Knowledge Equivalent Fractions



Crucial Knowledge	Remember More
Equivalent fractions are two fractions that are equal. You can multiply or divide.	
Multiply numerator and denominator by the same number	$\frac{1}{3} \xrightarrow{\times 2} \frac{2}{6}$
Divide numerator and denominator by the same number	$\frac{9}{24} \xrightarrow{\div 3} \frac{3}{8}$
Understand and Apply	
Fill in the missing numbers:	Fill in the missing numbers:
$\frac{2}{5} = \frac{\quad}{15}$	$\frac{4}{8} = \frac{\quad}{4}$
$\frac{3}{8} = \frac{9}{\quad}$	$\frac{12}{36} = \frac{4}{\quad}$
$\frac{2}{7} = \frac{\quad}{35}$	$\frac{15}{25} = \frac{\quad}{5}$
	Give 2 equivalent fractions to the following:
	$\frac{1}{4} =$
	$\frac{3}{15} =$
	$\frac{6}{10} =$

*10 - Equivalent Fractions*



## Crucial Knowledge Simplifying Fractions



Crucial Knowledge	Remember More
Divide numerator and denominator by the same number. Repeat.	$\frac{10}{30} \xrightarrow{\div 2} \frac{5}{15} \xrightarrow{\div 5} \frac{1}{3}$ $\frac{10}{30} \xrightarrow{\div 2} \frac{5}{15} \xrightarrow{\div 5} \frac{1}{3}$
Divide numerator and denominator by the highest common factor	$\frac{18}{30} \xrightarrow{\div 6} \frac{3}{5}$ $\frac{18}{30} \xrightarrow{\div 6} \frac{3}{5}$
Understand and Apply	
Simplify the following fractions	Simplify the following fractions
$\frac{3}{15} = \frac{1}{\square}$	$\frac{3}{35} =$
$\frac{4}{12} = \frac{\square}{3}$	$\frac{8}{40} =$
$\frac{4}{38} = \frac{2}{\square}$	$\frac{4}{64} =$

### 11 - Simplifying Fractions



## Crucial Knowledge Adding Fractions



Crucial Knowledge	Remember More
<b>Adding</b> Make sure the bottom numbers (the <b>denominators</b> ) are the same	$\frac{1}{3} + \frac{1}{5}$ <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <math>\frac{1}{3} \xrightarrow{\times 5} \frac{5}{15}</math> </div> <div style="text-align: center;"> <math>\frac{1}{5} \xrightarrow{\times 3} \frac{3}{15}</math> </div> </div>
Add the top numbers (the <b>numerators</b> ), put that answer over the denominator	$\frac{5}{15} + \frac{3}{15} = \frac{8}{15}$
Understand and Apply	
Add $\frac{2}{7}$ and $\frac{3}{7}$	Add $\frac{1}{4}$ and $\frac{3}{8}$
Add $\frac{1}{8}$ and $\frac{5}{12}$	Add $\frac{8}{15}$ and $\frac{3}{10}$

### 12 - Adding Fractions



## Crucial Knowledge Subtracting Fractions



Crucial Knowledge	Remember More
<p><b>Subtracting</b> Make sure the bottom numbers (the <b>denominators</b>) are the same</p> <p>Subtract the top numbers (the <b>numerators</b>), put that answer over the denominator</p>	$\frac{3}{16} - \frac{1}{8} = \frac{3}{16} - \frac{2}{16}$ $= \frac{1}{16}$
Understand and Apply	
<p>1) <math>\frac{3}{6} - \frac{1}{6}</math></p> <p>2) <math>\frac{3}{4} - \frac{4}{12} =</math></p>	<p>3) <math>\frac{2}{5} - \frac{4}{15}</math></p> <p>4) <math>\frac{1}{2} - \frac{3}{8} =</math></p>

13 - Subtracting Fractions



## Crucial Knowledge Multiplying Fractions



Crucial Knowledge	Remember More
<p><b>Multiplying</b> Multiply the top numbers (the <b>numerators</b>)</p> <p>Multiply the bottom numbers (the <b>denominators</b>)</p>	$\frac{4}{5} \times \frac{3}{7} = \frac{4 \times 3}{5 \times 7} = \frac{12}{35}$
Understand and Apply	
<p>What is <math>\frac{5}{8} \times \frac{4}{5}</math> ?</p> <p>What is <math>\frac{3}{7} \times \frac{5}{6}</math> ?</p>	<p>What is <math>\frac{3}{4} \times \frac{5}{6}</math> ?</p> <p>What is <math>\frac{5}{14} \times \frac{7}{8}</math> ?</p>

14 - Multiplying Fractions



## Crucial Knowledge Dividing Fractions



Crucial Knowledge	Remember More
<p><b>Dividing</b> Keep the first fraction the same</p> <p><b>Multiply</b> the numerators and denominators</p> <p>Flip the second fraction</p>	$\frac{1}{2} \div \frac{1}{6}$ $\frac{1}{2} \times \frac{6}{1} = \frac{1 \times 6}{2 \times 1} = \frac{6}{2}$ $\frac{6}{2} = 3$
Understand and Apply	
What is $\frac{1}{12} \div \frac{1}{4}$ ?	What is $\frac{7}{12} \div \frac{2}{3}$ ?
What is $\frac{6}{7} \div \frac{3}{14}$ ?	What is $\frac{3}{8} \div \frac{5}{12}$ ?

15 - Dividing Fractions

## Angles and 2D Shapes

### Chapter 5 – Angles and 2D Shapes

#### Angle Reasoning

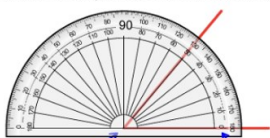
Angles on straight line =  $180^\circ$   
 Angles in a triangle =  $180^\circ$   
 Angles in quadrilateral =  $360^\circ$   
 Angles at a point =  $360^\circ$

#### Terminology of a Shape

Scalene – all sides and angles are different  
 Isosceles – 2 sides and angles are the same  
 Equilateral – 3 sides and angles are the same  
 Right – contains a right angle  
 Acute – an angle less than 90 degrees  
 Obtuse – an angle between 90 and 180 degrees  
 Reflex – an angle more than 180 degrees

#### Use of Protractor

Line up the bottom of the protractor with bottom line of the angle.

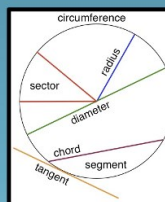


Don't forget to make sure the vertex of the angle is lined up with the center of the protractor.

Start at the zero and read up.

#### Polygons

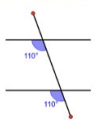
A shape with 3 or more straight sides  
 Total Interior Angles =  $(n-2) \times 180$   
 Interior + Exterior =  $180^\circ$   
 Sum of Exterior =  $360^\circ$



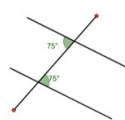
#### Angles with parallel lines

X – Vertically opposite angles are always equal  
 F – Corresponding angles are always equal  
 Z – Alternate angles are always equal  
 C – Co-Interior angles always add to 180

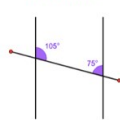
Corresponding Angles



Alternate Angles



Interior Angles

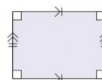


#### Square



4 equal sides  
 4 angles of  $90^\circ$   
 2 sets of parallel sides

#### Rectangle



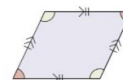
2 sets of equal sides  
 4 angles of  $90^\circ$   
 2 sets of parallel sides

#### Rhombus



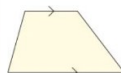
4 equal sides  
 2 pairs of equal angles  
 2 sets of parallel sides

#### Parallelogram



2 sets of equal sides  
 2 pairs of equal angles  
 2 sets of parallel sides

#### Trapezium



1 set of parallel sides

#### Isosceles trapezium



1 set of equal sides  
 2 pairs of equal angles  
 1 set of parallel sides

#### Kite



2 sets of equal sides  
 1 pair of equal angles  
 No parallel sides

#### Arrowhead



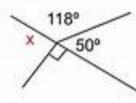
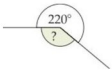


2 sets of equal sides  
 1 pair of equal angles  
 No parallel sides

Know More, Remember More, Understand and Apply



**Crucial Knowledge**  
**Angles at a point**



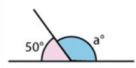
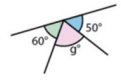
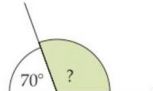
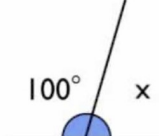

Crucial Knowledge	Remember More
Angles around a point add up to 360°	<p>The square represents 90 degrees</p>  <p><math>118 + 50 + 90 + x = 360</math> <math>x = 360 - 118 - 50 - 90</math> <math>x = 102^\circ</math></p>
Understand and Apply	
Find the missing angles	
	<p>Find the value of x</p> 
	<p>Find the value of x</p> 

16 - Angles around a point



**Crucial Knowledge**  
**Angles on a Straight line**



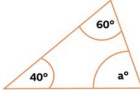
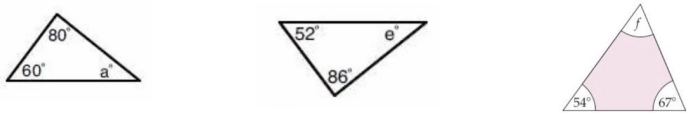
Crucial Knowledge	Remember More
Angles on a straight line add to 180 degrees	<p>Angles on a straight line add up to 180°</p>  <p><math>a + 50 = 180</math> <math>a = 180 - 50</math> <math>a = 130^\circ</math></p> <p>Angles on a straight line add up to 180°</p>  <p><math>g + 60 + 50 = 180</math> <math>g = 180 - 60 - 50</math> <math>g = 70^\circ</math></p>
Understand and Apply	
Find the missing angles	
	
	

17 - Angles on a straight line



## Crucial Knowledge Angles in triangles



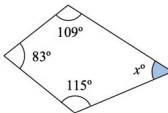
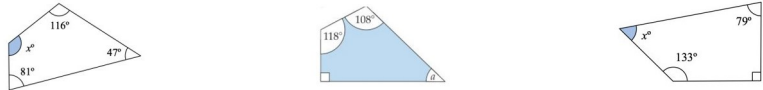
Crucial Knowledge	Remember More
Angles in a triangle add up to $180^\circ$	 $60 + 40 + a = 180$ $a = 180 - 60 - 40$ $a = 80^\circ$
<u>Understand and Apply</u>	
Find the missing angles	
	

*18 - Angles in a triangle*



## Crucial Knowledge Angles in a Quadrilateral



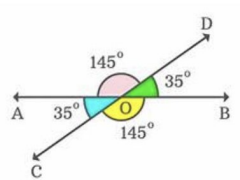
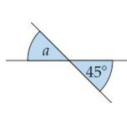
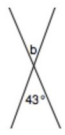
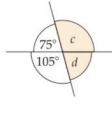
Crucial Knowledge	Remember More
Angles in a quadrilateral add up to $360^\circ$	 $\text{Angles in a Quadrilateral add up to } 360^\circ$ $109 + 115 + 83 + x = 360$ $x = 360 - 109 - 115 - 83$ $x = 53^\circ$
<u>Understand and Apply</u>	
Find the missing angles	
	

*19 - Angles in a quadrilateral*



## Crucial Knowledge Vertically Opposite Angles



Crucial Knowledge	Remember More
Vertically opposite angles are equal	
Understand and Apply	
Find the missing angles	
	
	

20 - Vertically Opposite

## Graphs

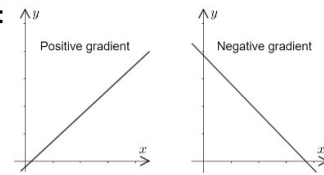
# Chapter 6 - Graphs

### Coordinates

- Along the corridor then up the stairs
- x and y values should be written on the axes
- There are 4 quadrants

### Horizontal, Vertical and Diagonal Lines

- An equation in the form  $y = \text{any number}$  always gives a horizontal line.
- An equation in the form  $x = \text{any number}$  always gives a vertical line.
- Diagonal lines:



### Parallel Lines

- Parallel lines have the same gradient

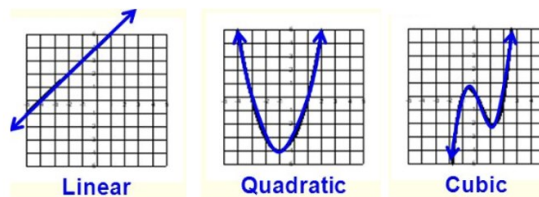
### Linear Lines

- $y = mx + c$
- $m = \text{gradient}$  (how steep the line is)
- $c = \text{y-intercept}$  (where the line crosses the y axis)
- y is the y coordinate
- x is the x coordinate

### Plotting Straight Lines

- Always plot at least three coordinates.
  - First create a table of values
- |   |  |  |  |  |  |
|---|--|--|--|--|--|
| x |  |  |  |  |  |
| y |  |  |  |  |  |
- Substitute in values to form coordinate points
  - Plot the coordinates one at a time

### Types of Lines



# Chapter 7 - Calculations

Getting to Know Your Calculator	
$x^2$	Squared (e.g. $3^2 = 3 \times 3 = 9$ )
SHIFT	Gets the second function of the key
$\sqrt{\quad}$	Square Root (e.g. $\sqrt{9} = 3$ )
S $\leftrightarrow$ D	Changes a fraction answer to a decimal
$x^3$	Cubed (e.g. $2^3 = 2 \times 2 \times 2 = 8$ )
"(" and ")"	Brackets
$\sqrt[3]{\quad}$	Cube Root (e.g. $\sqrt[3]{8} = 2$ )
$\frac{\square}{\square}$	Fraction

### Adding & Subtracting Decimals

Use the column method  
Line up the decimal places

### Multiplying Decimals

Ignore the decimal place and multiply the digits  
Count how many numbers are after the decimal place in the question.  
Make sure the answer has the same number

### Dividing Decimals

Multiply both numbers by 10 or 100 to get the numbers from a decimal to a whole number.  
Divide using the bus stop method

### Rounding

- Decimal places (column after decimal point)
- Significant Figures (highest value column)

### Negative Numbers

- + and + = +
- + and - = -
- and + = -
- and - = +

Know More, Remember More, Understand and Apply



## Crucial Knowledge Multiplying Decimals



Crucial Knowledge	Remember More
Multiply each decimal number by 10, 100 or 1000 to make it a whole number.	$0.12 \times 0.5$
Multiply the whole numbers.	$\begin{array}{r} \text{x100} \downarrow \quad \downarrow \text{x10} \\ 12 \times 5 \\ = 60 \end{array}$
Divide your answer by the same number that you multiplied the question by.	$60 \div 100 \div 10 = 0.06$
Understand and Apply	
Showing each step of the method, calculate...	
a) $0.6 \times 4$	b) $0.6 \times 0.4$
	c) $0.04 \times 0.6$

## Chapter 8 - Statistics

### Getting to Know Your Calculator

$x^2$	Squared (e.g. $3^2 = 3 \times 3 = 9$ )
SHIFT	Gets the second function of the key
$\sqrt{\quad}$	Square Root (e.g. $\sqrt{9} = 3$ )
S $\leftrightarrow$ D	Changes a fraction answer to a decimal
$x^3$	Cubed (e.g. $2^3 = 2 \times 2 \times 2 = 8$ )
"(" and ")"	Brackets
$\sqrt[3]{\quad}$	Cube Root (e.g. $\sqrt[3]{8} = 2$ )
$\frac{\square}{\square}$	Fraction

#### Rounding

- Decimal places (column after decimal point)
- Significant Figures (highest value column)

#### Negative Numbers

+ and + = +  
 + and - = -  
 - and + = -  
 - and - = +

#### Adding & Subtracting Decimals

Use the column method  
 Line up the decimal places

#### Multiplying Decimals

Ignore the decimal place and multiply the digits  
 Count how many numbers are after the decimal place in the question.  
 Make sure the answer has the same number

#### Dividing Decimals

Multiply both numbers by 10 or 100 to get the numbers from a decimal to a whole number.  
 Divide using the bus stop method

## Chapter 9 - Transformations

### Transformations

- A transformation moves a shape to a new position.

### Reflection

- A reflection flips an object over a mirror line.
- You describe a reflection by stating the equation of the mirror line

### Rotation

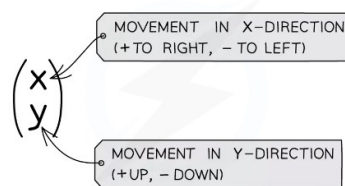
- A rotation turns an object about a point, this is called the centre of rotation.
- You describe a rotation by giving:
  - The centre of rotation
  - The angle of rotation
  - The direction of turn (clockwise or anticlockwise)

### Enlargement

- An enlargement changes the size of a shape from a point.
- You describe an enlargement by giving:
  - The scale factor
  - The centre of enlargement.

### Translation

- A translation slides an object.
- You describe a translation by giving the distance moved left or right and then up or down.
- Translations can be described using column vectors:



### Symmetry

- A line of symmetry divides a shape into two identical mirror images. If a shape has at least one line of symmetry it is said to have **reflectional symmetry**.
- A shape has **rotational symmetry** if it rotates onto itself more than once in a full turn. The number of times is called the **order of rotation**.

## Chapter 10 – Equations

### Solving equations

- To get a numerical answer for a letter
- You must do the same to both sides of the equation
- When moving terms across the equal sign, you must use the inverse operations:

Operation	Inverse Operation
+	-
-	+
x	÷
÷	x
Square	Square root
Square root	Square

### Method

#### Equations with unknowns on both sides.

- Expand any brackets
- Move all of the unknowns to one side
- Move all of the numbers to the other side
- Divide by the of unknowns to find what one unknown equals.

### Simultaneous Equations

- Equations solved at the same time to find more than one unknown.

#### Algebraic Method

- Multiply or divide the equations to make the same number of one of the unknowns. Add or subtract the equations to eliminate one variable.
- Solve this new equation for the unknown.
- Substitute back in and solve for the other unknown.

#### Graphical Method

- Plot the lines
- The solution is the point of intersection (where the lines cross).

### Inequalities

- Mathematic statements containing:
  - $<$  less than
  - $>$  greater than
  - $\leq$  less than or equal to
  - $\geq$  greater than or equal to
- Inequalities can be expressed on a number line:
  - Closed dot = equal to
  - Open dot = not equal to

# Chapter 11 – Powers and Roots

## Factors and Multiples

- A factor divides into a number without leaving any remainder
- A multiple of a number is any number in its times table

## Prime Numbers

Have **exactly two factors**  
 No other whole numbers, except **1** and **itself** divide into them  
 The first 5 prime numbers are 2, 3, 5, 7, 11,

## Highest Common Factor (HCF)

Write down all the factors from the numbers and find the biggest value on both lists – This is the **Highest Common Factor**

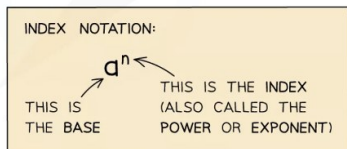
## Lowest Common Multiple (LCM)

Write down all the multiples of the two numbers and find the smallest on both lists – This is the **Lowest Common Multiple**

## Indices

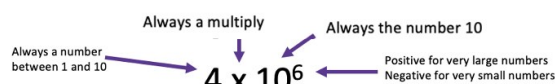
- $a^m \times a^n = a^{m+n}$
- $a^m \div a^n = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $(ab)^n = a^n b^n$
- $a^1 = a$
- $a^0 = 1$

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



## Standard Form

- A way of writing very big numbers (distances between planets) or very small numbers (measuring the size of atoms)
- Big numbers have a positive power
- Small numbers have a negative power



# Chapter 12 – Constructions and Triangles

**Pythagoras**

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

- Congruent and Similar Triangles**
- Congruent triangles have the same size and shape.
  - Similar triangles have been enlarged by a scale factor, but the angles have stayed the same.

<p>▶ <b>A perpendicular from a point to a line</b></p> <ol style="list-style-type: none"> <li>1 Draw arcs equidistant from P cutting the line at Q and S.</li> <li>2 Using Q and S as centres, draw arcs below the line that cross at R.</li> <li>3 Draw the line PR.</li> </ol>	<p>▶ <b>A perpendicular from a point on a line</b></p> <ol style="list-style-type: none"> <li>1 Draw arcs equidistant from P cutting the line at I and K.</li> <li>2 Using I and K as centres, draw arcs above and below the line that cross at J and L.</li> <li>3 Draw the line JL.</li> </ol>
<p>▶ <b>An angle bisector</b></p> <ol style="list-style-type: none"> <li>1 Draw arcs equidistant from O cutting OA and OB at Z and X.</li> <li>2 Using X and Z as centres, draw arcs that cross at Y.</li> <li>3 Draw the line OY.</li> </ol>	<p>▶ <b>A perpendicular bisector of a line</b></p> <ol style="list-style-type: none"> <li>1 Using A and B as centres, draw arcs above and below the line that cross at C and D.</li> <li>2 Draw the line CD.</li> </ol>

# Chapter 13 - Sequences

**Sequences Definitions**

- Each value in a sequence is called a term
- The term-to-term rule is a rule (often in words) used to find the next term
- The nth term is a general rule used to find any term in the sequence

A sequence is linear if the first difference is constant, and quadratic if the second difference is constant.

**Linear sequence**  
A number pattern with a common difference

## Chapter 14 – 3D Shapes and Trigonometry

### Terminology Shape

- Edge – Where 2 faces meet
- Vertices – Where 3 or more faces meet
- Face – side of a 3d shape
- Quadrilateral – a 4-sided polygon
- Polygon – a 2d shape with straight sides
- Cross-section – 2d shape of a prism
- Acute – an angle less than  $90^\circ$
- Obtuse – an angle between  $90^\circ$  and  $180^\circ$
- Reflex – an angle more than  $180^\circ$

### Surface Area

Total area of each face of the 3D shape

### Volume of Prisms

Volume is the space inside a 3D shape

Volume of Prism = cross sectional area x length

### Bearings

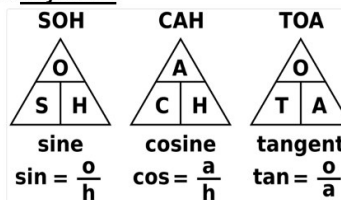
Used to give a direction from one point to another

A three-figure bearing is the angle:

- Measured from North
- Measured clockwise

### Right Angled Trigonometry

- The side opposite the right angle is called the hypotenuse
- The side opposite the given angle is called the opposite
- The side next to the given angle is called the adjacent



- Use the normal function for finding unknown sides
- Use the inverse function ( $\sin^{-1}$ ) for finding unknown angles

### Plans

The view from above

### Elevations

The view from the front or side

# Chapter 15 – Ratio and Proportion

### Ratio as a measure

A ratio is a comparison of parts.  
Use a colon (:) to separate parts of a ratio.  
Units must be the same.

### Dividing a given ratio

Find the total number of parts in the ratio.  
Divide the amount to be shared by the total parts.  
Multiply by each part of the ratio.

### Cancelling ratios

Divide the ratio by the highest common factor.

### Ratios to Fractions

If you and a friend share a a pie in the ratio 1:3 you get  $\frac{1}{4}$  of the pie.

### 1:n

Divide both values by the first value.  
Often used to compare different ratios.

### Direct Proportionality

Values that have a relationship with each other.  
As one variable goes up so does the other one, at the same rate.

### Inverse Proportionality

Values that have a relationship with each other.  
As one variable goes up, the other one goes down at the same rate.

Know More, Remember More, Understand and Apply



## Crucial Knowledge Simplifying a Ratio



<u>Crucial Knowledge</u>	<u>Remember More</u>
<p>Many ratios can be simplified by finding the <b>largest</b> number that divides <b>into</b> the numbers in the ratio</p>	<p>The ratio of red to blue dinosaurs is <b>12:18</b>. This ratio can be simplified. Both 12 and 18 can be divided by 6. <math>12 \div 6 = 2</math> <math>18 \div 6 = 3</math> So a simpler way to write 12:18 is <b>2:3</b></p>
<u>Understand and Apply</u>	
<p>Simplify the following ratios:</p> <p>a) 12:15      b) 25:20      c) 35:21      d) 18:30      e) 18:26</p>	



## Crucial Knowledge Sharing in a Ratio



<u>Crucial Knowledge</u>	<u>Remember More</u>
<p>Amounts can be shared in a ratio.</p> <p>£250 is shared in the ratio 3:2</p> <p>This means that the money is split into <b>5 parts</b> (3 parts for one person and 2 parts for the other)</p>	<p>Each part will be worth £50 (<math>£250 \div 5</math> <b>parts</b>)</p> <p>The person that receives 3 parts will get <math>3 \times £50 =</math> <b>£150</b></p> <p>The person that receives 2 parts will get <math>2 \times £50 =</math> <b>£100</b></p>
<u>Understand and Apply</u>	
<p>1) Share £350 in the ratio 2:5</p> <p>2) Share £450 in the ratio 5:4</p>	



## Crucial Knowledge Writing a Ratio



<u>Crucial Knowledge</u>	<u>Remember More</u>
<p>A ratio shows how much of one thing there is compared to another.</p> <p>Ratios are usually written in the form a:b</p>	<p>If you are making orange squash and you mix one part orange to four parts water:</p> <p>the ratio of orange to water will be <b>1:4</b> (1 to 4)</p>
<u>Understand and Apply</u>	
<p>If I want to make pink paint, I need to mix 3 cans of red paint with 2 cans of white paint. How will this be written as a ratio?</p>	



## Crucial Knowledge Dividing In A Given Ratio



Crucial Knowledge	Remember More
<p>The simple method of dividing in a given ratio is to:</p> <p>a) Add the ratios</p> <p>b) Divide the amount by the added ratios.</p> <p>c) Multiply each ratio part by step (b)</p> <p>d) Check your answers add to the original amount.</p>	<p>Share £400 in ratio 5:3</p> <p>a) <math>5 + 3 = 8</math></p> <p>b) <math>400 \div 8 = \text{£}50</math></p> <p>c) <math>5 \times \text{£}50 = \text{£}250</math>    <math>4 \times \text{£}50 = \text{£}200</math></p> <p>d) <math>\text{£}250 + \text{£}200</math> does make <math>\text{£}450</math></p>
<u>Understand and Apply</u>	
<p>1) Share £450 in the ratio 3:2</p> <p>2) Share £270 in the ratio 4:5</p> <p>3) Share £560 in the ratio 5: 3</p>	

## Probability

# Chapter 16 - Probability

### Probability Definitions

**Outcome** – A possible result of an experiment

**Event** – A set of outcomes

**Impossible** – An outcome that cannot happen

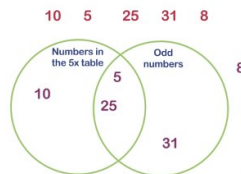
**Certain** – An event that must happen

**Independent** – If the outcome of one event does not affect what happens in another event

**Mutually Exclusive** – events that cannot happen at the same time

### Venn Diagrams

Sorts data into groups

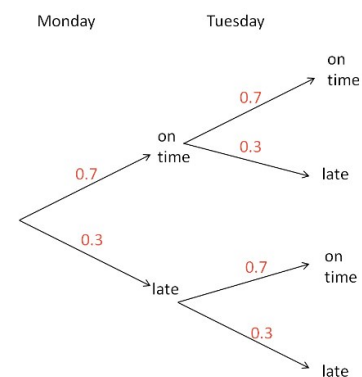


### Sample space diagrams

A list of all possible outcomes from an event

### Probability Trees

- Splits in branches add to 1
- Multiply probabilities along the branches
- Add multiple route probabilities



On time both days =  $0.7 \times 0.7 = 0.49$

### Probability and relative frequency

A list of all probabilities adds up to 1

Probabilities can be fractions, decimals or percentages

Relative frequency =  $\frac{\text{How often event happens}}{\text{Total outcomes}}$

## Chapter 17 - Circles

**Area and Circumference**

Circumference is distance around the circle

Area is space inside the circle (2D), measure in square units

Radius is the distance from the centre to the circumference

Diameter is the distance across the circle through the centre

$\pi$  (pi) is a Greek letter which represents the number value 3.1441592654.....

Circle Area =  $\pi \times \text{radius}^2$

Circumference =  $2\pi \times \text{radius}$

A semicircle is half a circle

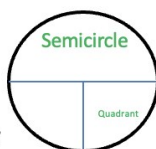
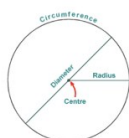
Its area is  $\frac{1}{2} \pi \times \text{radius}^2$

Its circumference is  $\frac{1}{2} \times 2\pi \times \text{radius}$

A quadrant is a quarter of a circle

Its area is  $\frac{1}{4} \times \text{radius}^2$

Its circumference is  $\frac{1}{4} \times 2\pi \times \text{radius}$

**Arcs and Sectors**

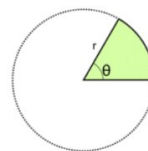
A sector is part of a circle  
It is made up of two Radii and an arc  
An arc is part of the circle edge

To find the arc length use

$\frac{\theta}{360} \times 2\pi \times \text{radius}$

To find the area sector use

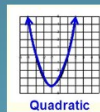
$\frac{\theta}{360} \times \pi \times \text{radius}^2$



## Chapter 18 - Quadratics

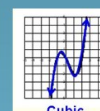
### Quadratic Graphs

Equations which contain powers of  $x$  greater than 1 (e.g.  $x^2$ ) produce curved lines



### Cubic Graphs

Equations which contain powers of  $x$  greater than 1 (e.g.  $x^3$ ) produce curved lines



### Quadratic Sequences

The  $n$ th term contains the term  $n^2$   
Format used is  $an^2 + bn + c$

### Factorising Quadratics

Factorising means writing a number or expression as a product of 2 factors. It is the inverse of expanding brackets.

## Chapter 19 - Vectors

### Vectors

A vector is a quantity that has a size (magnitude) and direction

A translation is a vector

Vectors can be multiplied by a scalar

A scalar is a number with size but no direction

## Bearings and Scale

### Chapter 20 – Bearings and Scale

#### Bearings

A bearing is given as an angle  
 It is always measured clockwise from North  
 They are always given using three figures  
 A back bearing is the direction of the return  
 Journey

#### Scale Drawings

A scale drawing is the same shape as the  
 original but a different size  
 The lengths are all in the same ratio  
 Scale drawings use a scale factor  
 A scale factor

## Further Trigonometry

### Chapter 21 – Further Trigonometry

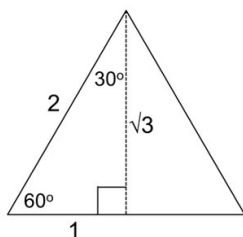
#### Exact Trigonometric Functions

Using exact values of some sines, cosines and  
 tangents avoids rounding errors.

	0°	30°	45°	60°	90°
sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
tan	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	Undefined

#### two famous triangles

an equilateral triangle



an isosceles, right-angled triangle

