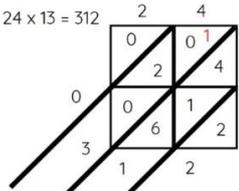
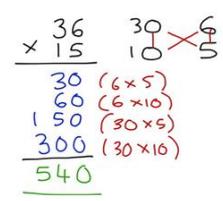


## Integers, Place Value and Decimals

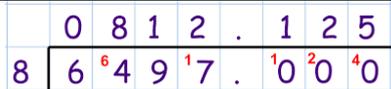
### Number Skills

|    |                |  |
|----|----------------|--|
| 1. | Addition       | To find the sum or total of two or more numbers.                                   |
| 2. | Subtraction    | To find the difference between two numbers.  |
| 3. | Multiplication | Repeated addition of a number. Also called 'product'                               |
| 4. | Division       | The process of calculating the number of times one number is contained in another. |
| 5. | Divisible      | Can be divided by a number without a remainder.                                    |

### Multiplication methods

|    |         |  |    |     |        |   |  |       |    |       |      |    |  |        |   |      |     |    |  |       |
|----|---------|--|----|-----|--------|---|--|-------|----|-------|------|----|--|--------|---|------|-----|----|--|-------|
| 6. | Lattice | $24 \times 13 = 312$<br>   |    |     |        |   |  |       |    |       |      |    |  |        |   |      |     |    |  |       |
| 7. | Grid    | <b>Eg) <math>574 \times 29</math></b><br><table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">500</td> <td style="text-align: center;">70</td> <td style="text-align: center;">4</td> <td></td> <td style="text-align: right;">11480</td> </tr> <tr> <td style="text-align: right;">20</td> <td style="border: 1px solid black; padding: 2px;">10000</td> <td style="border: 1px solid black; padding: 2px;">1400</td> <td style="border: 1px solid black; padding: 2px;">80</td> <td style="border: none;"></td> <td style="text-align: right;">+ 5166</td> </tr> <tr> <td style="text-align: right;">9</td> <td style="border: 1px solid black; padding: 2px;">4500</td> <td style="border: 1px solid black; padding: 2px;">630</td> <td style="border: 1px solid black; padding: 2px;">36</td> <td style="border: none;"></td> <td style="text-align: right; border-top: 1px solid black;">16646</td> </tr> </table> <p style="text-align: right; color: red; font-size: small;">Finished!</p> |    | 500 | 70     | 4 |  | 11480 | 20 | 10000 | 1400 | 80 |  | + 5166 | 9 | 4500 | 630 | 36 |  | 16646 |
|    | 500     | 70   | 4  |     | 11480  |   |  |       |    |       |      |    |  |        |   |      |     |    |  |       |
| 20 | 10000   | 1400   | 80 |     | + 5166 |   |  |       |    |       |      |    |  |        |   |      |     |    |  |       |
| 9  | 4500    | 630  | 36 |     | 16646  |   |  |       |    |       |      |    |  |        |   |      |     |    |  |       |
| 8. | Column  |   |    |     |        |   |  |       |    |       |      |    |  |        |   |      |     |    |  |       |

### Division methods

|    |       |  |
|----|-------|--|
| 9. | Short | e.g. $6497 \div 8$<br> |
|----|-------|--|

|     |      |                      |   |
|-----|------|----------------------|---|
| 10. | Long | e.g. $13032 \div 24$ | $  \begin{array}{r}  543 \\  24 \overline{)13032} \\  \underline{1-24} \phantom{00} \\  2-48 \phantom{00} \\  \underline{3-72} \phantom{00} \\  4-96 \phantom{00} \\  \underline{5-120} \phantom{00} \\  6-144 \phantom{00} \\  \underline{7-168} \phantom{00} \\  8-192 \phantom{00} \\  \underline{9-216} \phantom{00} \\  00  \end{array}  $ |
|-----|------|----------------------|---|

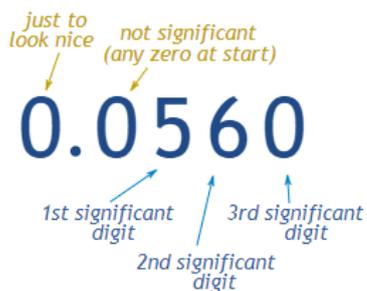
**Times Tables**

| x  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10  |
|----|----|----|----|----|----|----|----|----|----|-----|
| 1  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10  |
| 2  | 2  | 4  | 6  | 8  | 10 | 12 | 14 | 16 | 18 | 20  |
| 3  | 3  | 6  | 9  | 12 | 15 | 18 | 21 | 24 | 27 | 30  |
| 4  | 4  | 8  | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40  |
| 5  | 5  | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50  |
| 6  | 6  | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 60  |
| 7  | 7  | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70  |
| 8  | 8  | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80  |
| 9  | 9  | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 90  |
| 10 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

**Divisibility Rules**

|     |                       |  |
|-----|-----------------------|--|
| 11. | A number is divisible |  |
|     | by:                   | if:  |
|     | 2                     | The last digit is divisible by 2                         |
|     | 3                     | The sum of the digits is divisible by 3                  |
|     | 4                     | The number made by the last two digits is divisible by 4 |
|     | 5                     | The last digit is 5 or 0                                 |
|     | 6                     | The number is divisible by 2 and 3                       |
|     | 8                     | The number made by the last 3 digits is divisible by 8   |
|     | 9                     | The sum of its digits is divisible by 9                  |
|     | 10                    | The last digit is 0.                                     |

|            |                   |   |           |                   |               |           |                 |              |            |                 |                 |                    |            |                 |                    |            |            |  |  |  |  |  |  |   |              |  |  |  |  |  |
|------------|-------------------|---|-----------|-------------------|---------------|-----------|-----------------|--------------|------------|-----------------|-----------------|--------------------|------------|-----------------|--------------------|------------|------------|--|--|--|--|--|--|---|--------------|--|--|--|--|--|
| 12.        | Place value       | <p>The value of a digit based on its place in a number</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Millions</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Hundred Thousands</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Ten Thousands</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Thousands</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Hundreds</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Tens</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Ones</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Decimal point ↓</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Tenths</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Hundredths</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Thousandth</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Ten-Thousandths</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Hundred-Thousandth</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">Millionths</td> </tr> <tr> <td colspan="7" style="text-align: center;">Whole part</td> <td style="text-align: center;">•</td> <td colspan="6" style="text-align: center;">Decimal part</td> </tr> </table> | Millions  | Hundred Thousands | Ten Thousands | Thousands | Hundreds        | Tens         | Ones       | Decimal point ↓ | Tenths          | Hundredths         | Thousandth | Ten-Thousandths | Hundred-Thousandth | Millionths | Whole part |  |  |  |  |  |  | • | Decimal part |  |  |  |  |  |
| Millions   | Hundred Thousands | Ten Thousands   | Thousands | Hundreds          | Tens          | Ones      | Decimal point ↓ | Tenths       | Hundredths | Thousandth      | Ten-Thousandths | Hundred-Thousandth | Millionths |                 |                    |            |            |  |  |  |  |  |  |   |              |  |  |  |  |  |
| Whole part |                   |   |           |                   |               |           | •               | Decimal part |            |                 |                 |                    |            |                 |                    |            |            |  |  |  |  |  |  |   |              |  |  |  |  |  |

|                                   |                                 |   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
|-----------------------------------|---------------------------------|---|--|---------------------------------|-------------------------------|-----------------------------------|---------------------------------|-----------------------------------|---------------------------------|-----------------------------------|---------------------------------|
| 13.                               | Digit                           | <p>A single symbol used to make a number</p> <p>0, 1, 2, 3, 4, 5, 6, 7, 8, 9 are the ten digits we use every day.</p> |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 14.                               | Integer                         | A whole number that is can be positive, negative or zero.   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 15.                               | Negative number                 | A number that is less than zero.  |    |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 16.                               | Negative number rules           | When multipllying or dividing with numbers that include negative numbers to following applies:                        | <table border="0" style="width: 100%; text-align: center;"> <tr> <td><math>\oplus \times \oplus = \oplus</math></td> <td><math>\oplus \div \oplus = \oplus</math></td> </tr> <tr> <td><math>\oplus \times \ominus = \ominus</math></td> <td><math>\oplus \div \ominus = \ominus</math></td> </tr> <tr> <td><math>\ominus \times \oplus = \ominus</math></td> <td><math>\ominus \div \oplus = \ominus</math></td> </tr> <tr> <td><math>\ominus \times \ominus = \oplus</math></td> <td><math>\ominus \div \ominus = \oplus</math></td> </tr> </table> | $\oplus \times \oplus = \oplus$ | $\oplus \div \oplus = \oplus$ | $\oplus \times \ominus = \ominus$ | $\oplus \div \ominus = \ominus$ | $\ominus \times \oplus = \ominus$ | $\ominus \div \oplus = \ominus$ | $\ominus \times \ominus = \oplus$ | $\ominus \div \ominus = \oplus$ |
| $\oplus \times \oplus = \oplus$   | $\oplus \div \oplus = \oplus$   |   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| $\oplus \times \ominus = \ominus$ | $\oplus \div \ominus = \ominus$ |   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| $\ominus \times \oplus = \ominus$ | $\ominus \div \oplus = \ominus$ |   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| $\ominus \times \ominus = \oplus$ | $\ominus \div \ominus = \oplus$ |   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 17.                               | Ascending order                 | A set of numbers arranged from smallest to biggest.   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 18.                               | Descending order                | A set of numbers arranged from biggest to smallest.   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 19.                               | Decimal                         | A number with a decimal point in it, which can be negative or positive.   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 20.                               | Terminating decimal             | A decimal that has digits that end.   | <p>0.25 (it has two decimal digits)</p> <p>3.0375 (it has four decimal digits)</p>   |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 21.                               | Recurring decimal               | A decimal with a digit or groups of digits that repeat forever.   | <p><math>\frac{1}{3} = 0.333... = 0.\dot{3} = 0.\overline{3}</math></p> <p>Fraction      Ways to show recurring decimals</p>   |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 22.                               | Decimal place                   | The number of digits after the decimal point  |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 23.                               | Rounding                        | Changing a number to a simpler, easy to use value.  |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 24.                               | Approximate                     | An easier figure to use close to the value.   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| 25.                               | Significant figure              | The digits of a number that express a size to a given degree of accuracy  |   |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |
| Rounding to decimal places        |                                 |   |  |                                 |                               |                                   |                                 |                                   |                                 |                                   |                                 |

|     |   |  |
|-----|---|--|
| 26. | <ul style="list-style-type: none"> <li>Count the number of decimal places you need</li> <li>Look at the number directly to the right of that digit to decide if it rounds up or down</li> <li>5 or more means it rounds up; 4 or less means it rounds down</li> </ul> |  |
|-----|---|--|

|     |               |             |                      |
|-----|---------------|-------------|----------------------|
| 27. | e.g. 256.1873 | 256.1   873 | To 1 d.p. is 256.2   |
|     |               | 256.18   73 | To 2 d.p. is 256.19  |
|     |               | 256.187   3 | To 3 d.p. is 256.187 |

**Rounding large numbers to significant figures**

|     |  |  |
|-----|--|--|
| 28. | <ul style="list-style-type: none"> <li>Count the number of digits you need from the left</li> <li>Look at the number to the right of the digit to decide if it rounds up or down</li> <li>5 or more means it rounds up; 4 or less means it rounds down</li> <li>Replace remaining digits with zeros as placeholders</li> </ul> |  |
|-----|--|--|

|     |               |             |                  |
|-----|---------------|-------------|------------------|
| 29. | e.g. 256.1873 | 2   56.1873 | To 1 s.f. is 300 |
|     |               | 25   6.1873 | To 2 s.f. is 260 |
|     |               | 256   .1873 | To 3 s.f. is 256 |

**Rounding small numbers to significant figures**

|     |  |  |
|-----|--|--|
| 30. | <ul style="list-style-type: none"> <li>Zeros are not significant until after the first non-zero term</li> <li>Find the first non-zero term and count the number of digits you need from there</li> <li>Look at the number directly to the right of that digit to decide if it rounds up or down</li> <li>5 or more means it rounds up; 4 or less means it rounds down</li> </ul> |  |
|-----|--|--|

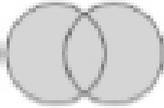
|    |                |              |                      |
|----|----------------|--------------|----------------------|
| 31 | e.g. 0.0023681 | 0.002   3681 | To 1 s.f. is 0.002   |
|    |                | 0.0023   681 | To 2 s.f. is 0.0024  |
|    |                | 0.00236   81 | To 3 s.f. is 0.00237 |

**Inequality notation**

|     |   |                          |
|-----|---|--------------------------|
| 32. | = | Equal to                 |
| 33. | ≠ | Not equal to             |
| 34. | < | Less than                |
| 35. | > | Greater than             |
| 36. | ≤ | Less than or equal to    |
| 37. | ≥ | Greater than or equal to |

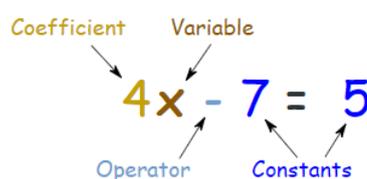
| Indices, powers and roots |                     |   |   |   |
|---------------------------|---------------------|---|---|---|
| 38.                       | Operations          | Symbols and words to show how to combine numbers.   |   |   |
|                           |                     | $\times$  | Multiply  | $+$ Add   |
|                           |                     | $\div$  | Divide  | $-$ Subtract  |
| 39.                       | Order of operations | The order in which operations should be carried out.  | B<br>I<br>DM<br>AS  | Brackets<br>Indices<br>Divide and Multiply<br>Add and Subtract  |
| 40.                       | Inverse operations  | The operation used to reverse the original operation  |   |   |
|                           |                     | $+$ and $-$ are inverse   | $\times$ and $\div$ are inverse   |   |
|                           |                     | Finding the square root is the inverse of finding the square of a number.   |   |   |
|                           |                     | Finding the cube root is the inverse of finding the cube of a number.   |   |   |
| 41.                       | Square numbers      | The product of a number multiplied by itself.   | 4   |  $2^2$ or $2 \times 2 = 4$ |
| 42.                       | Cube numbers        | The product of multiplying a number by itself three times   | $2^3 = 2 \times 2 \times 2 = 8$    |   |
| 43.                       | Square root         | A value that can be multiplied by itself to give the original number  | $\sqrt{1} = \pm 1$ $\sqrt{81} = \pm 9$<br>$\sqrt{4} = \pm 2$ $\sqrt{100} = \pm 10$<br>$\sqrt{9} = \pm 3$ $\sqrt{121} = \pm 11$<br>$\sqrt{16} = \pm 4$ $\sqrt{144} = \pm 12$<br>$\sqrt{25} = \pm 5$ $\sqrt{169} = \pm 13$<br>$\sqrt{36} = \pm 6$ $\sqrt{196} = \pm 14$<br>$\sqrt{49} = \pm 7$ $\sqrt{225} = \pm 15$<br>$\sqrt{64} = \pm 8$ |   |
| 44.                       | Cube root           | A value that can be multiplied by itself three times to give the original number                                      | $\sqrt[3]{1} = 1$ $\sqrt[3]{216} = 6$<br>$\sqrt[3]{8} = 2$ $\sqrt[3]{343} = 7$<br>$\sqrt[3]{27} = 3$ $\sqrt[3]{512} = 8$<br>$\sqrt[3]{64} = 4$ $\sqrt[3]{729} = 9$<br>$\sqrt[3]{125} = 5$ $\sqrt[3]{1000} = 10$   |   |
| 45.                       | Index               | A small number to the upper right of a base number that shows how many times the base number is multiplied by itself. |   |   |
| 46.                       | Power               | Another word for an index.  |   |   |

|                                      |                            |   |   |
|--------------------------------------|----------------------------|---|---|
| 47.                                  | Indices                    | The plural of index.  |   |
| 48.                                  | Index form                 | A number written to the power of an index.  |   |
| <b>Laws of indices</b>               |                            |   |   |
| 49.                                  | Multiplying                | Add the powers  | $x^7 \times x^6 = x^{13}$   |
| 50.                                  | Dividing                   | Subtract the powers   | $x^5 \div x^6 = x^{-1}$   |
| 51.                                  | Brackets                   | Multiply the powers   | $(x^2)^3 = x^6$   |
| 52.                                  | Power of 0                 | Always = 1  | $x^0 = 1$   |
| 53.                                  | Negative                   | Means "1 over"  | $x^{-n} = \frac{1}{x^n}$  |
| 54.                                  | Unit Fraction              | Means root  | $x^{\frac{1}{n}} = \sqrt[n]{x}$   |
| 55.                                  | Fractional                 | Means root and bracket  | $x^{\frac{a}{n}} = (\sqrt[n]{x})^a$   |
| <b>Factors, multiples and primes</b> |                            |   |   |
| 56.                                  | Multiple                   | The result of multiplying a number by an integer.   |   |
| 57.                                  | Factor                     | A number that divides into another number without a remainder.                                  |   |
| 58.                                  | Remainder                  | An amount left over after dividing.   |   |
| 59.                                  | Prime number               | A number with exactly two factors; 1 and itself.  |   |
|                                      |                            | 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97. |   |
| 60.                                  | Product                    | The answer when two or more numbers are multiplied together.                                    |   |
| 61.                                  | Prime factor decomposition | Writing a number as a product of its prime factors.   | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><math>60 = 2 \times 2 \times 3 \times 5</math><br/><math>60 = 2^2 \times 3 \times 5</math></p> </div> <div style="text-align: center;"> <p><math>72 = 2 \times 2 \times 2 \times 2 \times 3 \times 3</math><br/><math>72 = 2^4 \times 3^2</math></p> </div> </div> |
| 62.                                  | Highest common factor      | HCF   | <p>The highest number that divides exactly into two or more numbers.</p> <p>e.g. the HCF of 12 and 8 is 4</p>   |

|     |                        |     |  |                                |   |
|-----|------------------------|-----|--|--------------------------------|---|
| 63. | Lowest common multiple | LCM | The smallest positive integer that is a multiple of two or more numbers. | e.g. the LCM of 12 and 8 is 24 |  |
|-----|------------------------|-----|--|--------------------------------|---|

## Algebra: the basics

### Definitions

|     |             |   |   |
|-----|-------------|---|---|
| 1.  | Variable    | A letter representing a varying or unknown quantity.  |   |
| 2.  | Coefficient | A number which multiplies a variable e.g. 4 is the coefficient in $4a$                          |   |
| 3.  | Term        | One part of an expression/equation/formula  | e.g. $4c$<br>$\frac{w}{5}$  |
|     |             | Can involve multiplying and dividing coefficients and variables                                 |   |
|     |             | Separated from other terms by addition and subtraction  |   |
| 4.  | Like terms  | Terms that have the same variable but have different coefficients                               | e.g. $c + 4c$ are like terms<br><br>$c^2$ and $c^3$ are not like terms  |
| 5.  | Constant    | A fixed value.  |    |
|     |             | A number on its own or sometimes a letter such as $a$ , $b$ or $c$ to represent a fixed number. |   |
| 6.  | Expression  | One or a group of terms.  | e.g. $3y - 3$<br>$3y^2 + y^3$   |
|     |             | Can include variables, constants, operators and grouping symbols.                               |   |
|     |             | No 'equals' sign  |   |
| 7.  | Equation    | Contains an 'equals' sign, =  | e.g. $3y - 3 = 12$  |
|     |             | Has at least one variable   |   |
| 8.  | Formula     | A special type of equation that shows the relationship between a set of variables               |   |
| 9.  | Formulae    | Plural of 'formula'   |   |
| 10. | Identity    | An equation that is true no matter what values are chosen, $\equiv$                             | e.g. $3y \equiv 2y - y$ for any value of $y$ .  |
| 11. | Subject     | The variable on its own on one side of the equals sign.   |   |
| 12. | Substitute  | Replace a variable with a number.   | $a = 3, b = 2$ and $c = 5$ .<br><br><b>Find:</b><br>1. $2a = 2 \times 3 = 6$<br>2. $3a - 2b = 3 \times 3 - 2 \times 2 = 5$<br>3. $7b^2 - 5 = 7 \times 2^2 - 5 = 23$ |
| 13. | Simplify    | Minimising the size of an expression  |   |

|     |           |   |
|-----|-----------|---|
| 14. | Factorise | Splitting an expression into a product of factors |
| 15. | Expand    | Removing brackets by using multiplication         |
| 16. | Solve     | Find the value of an unknown                      |

### Algebraic Notation

|     |   |  |                              |
|-----|---|--|------------------------------|
| 17. | Adding like terms                             | Add the coefficients   | $b + 2b = 3b$                |
| 18. | Subtracting like terms                        | Subtract the coefficients  | $5b - 4b = b$                |
| 19. | Multiplying like terms                        | If the base is the same, add the powers  | $b \times b = b^2$           |
| 20. | Dividing terms                                | If the base is the same, subtract the powers                                   | $b^5 \div b^2 = b^3$         |
| 21. | Adding different terms                        | Cannot combine if the terms are different.                                     | $b + 2c = b + 2c$            |
| 22. | Subtracting different terms                   | Cannot combine if the terms are different.                                     | $3c - 4 = 3c - 4$            |
| 23. | Multiplying different terms                   | Combine with no '×' sign   | $d \times e = de$            |
| 24. | Multiplying different terms with coefficients | Combine with no '×' sign, multiply the coefficients                            | $2d \times 3e = d6e$         |
| 25. | Dividing different terms                      | Write as fractions with no '÷' sign  | $3d \div e = \frac{3d}{e}$   |
| 26. | Dividing different terms with coefficients    | Write as fractions with no '÷' sign, simplify the coefficients where possible. | $14d \div 7e = \frac{2d}{e}$ |

### Expanding (single brackets)

|     |  |  |  |
|-----|--|--|--|
| 27. | Multiply all the terms inside the bracket, by the term on the outside. |  |  |
| 28. | $3(a + 4) = 3a + 12$   | $\begin{array}{r} \times \\ 2x \end{array} \begin{array}{ c c } \hline 2x & -3 \\ \hline 4x^2 & -6x \\ \hline \end{array} = 4x^2 - 6x$ |  |

### Factorising (single brackets)

|     |  |                             |                             |
|-----|--|-----------------------------|-----------------------------|
| 29. | <ul style="list-style-type: none"> <li>Find the highest common factor of the terms</li> <li>This goes outside the bracket</li> <li>Divide each term by the factor to get the new terms inside the bracket</li> <li>Always check by expanding your bracket</li> </ul> | $2x + 4y$<br>$5x^2y - 10xy$ | $2(x + 2y)$<br>$5xy(x - 2)$ |
|-----|--|-----------------------------|-----------------------------|

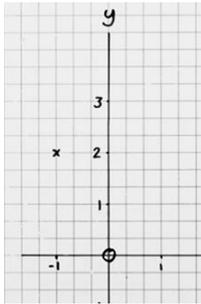
### Expressions

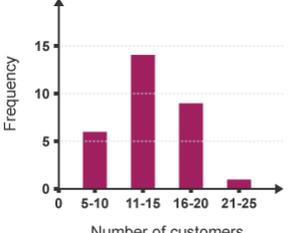
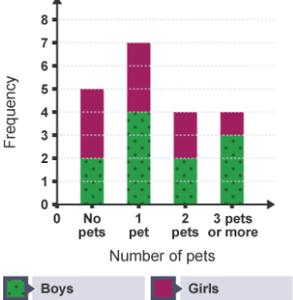
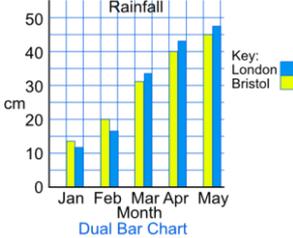
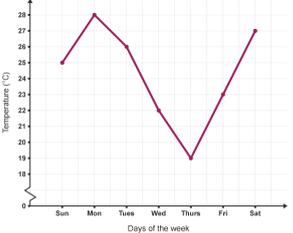
|     |           |  |                      |
|-----|-----------|--|----------------------|
| 30. | Linear    | Can be represented by a straight line      | e.g. $2x + 2$        |
|     |           | No indices above 1                         |                      |
| 31. | Quadratic | An expression where the highest index is 2 | e.g. $2x^2 + 2x + 2$ |

## 3a. TABLES

| 1    | TYPES OF DATA     |   |   |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|------|-------------------|---|---|---|-----------|-----------|-----|------|---|-------|------|---|------|-----|---|-------|----------|---|------|--------|---|
| 1a   | Qualitative Data  | Non-numerical data  | i.e. Colour of car  |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 1b   | Quantitative Data | Numerical data  | i.e. House number   |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 1c   | Discrete Data     | Numerical data that <u>CANNOT</u> be shown in decimals  | i.e. Number of children in a class  |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 1d   | Continuous Data   | Numerical data that <u>CAN</u> be shown in decimals   | i.e. The heights of children in a class   |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 1e   | Grouped Data      | Numerical data given in intervals   | i.e. Year group ranges:<br>Year 7-9    Year 10-11    Year 12-13   |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 2    | Data Collection   | Three Columns: <ul style="list-style-type: none"> <li>• Data values</li> <li>• Tally</li> <li>• Frequency (how many)</li> </ul> | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Colour of Car</th> <th style="width: 33%;">Tally</th> <th style="width: 33%;">Frequency</th> </tr> </thead> <tbody> <tr> <td>Red</td> <td>IIII</td> <td>4</td> </tr> <tr> <td>White</td> <td>IIII</td> <td>5</td> </tr> <tr> <td>Grey</td> <td>III</td> <td>3</td> </tr> <tr> <td>Black</td> <td>IIII III</td> <td>8</td> </tr> <tr> <td>Blue</td> <td>IIII I</td> <td>6</td> </tr> </tbody> </table> | Colour of Car   | Tally     | Frequency | Red | IIII | 4 | White | IIII | 5 | Grey | III | 3 | Black | IIII III | 8 | Blue | IIII I | 6 |
|      |                   |   | Colour of Car   | Tally   | Frequency |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   |   | Red   | IIII  | 4         |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   |   | White   | IIII  | 5         |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   |   | Grey  | III   | 3         |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   |   | Black   | IIII III  | 8         |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| Blue | IIII I            | 6   |   |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 3    | Mode              | Most popular (i.e. most common colour of car is Black)  |   |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 4a   | 24-hour clock     | 15:30   | Uses hours 00 (Midnight) to 23 (11 in the evening)  |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 4b   | 12-hour clock     | 03:30 pm  | Uses hours 01 to 12 with morning (AM) and afternoon/evening (PM)  |   |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
| 5    | Two-Way Tables    |   |   | Two-way tables are a way of sorting data with two categories. |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   |   | Boys  |   | Girls     | TOTAL     |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   | Pet   | 9   |   | 4         | 13        |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      |                   | No Pet  | 2   |   | 5         | 7         |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |
|      | TOTAL             | 11  | 9   | 20  |           |           |     |      |   |       |      |   |      |     |   |       |          |   |      |        |   |

## 3b. Charts and Graphs

|   |                 |   |  |
|---|-----------------|---|--|
| 6 | Plotting Points | <p>Co-ordinates show an exact position</p> <p><math>(x, y)</math></p> |  |
|---|-----------------|---|--|

| 7  | Pictograms   | <table border="1"> <thead> <tr> <th>Movie genre</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>Horror</td> <td></td> </tr> <tr> <td>Action</td> <td></td> </tr> <tr> <td>Romance</td> <td></td> </tr> <tr> <td>Comedy</td> <td></td> </tr> <tr> <td>Other</td> <td></td> </tr> </tbody> </table><br><table border="0"> <tr> <td> = 4 people</td> <td> = 3 people</td> </tr> <tr> <td> = 2 people</td> <td> = 1 person</td> </tr> </table> | Movie genre  | Frequency | Horror |  | Action |  | Romance |  | Comedy |  | Other |  |  = 4 people |  = 3 people |  = 2 people |  = 1 person | <p>Used to show frequencies</p> <p>Pictures and images used to represent frequency<br/>A key at the bottom helps you interpret the diagram</p> |
|--|--|---|--|-----------|--------|---|--------|---|---------|---|--------|---|-------|---|--|--|--|--|--|
| Movie genre  | Frequency  |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| Horror   |             |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| Action   |             |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| Romance  |             |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| Comedy   |             |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| Other  |             |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
|  = 4 people |  = 3 people |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
|  = 2 people |  = 1 person |   |  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| 8a   | Bar Charts   |    | <p>Frequency on the vertical axis, and categories along the horizontal axis.</p> <p>Used to compare frequencies</p>  |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| 8b   | Composite Bar Chart  |   | <p>Frequency on the vertical axis, and categories along the horizontal axis.</p> <p>Two shades used to show difference in proportion between sub-groups (i.e. gender)</p> <p>Used to compare frequencies within sub-groups</p>                     |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| 8c   | Comparative Bar Chart  |    | <p>Frequency on the vertical axis, and categories along the horizontal axis.</p> <p>Bars are next to each other and used to show difference in frequency between sub-groups (i.e. gender)</p> <p>Used to compare frequencies within sub-groups</p> |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |
| 9  | Line Graph   |    | <p>A line graph is used to show a change or relationship between two variables.</p> <p>Once the points are plotted, they are joined with straight lines.</p>   |           |        |   |        |   |         |   |        |   |       |   |  |  |  |  |  |

|    |             |  |   |
|----|-------------|--|---|
| 10 | Time-Series |  | <p>A time-series graph plots frequencies (vertical) axis against time (horizontal).</p> <p>It is used to spot trends over time.</p> <p>Time could be: weeks, months, quarters (3 months), years</p> |
|----|-------------|--|---|

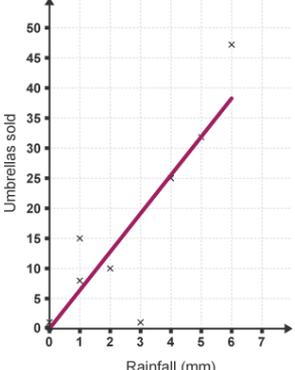
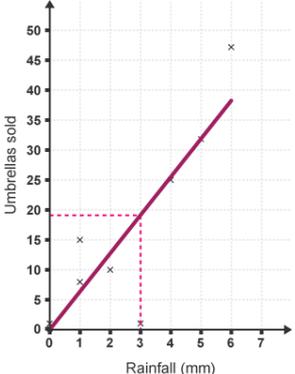
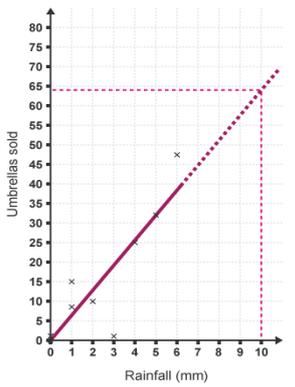
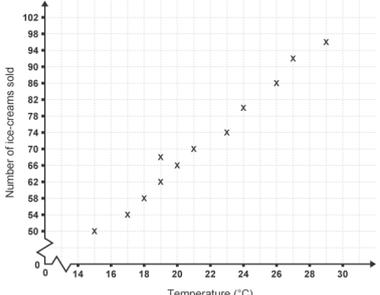
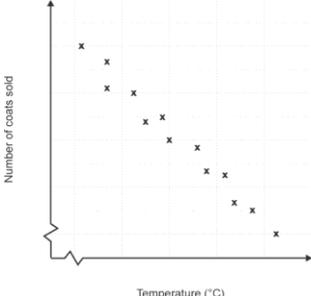
|    |                       |  |   |   |   |         |   |               |   |                 |   |         |   |
|----|-----------------------|--|---|---|---|---------|---|---------------|---|-----------------|---|---------|---|
| 11 | Stem & Leaf Diagrams: | <p>Key: 1   1 = 11 marks</p> <table border="1"> <tr><td>0</td><td>9</td></tr> <tr><td>1</td><td>1 6 7 8</td></tr> <tr><td>2</td><td>1 2 7 7 8 8 9</td></tr> <tr><td>3</td><td>0 0 1 5 6 7 8 9</td></tr> <tr><td>4</td><td>0 1 2 5</td></tr> </table> | 0 | 9 | 1 | 1 6 7 8 | 2 | 1 2 7 7 8 8 9 | 3 | 0 0 1 5 6 7 8 9 | 4 | 0 1 2 5 | <p>A stem and leaf diagram shows numbers in a table format. It can be a useful way to organise data to find the median, mode and range of a set of data.</p> <p>Only one digit is allowed to be a 'leaf'</p> <p>There should be a key to help you interpret the diagram</p> |
| 0  | 9                     |  |   |   |   |         |   |               |   |                 |   |         |   |
| 1  | 1 6 7 8               |  |   |   |   |         |   |               |   |                 |   |         |   |
| 2  | 1 2 7 7 8 8 9         |  |   |   |   |         |   |               |   |                 |   |         |   |
| 3  | 0 0 1 5 6 7 8 9       |  |   |   |   |         |   |               |   |                 |   |         |   |
| 4  | 0 1 2 5               |  |   |   |   |         |   |               |   |                 |   |         |   |

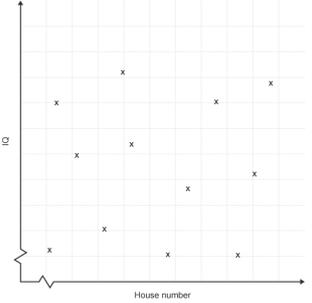
### 3c. Pie Charts

| 12                             | Pie Charts | <p>A pie chart is a chart represented by a circle. It shows the proportion of each group at a glance.</p> <table border="1"> <thead> <tr> <th>People travelling in a vehicle</th> <th>Frequency</th> <th>Calculation</th> <th>Angle</th> </tr> </thead> <tbody> <tr> <td>1 person</td> <td>120</td> <td><math>\frac{120}{180} \times 360^\circ</math></td> <td>240°</td> </tr> <tr> <td>2 people</td> <td>40</td> <td><math>\frac{40}{180} \times 360^\circ</math></td> <td>80°</td> </tr> <tr> <td>3 people</td> <td>13</td> <td><math>\frac{13}{180} \times 360^\circ</math></td> <td>24°</td> </tr> <tr> <td>4 people</td> <td>5</td> <td><math>\frac{5}{180} \times 360^\circ</math></td> <td>10°</td> </tr> <tr> <td>5 or more</td> <td>2</td> <td><math>\frac{2}{180} \times 360^\circ</math></td> <td>4°</td> </tr> <tr> <td>Total</td> <td>180</td> <td></td> <td></td> </tr> </tbody> </table> <p>To find the angle: <math>\frac{\text{frequency}}{\text{total}} \times 360^\circ</math></p> | People travelling in a vehicle | Frequency | Calculation | Angle | 1 person | 120 | $\frac{120}{180} \times 360^\circ$ | 240° | 2 people | 40 | $\frac{40}{180} \times 360^\circ$ | 80° | 3 people | 13 | $\frac{13}{180} \times 360^\circ$ | 24° | 4 people | 5 | $\frac{5}{180} \times 360^\circ$ | 10° | 5 or more | 2 | $\frac{2}{180} \times 360^\circ$ | 4° | Total | 180 |  |  |
|--------------------------------|------------|---|--------------------------------|-----------|-------------|-------|----------|-----|------------------------------------|------|----------|----|-----------------------------------|-----|----------|----|-----------------------------------|-----|----------|---|----------------------------------|-----|-----------|---|----------------------------------|----|-------|-----|--|--|
| People travelling in a vehicle | Frequency  | Calculation   | Angle                          |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |
| 1 person                       | 120        | $\frac{120}{180} \times 360^\circ$  | 240°                           |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |
| 2 people                       | 40         | $\frac{40}{180} \times 360^\circ$   | 80°                            |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |
| 3 people                       | 13         | $\frac{13}{180} \times 360^\circ$   | 24°                            |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |
| 4 people                       | 5          | $\frac{5}{180} \times 360^\circ$  | 10°                            |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |
| 5 or more                      | 2          | $\frac{2}{180} \times 360^\circ$  | 4°                             |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |
| Total                          | 180        |   |                                |           |             |       |          |     |                                    |      |          |    |                                   |     |          |    |                                   |     |          |   |                                  |     |           |   |                                  |    |       |     |  |  |

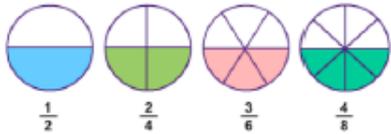
### 3d. SCATTER GRAPHS

|    |          |  |  |
|----|----------|--|--|
| 13 | Outliers |  | <p>Outliers don't follow the trend</p> |
|----|----------|--|--|

|     |                      |   |  |  |
|-----|----------------------|---|--|--|
| 14  | Line of Best Fit     |    | <p>A sensible straight line that goes as centrally as possible through the points plotted.</p> <p>It should also follow the same steepness of the crosses.</p>   |  |
| 15  | Interpolate          |    | <p>Using a line of best fit to estimate data <u>WITHIN</u> our range</p> <p><u>For example:</u> To estimate how many umbrellas are sold with 3mm rain.</p> <ul style="list-style-type: none"> <li>• Find where 3 mm of rainfall is on the graph.</li> <li>• Draw a line by going across from 3 mm and then down.</li> </ul>  |  |
| 16  | Extrapolate          |   | <p>Continuing a line of best fit to estimate data <u>BEYOND</u> our range (not as reliable as interpolation)</p> <p><u>For example:</u> To estimate how many umbrellas are sold with 10mm rain.</p> <ul style="list-style-type: none"> <li>• Continue the line of best fit.</li> <li>• Find where 10mm of rainfall is on the graph.</li> <li>• Draw a line by going across from 10mm and then down.</li> </ul> |  |
| 17a | Positive Correlation |  | <p><b>BOTH</b> variables increase with each other</p>  | <p>i.e. Ice creams sold vs Temperature</p> |
| 17b | Negative Correlation |  | <p><b>ONE</b> variable increases as the other decreases</p>  | <p>i.e. Coats sold vs temperature</p>      |

|     |                |  |                                   |                          |
|-----|----------------|--|-----------------------------------|--------------------------|
| 17c | No Correlation |   | NO relationship between variables | i.e. IQ and House Number |
| 18  | Causation      | <p>If one variable causes a change in the other.</p> <ul style="list-style-type: none"> <li>• i.e. an increase temperature <u>WILL</u> cause an increase ice cream sales</li> <li>• i.e. the number of bee stings <u>WILL NOT</u> cause an increase in ice cream sales (although both will increase in hot weather)</li> </ul> |                                   |                          |

## Fractions

|    |                      |   |   |
|----|----------------------|---|---|
| 1. | Fraction             | Part of a whole   |   |
| 2. | Numerator            | The number on the top of the fraction                             | $\frac{\text{numerator}}{\text{denominator}}$                                       |
| 3. | Denominator          | The number on the bottom of the fraction                          |   |
| 4. | Equivalent fractions | Fractions that have the same value but look different.            |  |
| 5. | Improper fraction    | A fraction where the numerator is larger than the denominator.    | e.g. $\frac{4}{3}$  |
| 6. | Mixed number         | A number made from integer and fraction parts.                    | e.g. $2\frac{2}{3}$   |
| 7. | Unit fraction        | A fraction that has a numerator of 1                              |   |
| 8. | Reciprocal           | The reciprocal of a number is 1 divided by the number.            | e.g. the reciprocal of 3 is $\frac{1}{3}$   |
|    |                      | Dividing by a number is the same as multiplying by its reciprocal | e.g. $\times$ by $\frac{1}{3}$ is the same as $\div$ by 3                           |

## Fractions - processes

|     |                              |  |   |
|-----|------------------------------|--|---|
| 9.  | Simplifying fractions        | Divide the numerator and denominator by the HCF.   | $\frac{24}{30} = \frac{4}{5}$   |
| 10. | Finding equivalent fractions | Multiply the numerator and denominator by the same number  | $\frac{4}{8} \times 2 = \frac{8}{16}$   |
| 11. | Comparing fractions          | Write them with a common denominator   |   |
| 12. | Fraction of an amount        | Amount divided by the denominator then multiplied by the numerator   | e.g. $\frac{5}{7}$ of 42<br>$42 \div 7 \times 5 = 30$   |
| 13. | Multiply fractions           | Multiply the numerators and multiply the denominators  | $\frac{6}{7} \times \frac{4}{5} = \frac{6 \times 4}{7 \times 5} = \frac{24}{35}$                                |
| 14. | Divide fractions             | <ul style="list-style-type: none"> <li>Flip the second fraction (find the reciprocal).</li> <li>Change the divide to multiply.</li> <li>Multiply the fractions.</li> </ul> | $\frac{4}{7} \div \frac{5}{6} = \frac{4}{7} \times \frac{6}{5} = \frac{4 \times 6}{7 \times 5} = \frac{24}{35}$ |

|     |   |   |  |
|-----|---|---|--|
| 15. | Add or subtract fractions                   | <ul style="list-style-type: none"> <li>Write as fractions with a common denominator.</li> <li>Add or subtract the numerators</li> </ul>   | $\frac{2}{8} + \frac{1}{6} = \frac{6}{24} + \frac{4}{24} = \frac{10}{24} = \frac{5}{12}$ |
| 16. | Convert improper fractions to mixed numbers | <ul style="list-style-type: none"> <li>Divide the numerator by the denominator</li> <li>The answer gives the whole number part.</li> <li>The remainder becomes the numerator of the fraction part with the same denominator.</li> </ul> | $\frac{43}{6} = 7\frac{1}{6}$  |
| 17. | Convert mixed numbers to improper fractions | <ul style="list-style-type: none"> <li>Multiply the denominator by the whole number part.</li> <li>Add the numerator to this.</li> <li>Put the answer to this back over the denominator</li> </ul>                                      | $7\frac{1}{6} = \frac{6 \times 7 + 1}{6} = \frac{43}{6}$                                 |

## Percentages

|     |   |  |   |
|-----|---|--|---|
| 18. | Percentage                                    | Means 'out of 100'   |   |
| 19. | Multiplier                                    | A decimal you multiply by to represent a percentage  |   |
|     |   | To use a multiplier to find a percentage, divide your percentage by 100, then multiply the amount by this value.               |   |
| 20. | Percentage increase                           | Calculate the percentage and add onto the original   |   |
|     |   | Or use a multiplier  | $amount \times \frac{100 + \% \text{ increase}}{100}$ |
| 21. | Percentage decrease                           | Calculate the percentage and subtract from the original  |   |
|     |   | Or use a multiplier  | $amount \times \frac{100 - \% \text{ increase}}{100}$ |
| 22. | Percentage change                             | $\frac{\text{Change}}{\text{Original}} \times 100$   |   |
| 23. | Express one number as a percentage of another | $\frac{\text{Number 1}}{\text{Number 2}} \times 100$   |   |
| 24. | Reverse percentage                            | Use when asked to find the original amount after a percentage increase or decrease.  |   |
|     |   | <p>Original Value x Multiplier = New Value</p> <p>Original Value = <math>\frac{\text{New Value}}{\text{Multiplier}}</math></p> |   |
| 25. | Interest                                      | A fee paid for borrowing money or money earned through investing.  |   |

|                           |                        |  |   |               |               |               |               |               |               |               |
|---------------------------|------------------------|--|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 26.                       | Simple interest        | Interest that is calculated as a percentage of the original                            | $I = Prt$<br>I – Interest<br>P – Original amount<br>r – interest rate<br>t – time   |               |               |               |               |               |               |               |
| 27.                       | Compound interest      | When interest is calculate on the original amount and any previous interest            | $P \left( 1 + \frac{R}{100} \right)^n$<br>P – Original amount<br>R – Interest rate<br>n – the number of interest periods (e.g. yrs) |               |               |               |               |               |               |               |
|                           |                        | OR<br><i>Original × Multiplier<sup>time</sup></i>                                      |   |               |               |               |               |               |               |               |
| 28.                       | Tax                    | A financial charge placed on sales or savings by the government e.g. VAT               |   |               |               |               |               |               |               |               |
| 29.                       | Loss                   | Income minus all expenses, resulting in a negative value                               |   |               |               |               |               |               |               |               |
| 30.                       | Profit                 | Income minus all expenses, resulting in a positive value                               |   |               |               |               |               |               |               |               |
| 31.                       | Depreciation           | A reduction in the value of a product over time  |   |               |               |               |               |               |               |               |
| 32.                       | Annual                 | Means yearly   |   |               |               |               |               |               |               |               |
| 33.                       | Per annum              | Means per year   |   |               |               |               |               |               |               |               |
| 34.                       | Salary                 | A fixed regular payment, often paid monthly  |   |               |               |               |               |               |               |               |
| <b>FDP Conversions</b>    |                        |  |   |               |               |               |               |               |               |               |
| 35.                       | Percentage to decimal  | Divide by 100  |   |               |               |               |               |               |               |               |
| 36.                       | Decimal to percentage  | Multiply by 100  |   |               |               |               |               |               |               |               |
| 37.                       | Fraction to percentage | Find an equivalent fraction with 100 as the denominator                                |   |               |               |               |               |               |               |               |
| 38.                       | Percentage to fraction | Write as a fraction over 100 then simplify   |   |               |               |               |               |               |               |               |
| 39.                       | Fraction to decimal    | Carry out division or convert to a percentage first                                    |   |               |               |               |               |               |               |               |
| 40.                       | Decimal to fraction    | Use place value to find the denominator and simplify or convert to a percentage first. |   |               |               |               |               |               |               |               |
| <b>Basics to memorise</b> |                        |  |   |               |               |               |               |               |               |               |
| 41.                       | Fraction               | $\frac{1}{100}$  | $\frac{1}{10}$  | $\frac{1}{8}$ | $\frac{1}{5}$ | $\frac{1}{4}$ | $\frac{1}{3}$ | $\frac{1}{2}$ | $\frac{2}{3}$ | $\frac{3}{4}$ |
|                           | Decimal                | 0.01   | 0.1   | 0.125         | 0.2           | 0.25          | 0.3̇          | 0.5           | 0.6̇          | 0.75          |
|                           | Percentage             | 1%   | 10%   | 12.5%         | 20%           | 25%           | 33.3̇%        | 50%           | 66.7̇%        | 75%           |

## Equations

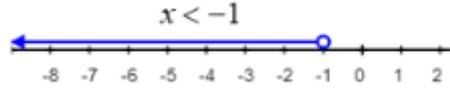
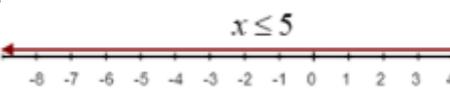
|    |                    |   |  |
|----|--------------------|---|--|
| 1. | Equation           | Contains an 'equals' sign   | e.g. $3y - 3 = 12$                             |
|    |                    | Has at least one variable   |  |
| 2. | Linear             | Produces a straight line graph  |  |
|    |                    | No indices above 1  |  |
| 3. | Term               | One part of an expression/equation/formula  | e.g. $4c$                                      |
|    |                    | Can involve multiplying and dividing coefficients and variables                   | $\frac{w}{5}$                                  |
|    |                    | Separated from other terms by addition and subtraction                            |  |
| 4. | Expression         | One or a group of terms.  | e.g. $3y - 3$                                  |
|    |                    | Can include variables, constants, operators and grouping symbols.                 | $3y^2 + y^3$                                   |
|    |                    | No 'equals' sign  |  |
| 5. | Formula            | A special type of equation that shows the relationship between a set of variables |  |
| 6. | Identity           | An equation that is true no matter what values are chosen, $\equiv$               | e.g. $3y \equiv 2y - y$ for any value of $y$ . |
| 7. | Unknown            | A letter representing a number  |  |
| 8. | Solve              | TO find the value of the unknown  |  |
| 9. | Inverse operations | The operation used to reverse the original operation                              |  |
|    |                    | + and - are inverse   | $\times$ and $\div$ are inverse                |
|    |                    | Finding the square root is the inverse of finding the square of a number.         |  |
|    |                    | Finding the cube root is the inverse of finding the cube of a number.             |  |

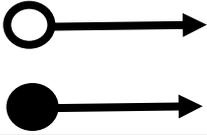
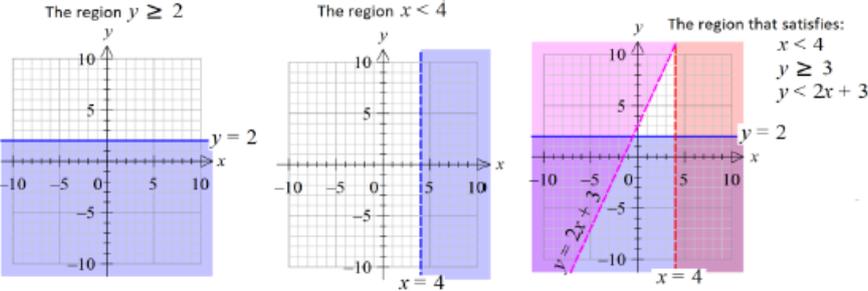
## Solving equations

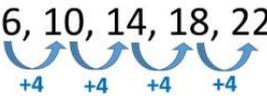
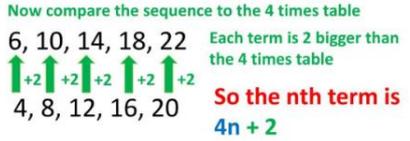
|                               |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
|-------------------------------|---|--|-------------|-------------------|----------|---|--------------|-------------------|----------|---|-----------|---------------------------|---------|--|-------------------|-------------------------------|----------|
| 10.                           | To solve equations we need to use inverse operations                              |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| 11.                           | What ever you do to one side of the equals sign you must do the same to the other |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| 12.                           | One step  | <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><math>x + 4 = 7</math></td></tr> <tr><td><math>(-4) \quad (-4)</math></td></tr> <tr><td><math>x = 11</math></td></tr> </table> | $x + 4 = 7$ | $(-4) \quad (-4)$ | $x = 11$ | <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><math>x - 5 = 12</math></td></tr> <tr><td><math>(+5) \quad (+5)</math></td></tr> <tr><td><math>x = 17</math></td></tr> </table> | $x - 5 = 12$ | $(+5) \quad (+5)$ | $x = 17$ | <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><math>3x = 18</math></td></tr> <tr><td><math>(\div 3) \quad (\div 3)</math></td></tr> <tr><td><math>x = 1</math></td></tr> </table> | $3x = 18$ | $(\div 3) \quad (\div 3)$ | $x = 1$ | <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><math>\frac{x}{4} = 6</math></td></tr> <tr><td><math>(\times 4) \quad (\times 4)</math></td></tr> <tr><td><math>x = 24</math></td></tr> </table> | $\frac{x}{4} = 6$ | $(\times 4) \quad (\times 4)$ | $x = 24$ |
| $x + 4 = 7$                   |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $(-4) \quad (-4)$             |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $x = 11$                      |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $x - 5 = 12$                  |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $(+5) \quad (+5)$             |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $x = 17$                      |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $3x = 18$                     |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $(\div 3) \quad (\div 3)$     |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $x = 1$                       |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $\frac{x}{4} = 6$             |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $(\times 4) \quad (\times 4)$ |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |
| $x = 24$                      |   |  |             |                   |          |   |              |                   |          |   |           |                           |         |  |                   |                               |          |

|     |                        |  |  |
|-----|------------------------|--|--|
| 13. | Two step               | Requires the use of two inverse operations   | $2x - 7 = 19$ $2x = 26$ $x = 13$   |
| 14. | With brackets          | Expand the brackets first<br>$5(2x + 1) = 35$ $10x + 5 = 35$ $10x = 30$ $x = 3$  | OR if possible divide by the number outside of the bracket first<br>$4(2x + 4) = 20$ $2x + 4 = 5$ $2x = 1$ $x = \frac{1}{2}$ |
| 15. | Unknowns on both sides | Start by eliminating the unknown from one of the signs.  | $5x + 2 = 3x - 8$ $2x + 2 = -8$ $2x = -10$ $x = -5$  |
| 16. | With fractions         | Eliminate any terms that are being added or subtracted separate from the fraction first.<br>$\frac{f}{5} + 2 = 8$ $\frac{f}{5} = 6$ $f = 30$ | If everything is part of the fraction then multiply by the denominator first.<br>$\frac{f + 2}{5} = 8$ $f + 2 = 40$ $f = 38$ |

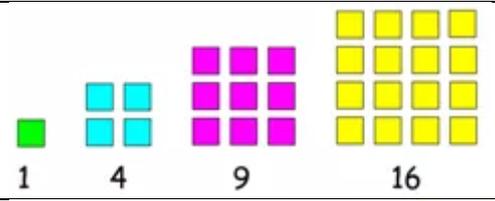
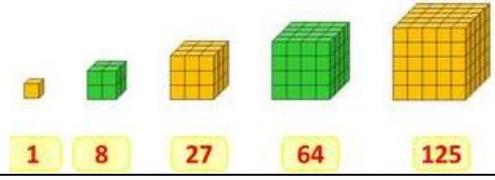
## Inequalities

|     |            |   |   |
|-----|------------|---|---|
| 17. | Inequality | The relationship between two expressions that are not equal |   |
| 18. | =          | Equal to  |   |
| 19. | ≠          | Not equal to  |   |
| 20. | <          | Less than   |  <p>A number line from -8 to 2 with an open circle at -1 and a blue arrow pointing to the left.</p>    |
| 21. | >          | Greater than  |  <p>A number line from -1 to 11 with an open circle at 5 and a purple arrow pointing to the right.</p> |
| 22. | ≤          | Less than or equal to                                       |  <p>A number line from -8 to 4 with a closed circle at 5 and a red arrow pointing to the left.</p>     |
| 23. | ≥          | Greater than or equal to                                    |  <p>A number line from -1 to 11 with a closed circle at 3 and a green arrow pointing to the right.</p> |

|                  |                            |  |   |
|------------------|----------------------------|--|---|
| 24.              | Inclusive                  | Gives a finite range of solutions  | e.g. $3 < x \leq 8$   |
| 25.              | Exclusive                  | Gives an infinite range of solutions   | e.g. $x > 5$ $-4 \leq x$  |
| 26.              | Integer                    | A whole number that can be positive negative or zero   |   |
| 27.              | Solve                      | Inequalities are solved in the same way as solving equations   |   |
|                  |                            | Only exception: if you multiply or divide by a negative number you must swap the sign e.g. less than to greater than         |   |
| 28.              | List integers solutions    | Give the integers that satisfy the inequality  |   |
|                  |                            | e.g. $x > 6$ integer solutions are 6, 7, 8...  |   |
|                  |                            | e.g. $-5 < x \leq 5$ integer solutions are -4, -3, -2, -1, 0, 1, 2, 3, 4, 5  |   |
| 29.              | Represent on a number line | An empty circle shows the value is not included  |    |
|                  |                            | A shaded circle shows the value is included  |    |
|                  |                            | An arrow shows that the solution continues to infinity   |  |
| 30.              | Inequalities on graphs     |  <p>The unwanted sections are shaded</p> |   |
|                  |                            | Dashed lines are used to represent $<$ or $>$  |   |
|                  |                            | Solid line is used to represent $\leq$ or $\geq$   |   |
| <b>Sequences</b> |                            |  |   |
| 31.              | Sequence                   | An order pattern of numbers or diagrams  |   |
| 32.              | Term                       | One of the numbers or diagrams in a sequence   |   |
| 33.              | Term to term rule          | The rule for moving from one term to the next in a sequence  |   |
| 34.              | Formula                    | A rule written to describe a relationship between two quantities   |   |
| 35.              | Arithmetic sequence        | A sequence where the term to term rule is to add or subtract the same amount each time                                       |   |

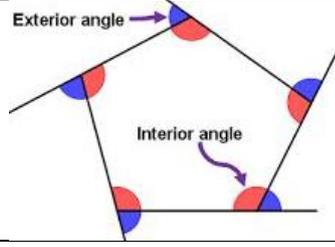
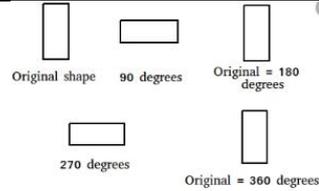
|     |   |  |
|-----|---|--|
| 36. | Quadratic sequence                          | A sequence where the term to term rule is changing by the same amount each time<br>The second difference is a constant amount.   |
| 37. | Geometric sequence                          | A sequence where the term to term rule is to multiply by the same amount each time   |
| 38. | Common ratio                                | The value a geometric sequence is multiplied by from one term to the next<br>Denoted by the letter $r$   |
| 39. | Series                                      | The sum of the terms in a sequence   |
| 40. | Position to term rule                       | The rule for finding any value of a sequence   |
| 41. | $n$ th term rule for an arithmetic sequence | <p>The rule to find any term in a sequence of numbers</p> <ul style="list-style-type: none"> <li>Find the common difference between the terms</li> <li>This becomes your coefficient of <math>n</math> (this is the times table the sequence is linked to)</li> <li>The number you need to add or subtract to get to the second term becomes the second term in the <math>n</math>th term rule</li> </ul> <p>  <b>6, 10, 14, 18, 22</b> The sequence increases by 4, so the <math>n</math>th term starts with <math>4n</math> </p> <p>  Now compare the sequence to the 4 times table<br/> 6, 10, 14, 18, 22 Each term is 2 bigger than the 4 times table<br/> 4, 8, 12, 16, 20 So the <math>n</math>th term is <math>4n + 2</math> </p> |
| 42. | $n$ th term for a geometric sequence        | <ul style="list-style-type: none"> <li>Divide the second sequence by the first to find the common ratio, <math>r</math></li> <li>The <math>n</math>th term is <math>ar^{n-1}</math> where <math>a</math> is the first term and <math>n</math> is the term position in the sequence</li> </ul>  |
| 43. | Finite                                      | Has a final point  |
| 44. | Infinite                                    | Carries on forever   |
| 45. | Ascending                                   | Increases  |
| 46. | Descending                                  | Decreases  |
| 47. | Linear function                             | An arithmetic sequence that can be represented by a straight line graph  |

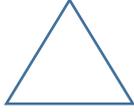
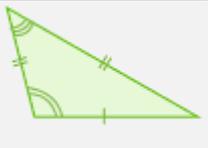
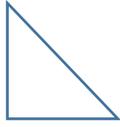
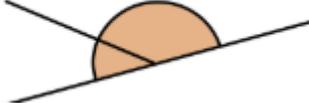
### Special Sequences

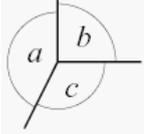
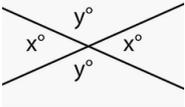
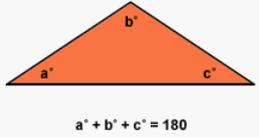
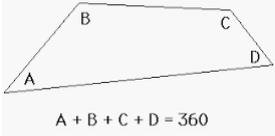
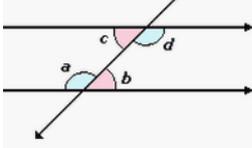
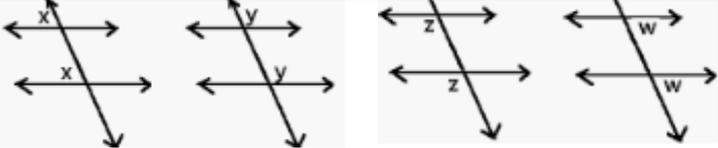
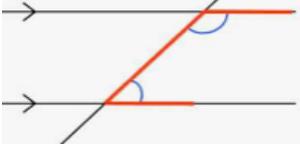
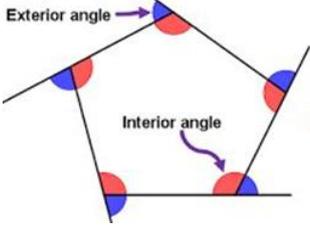
|     |                |                                      |   |
|-----|----------------|--------------------------------------|---|
| 48. | Square numbers | 1, 4, 9, 16, 25, 36, 49, 64, 81, 100 |  |
| 49. | Cube numbers   | 1, 8, 27, 64, 125                    |  |

|     |                    |  |   |
|-----|--------------------|--|---|
| 50. | Triangular numbers | 1, 3, 6, 10, 15, 21, 28  |  |
| 51. | Fibonacci sequence | <p>A sequence where each term is the sum of the two previous terms</p> <p>e.g. 1, 1, 2, 3, 5, 8, 13, 21...</p> |   |

### Shapes and angles - definitions

|     |                     |   |  |
|-----|---------------------|---|--|
| 1.  | Angle               | A measure of turn, measured in degrees °  |  |
| 2.  | Protractor          | Instrument used to measure the size of an angle   |  |
| 3.  | Acute angle         | An angle less than 90°  |  |
| 4.  | Right angle         | A 90° angle   |  |
| 5.  | Obtuse angle        | An angle more than 90° but less than 180°   |  |
| 6.  | Reflex angle        | An angle more than 180°   |  |
| 7.  | Parallel lines      | Lines that are equal distance apart that will never meet even when extended   |  |
| 8.  | Perpendicular lines | Lines that intersect at a right angle   |  |
| 9.  | Polygon             | A 2D shape with straight lines only   |  |
| 10. | Regular polygon     | A polygon where:<br>All sides are the same length<br>All angles are the same size   |  |
| 11. | Interior angles (I) | An angle inside a polygon   |  <p>For any polygon:<br/><math>I + E = 180^0</math></p>                 |
| 12. | Exterior angles (E) | An angle outside a polygon  |  |
| 13. | Congruent           | Shapes that are the same shapes and size, they are identical.   |  |
| 14. | Similar             | Shapes that are the same shape but are different sizes  |  |
| 15. | Bisect              | Cut in half   |  |
| 16. | Tessellate          | Fit together without leaving gaps   |  |
| 17. | Symmetry            | A shape has symmetry if a central line is drawn to show both sides are exactly the same.<br><br>We call these lines of symmetry |   |
| 18. | Rotational symmetry | A shape has rotational symmetry when it looks the same after some rotation of less than a full turn                             |  <p style="text-align: center;">Order of rotational symmetry of 2</p> |

| Quadrilaterals (4 sided shapes) |                                       |   |  |  |
|---------------------------------|---------------------------------------|---|--|--|
| 19.                             | Square                                |    | 4 equal sides<br>4 equal angles<br>2 pairs of parallel sides<br>Diagonals cross at right angles                  | 4 lines symmetry<br>Rotational symmetry order 4    |
| 20.                             | Rectangle                             |    | 2 pairs of equal sides<br>4 right angles<br>3 pairs of parallel sides  | 2 lines of symmetry<br>Rotational symmetry order 2 |
| 21.                             | Rhombus                               |    | 4 equal sides<br>2 pairs of equal angles<br>2 pairs of parallel sides<br>Diagonals cross at right angles         | 2 lines of symmetry<br>Rotational symmetry order 2 |
| 22.                             | Parallelogram                         |    | 2 pairs of equal sides<br>2 pairs of equal angles<br>2 pairs of parallel sides                                   | 0 lines of symmetry<br>Rotational symmetry order 2 |
| 23.                             | Kite                                  |    | 2 pairs of equal sides<br>1 pair of equal angles<br>2 pairs of parallel sides<br>Diagonals cross at right angles | 1 line of symmetry<br>Rotational symmetry order 1  |
| 24.                             | Trapezium                             |    | One pair of parallel lines   |  |
| 25.                             | Isosceles trapezium                   |  | 1 pair of parallel sides<br>1 pair of equal sides<br>2 pairs of equal angles                                     | 1 line of symmetry<br>Rotational symmetry order 1  |
| Triangles (3 sided shapes)      |                                       |   |  |  |
| 26.                             | Equilateral                           |  | 3 equal sides<br>3 equal angles  | 3 lines of symmetry<br>Rotational symmetry order 3 |
| 27.                             | Isosceles                             |  | 2 equal sides<br>2 equal angles  | 1 line of symmetry<br>Rotational symmetry order 1  |
| 28.                             | Scalene                               |  | No equal sides<br>No equal angles  |  |
| 29.                             | Right-angled                          |  | 1 right angle<br>Can be scalene or isosceles   |  |
| Basic angle rules               |                                       |   |  |  |
| 30.                             | Angles on a straight line add to 180° |   |                             |  |

|                                 |  |   |
|---------------------------------|--|---|
| 31.                             | Angles around a point add up to $360^\circ$          |    |
| 32.                             | Vertically opposite angles are equal                 |    |
| 33.                             | Angles in a triangle add to $180^\circ$              |   |
| 34.                             | Angles in a quadrilateral add up to $360^\circ$      |   |
| <b>Angles on parallel lines</b> |  |   |
| 35.                             | Alternate angles are equal                           |   |
| 36.                             | Corresponding angles are equal                       |   |
| 37.                             | Co-interior angles add up to $180^\circ$             |   |
| <b>Angles in polygons</b>       |  |   |
| 38.                             | Interior and exterior angles add to give $180^\circ$ |  <p data-bbox="1235 1693 1445 1765">For any polygon:<br/><math>I + E = 180^\circ</math></p> |
| 39.                             | Sum of interior angles                               | <p data-bbox="801 1854 1104 1886">For a 'n' sided polygon</p> <p data-bbox="801 1921 1264 1953">Sum of interior angles = <math>180 \times (n-2)</math></p>                      |

|     |                            |  |
|-----|----------------------------|--|
| 40. | Size of one interior angle | <p>For a 'n' sided polygon</p> <p>Interior angle = <math>\frac{180 \times (n-2)}{n}</math></p> |
| 41. | Sum of exterior angles     | For all polygons, sum of exterior angles = $360^\circ$   |
| 42. | Regular polygons           | Exterior angle = $360 \div$ number of sides  |
|     |                            | Number of sides = $360 \div$ exterior angle  |
|     |                            | Interior angle = $180 -$ exterior angle  |

### Statistics and sampling: definitions

|  |                  |  |                       |   |                                 |
|--|------------------|--|-----------------------|---|---------------------------------|
| 1.   | Primary          | Data that is collector by the researcher first hand                                  |                       |   |                                 |
| 2.   | Secondary        | Data that is collected by someone other than the user                                |                       |   |                                 |
| 3.   | Qualitative      | Data described by words  | e.g. favourite colour |   |                                 |
| 4.   | Quantitative     | Data that is categorised by numbers, can be discrete or continuous                   |                       | e.g. height, shoe size  |                                 |
| 5.   | Discrete         | Can be counted, can only have a finite number of possible values                     |                       | e.g. number of people in a class                                  |                                 |
| 6.   | Continuous       | Can be measured, can have an infinite number of possible values within a given range |                       | e.g. height, weight, time, distance                               |                                 |
| 7.   | Population       | The whole group  |                       |   |                                 |
| 8.   | Census           | A survey of the whole population   |                       |   |                                 |
| 9.   | Sample           | A selection of the whole population  |                       |   |                                 |
| 10.  | Survey           | A tool used to gather information from individuals                                   |                       |   |                                 |
| 11.  | Bias             | Prejudice or favour shown for one person, group, thing or opinion over another.      |                       | e.g. asking people leaving a library whether they enjoyed reading |                                 |
| 12.  | Random sample    | Every member of the population has an equal chance of being selected.                |                       |   |                                 |
| 13.  | Inequality signs | < less than  | > greater than        | $\leq$ less than or equal to                                      | $\geq$ greater than or equal to |
| 14.  | Frequency        | How often something occurs   |                       |   |                                 |
| 15.  | Estimate         | Find a value close to the correct answer if you were to calculate accurately         |                       |   |                                 |
| 16.  | Interval         | What is between two values of points   |                       | e.g. all the numbers between 0 and 10                             |                                 |
| 17.  | Midpoint         | The middle or half way point of an interval  |                       | e.g. the midpoint of all the umbers between 0 and 10 is 5         |                                 |
| <b>Measures of central tendency and spread</b> |                  |  |                       |   |                                 |
| 18.  | Central tendency | A calculated central value of a set of numbers                                       |                       | Mean, median and mode are measures of central tendency            |                                 |
| 19.  | Spread           | Describes how similar or varied a set of values are                                  |                       | Range and interquartile range are measures of spread              |                                 |

|     |         |  |
|-----|---------|--|
| 20. | Mean    | Add up all the mounts then divide by how many there are.                 |
| 21. | Median  | Put values in order and locate the middle value                          |
| 22. | Mode    | The value that occurs most often i.e. has the highest frequency.         |
| 23. | Range   | The biggest value minus the smaller value                                |
| 24. | Outlier | An extreme data value that doesn't fit with the overall trend or pattern |

### Advantages and disadvantages of averages

|     |                |   |  |
|-----|----------------|---|--|
|     | <b>Average</b> | <b>Advantages</b>   | <b>Disadvantages</b>                   |
| 26. | <b>Mean</b>    | Every value is included   | Affected by extreme values             |
|     | <b>Median</b>  | Not affected by extreme values  | May not change if a data value changes |
|     | <b>Mode</b>    | Easy to find; not affected by extreme values; can be used with non-numerical data | There may not be a mode                |

### Averages from frequency tables

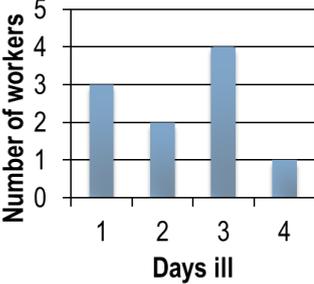
|     |             |  |
|-----|-------------|--|
| 27. | Modal class | The class with the highest frequency   |
| 28. | Median      | If the total frequency is $n$ , then the median lies in the class with the $\frac{n+1}{2}$ th value in it. |

| 29. | Mean from a frequency table                  | <table border="1"> <caption>No of make-up items in handbags</caption> <thead> <tr> <th>No of Items<br/><math>x</math></th> <th>Freq<br/><math>f</math></th> <th><math>f \times x</math></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>7</td> <td><math>1 \times 7 = 7</math></td> </tr> <tr> <td>2</td> <td>2</td> <td><math>2 \times 2 = 4</math></td> </tr> <tr> <td>3</td> <td>1</td> <td><math>3 \times 1 = 3</math></td> </tr> <tr> <td>4</td> <td>4</td> <td><math>4 \times 4 = 16</math></td> </tr> <tr> <td>5</td> <td>2</td> <td><math>5 \times 2 = 10</math></td> </tr> <tr> <td></td> <td>16</td> <td>40</td> </tr> </tbody> </table> | No of Items<br>$x$ | Freq<br>$f$  | $f \times x$ | 1 | 7 | $1 \times 7 = 7$ | 2 | 2 | $2 \times 2 = 4$ | 3 | 1 | $3 \times 1 = 3$ | 4 | 4 | $4 \times 4 = 16$ | 5 | 2 | $5 \times 2 = 10$ |  | 16 | 40 |
|-----|--|--|--------------------|--------------|--------------|---|---|------------------|---|---|------------------|---|---|------------------|---|---|-------------------|---|---|-------------------|--|----|----|
|     | No of Items<br>$x$                           |  | Freq<br>$f$        | $f \times x$ |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
| 1   | 7  | $1 \times 7 = 7$   |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
| 2   | 2  | $2 \times 2 = 4$   |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
| 3   | 1  | $3 \times 1 = 3$   |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
| 4   | 4  | $4 \times 4 = 16$  |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
| 5   | 2  | $5 \times 2 = 10$  |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
|     | 16   | 40   |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |
|     | <p>Times →</p> <p>Add ↓↓</p> <p>Divide ←</p> | $\text{Mean} = \frac{40}{16} = 2.5$  |                    |              |              |   |   |                  |   |   |                  |   |   |                  |   |   |                   |   |   |                   |  |    |    |

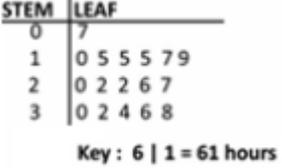
| 30.                | Estimated mean from a grouped frequency table | <table border="1"> <thead> <tr> <th>Class Interval</th> <th>Mid-point</th> <th>Frequency</th> <th>Mid-point <math>\times</math> Frequency</th> </tr> </thead> <tbody> <tr> <td><math>140 \leq h &lt; 150</math></td> <td>145</td> <td>6</td> <td><math>145 \times 6 = 870</math></td> </tr> <tr> <td><math>150 \leq h &lt; 160</math></td> <td>155</td> <td>16</td> <td><math>155 \times 16 = 2480</math></td> </tr> <tr> <td><math>160 \leq h &lt; 170</math></td> <td>165</td> <td>21</td> <td><math>165 \times 21 = 3465</math></td> </tr> <tr> <td><math>170 \leq h &lt; 180</math></td> <td>175</td> <td>8</td> <td><math>175 \times 8 = 1400</math></td> </tr> <tr> <td></td> <td><b>Totals</b></td> <td><b>51</b></td> <td><b>8215</b></td> </tr> </tbody> </table> | Class Interval         | Mid-point | Frequency                    | Mid-point $\times$ Frequency | $140 \leq h < 150$ | 145 | 6 | $145 \times 6 = 870$ | $150 \leq h < 160$ | 155 | 16 | $155 \times 16 = 2480$ | $160 \leq h < 170$ | 165 | 21 | $165 \times 21 = 3465$ | $170 \leq h < 180$ | 175 | 8 | $175 \times 8 = 1400$ |  | <b>Totals</b> | <b>51</b> | <b>8215</b> |
|--------------------|---|--|------------------------|-----------|------------------------------|------------------------------|--------------------|-----|---|----------------------|--------------------|-----|----|------------------------|--------------------|-----|----|------------------------|--------------------|-----|---|-----------------------|--|---------------|-----------|-------------|
|                    | Class Interval                                |  | Mid-point              | Frequency | Mid-point $\times$ Frequency |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |
| $140 \leq h < 150$ | 145   | 6  | $145 \times 6 = 870$   |           |                              |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |
| $150 \leq h < 160$ | 155   | 16   | $155 \times 16 = 2480$ |           |                              |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |
| $160 \leq h < 170$ | 165   | 21   | $165 \times 21 = 3465$ |           |                              |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |
| $170 \leq h < 180$ | 175   | 8  | $175 \times 8 = 1400$  |           |                              |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |
|                    | <b>Totals</b>                                 | <b>51</b>  | <b>8215</b>            |           |                              |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |
|                    | <p>Times →</p> <p>Add ↓↓</p> <p>Divide ←</p>  | $\begin{aligned} \text{Mean} &= 8215 \div 51 \\ &= 161.07843... \\ &= 161.08 \text{ (2dp)} \end{aligned}$  |                        |           |                              |                              |                    |     |   |                      |                    |     |    |                        |                    |     |    |                        |                    |     |   |                       |  |               |           |             |

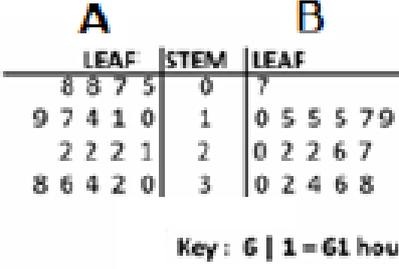
|     |  |   |
|-----|--|---|
| 31. | Estimate of range from grouped frequency table | The maximum possible value minus the smallest possible value. |
|-----|--|---|

**Averages from charts/graphs**

|     |           |  |  |
|-----|-----------|--|--|
| 32. | Bar chart | <p>A chart to display discrete data where the height of the bar shows the frequency.</p> <p style="text-align: center;"><b>Worker absences</b></p>  | <p>Mean: <math>23 \div 10 = 2.3</math><br/>         Median: 2.5<br/>         Mode : 3<br/>         Range: <math>4-1 = 3</math></p> |
|-----|-----------|--|--|

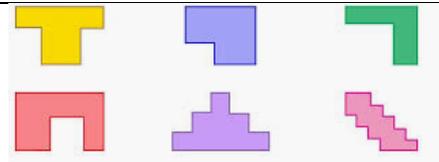
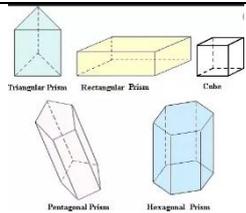
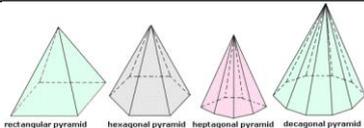
|     |           |  |  |
|-----|-----------|--|--|
| 33. | Pictogram | <p>A chart that uses pictures to represent quantities. Must include a key.</p> <p style="text-align: center;"><i>Apples Sold</i></p>  | <p>Mean: <math>95 \div 4 = 23.75</math><br/>         Median: 22.5<br/>         Range: 30</p> |
|-----|-----------|--|--|

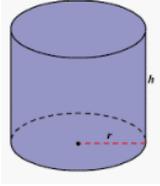
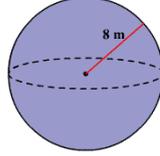
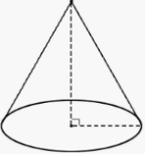
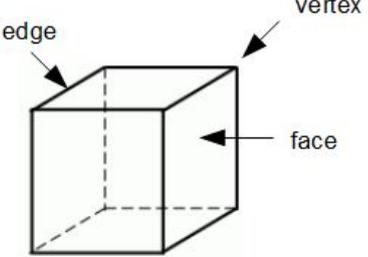
|     |                       |   |   |
|-----|-----------------------|---|---|
| 34. | Stem and leaf diagram |  <p>A diagram that shows groups of data arranged by place value. 'Leaves' should be in order. Must have a key.</p> | <p>Mean: <math>385 \div 17 = 22.6</math><br/>         Median: 22<br/>         Mode: 15<br/>         Range: <math>38-7 = 31</math></p> |
|-----|-----------------------|---|---|

|     |                            |  |   |
|-----|----------------------------|--|---|
| 35. | Back to back stem and leaf | <p>Compares two sets of results. Must have a key.</p> <p style="text-align: center;"><b>A</b>                      <b>B</b></p>  | <p>Set A<br/>         Mean: <math>356 \div 18 = 19.8</math><br/>         Median: 20<br/>         Mode: 22<br/>         Range: <math>38-5 = 33</math></p> <p>Set B<br/>         Mean: <math>385 \div 17 = 22.6</math><br/>         Median: 22<br/>         Mode: 15<br/>         Range: <math>38-7 = 31</math></p> |
|-----|----------------------------|--|---|



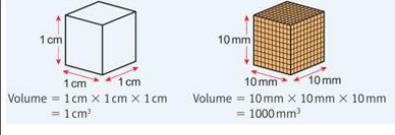
### 2D and 3D shapes: definitions

|     |                   |   |   |
|-----|-------------------|---|---|
| 1.  | Dimension         | The size of something in a particular direction e.g. height, depth, length, width |   |
| 2.  | 2D shape          | A shape that has length/height and a width but no depth                           |   |
| 3.  | 3D shape          | A shape that depth as well as length/height and width                             |   |
| 4.  | Polygon           | A 2D shape with straight lines only   |   |
| 5.  | Regular polygon   | A polygon where:  |   |
|     |                   | All sides are the same length<br>All angles are the same size                     |   |
| 6.  | Compound shape    | A shape made up of two or more simple shapes                                      |   |
| 7.  | Rectilinear shape | A shape where all of its sides meet at right angles                               |    |
| 8.  | Perimeter         | The distance around the outside of a 2D shape                                     |   |
| 9.  | Area              | The space inside a 2D shape   |   |
| 10. | Surface area      | The total area of all the faces of a 3D shape                                     |   |
| 11. | Volume            | The space inside a 3D shape   |   |
| 12. | Capacity          | The amount of fluid a 3D object can hold  |   |
| 13. | S.I. Units        | Standard units of measurement used by scientists across the world                 |   |
| 14. | Metric units      | Standard units of measurement that vary by powers of 10                           |   |
| 15. | Imperial units    | Older units of measurement, some of which are still common e.g. miles, gallons    |   |
| 16. | Cross section     | The shape we get when cutting straight through a 3D shape                         |   |
| 17. | Prism             | A 3D shape that has a constant cross section through its length                   |  |
| 18. | Pyramid           | A 3D shape with a polygon as its base and triangular sides that meet at the top   |  |

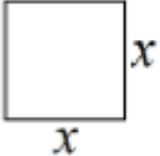
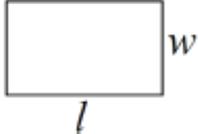
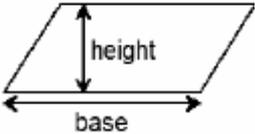
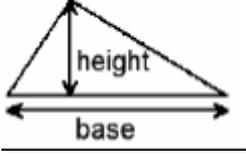
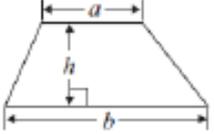
|     |           |  |  |
|-----|-----------|--|--|
| 19. | Cylinder  | A prism with two circular ends connected by a curved surface                     |   |
| 20. | Sphere    | A 3D shape where all points on the surface are the same distance from the centre |   |
| 21. | Spherical | Means in the shape of a sphere   |  |
| 22. | Cone      | A 2D shape that has a circular base joined to a point by a curved side           |   |
| 23. | Face      | A flat surface of a 3D shape (can be curved)                                     |  |
| 24. | Edge      | A line segment where two faces meet  |  |
| 25. | Vertex    | A point where two or more edges meet   |  |
| 26. | Vertices  | Plural of vertex   |  |

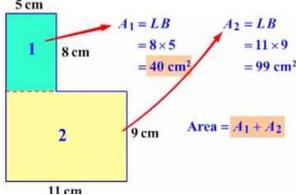
**Measures**

|     |                 |  |                     |   |                   |
|-----|-----------------|--|---------------------|---|-------------------|
| 27. | Units of time   | Standard units of time are seconds, minutes, hours, days, years  |                     |   |                   |
|     |                 | 60 seconds = 1 minute  | 60 minutes = 1 hour | 24 hours = 1 day  | 365 days = 1 year |
| 28. | Units of mass   | Metric units of mass are milligrams, grams, kilograms and tonnes   |                     |   |                   |
|     |                 | 1000mg = 1g  | 1000g = 1kg         | 1000kg = 1 tonne  |                   |
| 29. | Units of length | Metric units of length are millimetres, centimetres, metres and kilometres   |                     |   |                   |
|     |                 | 10mm = 1cm   | 100cm = 1m          | 1000m = 1km   |                   |
| 30. | Units of area   | Metric units of length are millimetres <sup>2</sup> , centimetres <sup>2</sup> , metres <sup>2</sup> and kilometres <sup>2</sup> |                     |   |                   |
|     |                 | 1cm <sup>2</sup> = 100mm <sup>2</sup>  |                     |  |                   |
|     |                 | 1m <sup>2</sup> = 10000cm <sup>2</sup>   |                     | Area = 1 cm × 1 cm = 1cm <sup>2</sup><br>Area = 10 mm × 10 mm = 100mm <sup>2</sup>    |                   |

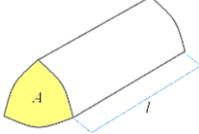
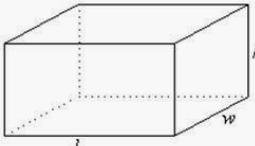
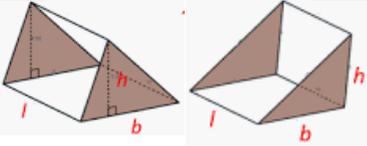
|     |                                 |  |   |
|-----|---------------------------------|--|---|
| 31. | Units of volume                 | Metric units of length are millimetres <sup>3</sup> , centimetres <sup>3</sup> , metres <sup>3</sup> and kilometres <sup>3</sup> |   |
|     |                                 | $1\text{cm}^3 = 1000\text{mm}^3$   |  |
|     |                                 | $1\text{m}^3 = 1000000\text{cm}^3$   |   |
| 32. | Units of capacity               | Metric units of capacity are millilitres, centilitres and litres   |   |
|     |                                 | $10\text{ml} = 1\text{cl}$   | $1000\text{ml} = 100\text{cl} = 1\text{l}$  |
| 33. | Capacity and volume conversions | $1\text{cm}^3 = 1\text{ml}$  | $1000\text{cm}^3 = 1\text{l}$   |

**2D Shapes**

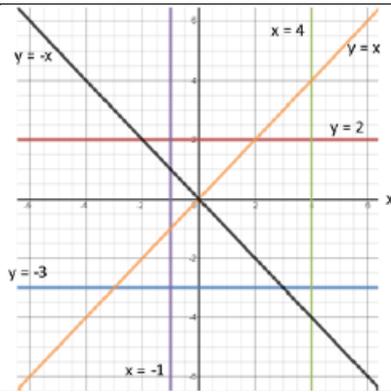
|     |               |  |   |
|-----|---------------|--|---|
| 34. | Square        | $\text{Area} = l \times w$ or $l^2$ as length and width are equal        |    |
| 35. |               | $\text{Perimeter} = l + l + l + l$ or $4l$                               |   |
| 36. | Rectangle     | $\text{Area} = l \times w$   |  |
| 37. |               | $\text{Perimeter} = l + l + w + w$ or $2l + 2w$                          |   |
| 38. | Parallelogram | $\text{Area} = b \times h$   |  |
| 39. | Triangle      | $\text{Area} = \frac{b \times h}{2}$ or $\frac{1}{2} \times b \times h$  |  |
| 40. | Trapezium     | $\text{Area} = \frac{a+b}{2} \times h$ or $\frac{1}{2} (a + b) \times h$ |  |

|     |                |  |   |
|-----|----------------|--|---|
| 41. | Compound shape | <p>To find the area, split up into simple shapes, find each area and add together.</p> <p>To find the perimeter, find any missing sides than add all the sides together.</p> |  |
|-----|----------------|--|---|

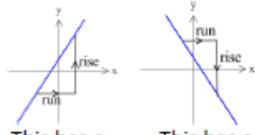
### 3D shapes: volume

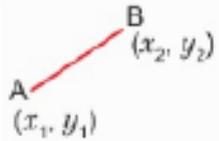
|     |                  |   |   |
|-----|------------------|---|---|
| 42. | Prism            | <p><b>Volume = area of cross section <math>\times</math> length</b></p>   |  |
| 43. | Cuboid           | <p><b>Volume = area of cross section <math>\times</math> length</b><br/> <b>Volume = length <math>\times</math> width <math>\times</math> height</b></p>                                |  |
| 44. | Triangular prism | <p><b>Volume = area of cross section <math>\times</math> length</b><br/> <b>Volume = <math>\frac{1}{2} \times</math> base <math>\times</math> height <math>\times</math> length</b></p> |  |

**Graphs - definitions**

|     |                 |  |  |
|-----|-----------------|--|--|
| 1.  | Axis            | A reference line on a graph  |  |
| 2.  | Axes            | Plural of axis   |  |
| 3.  | Quadrant        | A quarter of a graph separated by a axes   |  |
| 4.  | Coordinate      | Used to show a position on a coordinate plane, $(x, y)$  |  |
|     |                 | First coordinate is the horizontal position, (x axis) and the second is the vertical position (y axis) |  |
| 5.  | Origin          | The point $(0,0)$ on a set of axes   |  |
| 6.  | Plot            | Mark a position or positions on a graph  |  |
| 7.  | y intercept     | The y value where a graph crosses the y axis   | where $x=0$  |
| 8.  | x intercept     | The x value where a graph crosses the x axis   | where $y=0$  |
| 9.  | Parallel        | Lines that are equal distance apart that if extended will never meet                                   |  |
| 10. | "y=" graph      | Constant y coordinate  |  |
|     |                 | Will be parallel to the x axis   |  |
| 11. | "x=" graph      | Constant x coordinate  |  |
|     |                 | Will be parallel to the y axis   |  |
| 12. | Linear function | An arithmetic sequence that can be represented by a straight line graph                                |  |
| 13. | Linear equation | An equation that produces a straight line graph  |  |
| 14. | $y = mx + c$    | The general equation of a straight line  | $m =$ gradient and $c =$ y intercept   |

**Linear graphs**

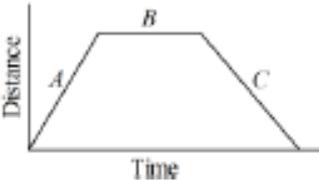
|     |          |  |   |
|-----|----------|--|---|
| 15. | Gradient | The steepness of a graph   |  <p>This has a positive gradient      This has a negative gradient</p> |
|     |          | $\text{Gradient} = \frac{\text{change in } y}{\text{change in } x} = \frac{\text{rise}}{\text{run}}$ |   |

|     |                             |   |  |
|-----|-----------------------------|---|--|
| 16. | Gradient between two points | If A = (x <sub>1</sub> , y <sub>1</sub> ) and B = (x <sub>2</sub> , y <sub>2</sub> )<br><br>The gradient of line AB = $\frac{y_2 - y_1}{x_2 - x_1}$ |   |
| 17. | Parallel lines              | Have the same gradients   |  |
| 18. | Mid-point                   | The coordinate half way between two point   | If A = (x <sub>1</sub> , y <sub>1</sub> ) and B = (x <sub>2</sub> , y <sub>2</sub> ) the mid-point is $(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$ |

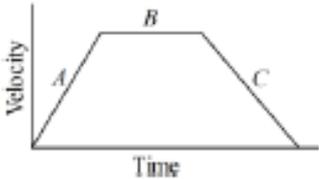
### Real life graphs

|     |                |  |
|-----|----------------|--|
| 19. | Steady speed   | Travelling the same distance each minute   |
| 20. | Velocity       | Speed in a particular direction  |
| 21. | Rate of change | Shows how a variable changes over time   |
| 22. | Acceleration   | How fast velocity changes; measured in m/s <sup>2</sup> or km/s <sup>2</sup> etc |

### Distance - Time graphs

|     |   |  |
|-----|---|--|
| 23. | Represent a journey   |  <p>A = steady speed,<br/>B = no movement,<br/>C = steady speed back to start</p> |
| 24. | Vertical axis represents the distance from the starting point     |  |
| 25. | Horizontal axis represents the time taken                         |  |
| 26. | Straight lines mean constant speed                                |  |
| 27. | Horizontal lines mean no movement                                 |  |
| 28. | Gradient = speed  |  |
| 29. | Average speed = $\frac{\text{total distance}}{\text{total time}}$ |  |

### Velocity – Time graphs

|     |   |  |
|-----|---|--|
| 30. | Represents the speed at given times                               |  <p>A = steady acceleration,<br/>B = constant speed,<br/>C = steady deceleration back to a stop</p> |
| 31. | Straight lines mean constant acceleration or deceleration         |  |
| 32. | Horizontal change means no change in velocity e.g. constant speed |  |
| 33. | Positive gradient = acceleration                                  |  |
| 34. | Negative gradient = deceleration                                  |  |
| 35. | Distance travelled = area under the graph                         |  |



**Transformations - definitions**

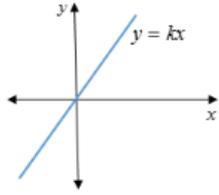
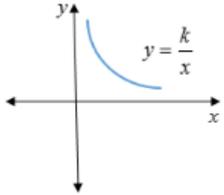
|      |                       |   |            |   |             |
|------|-----------------------|---|------------|---|-------------|
| 1.   | Transformation        | Changing a 2D shape in some way.  |            |   |             |
|      |                       | Rotation  | Reflection | Translation                                 | Enlargement |
| 2.   | Object                | The name given to a shape before a transformation has occurred.                       |            |   |             |
| 3.   | Image                 | The name given to a shape after a transformation has occurred                         |            |   |             |
| 4.   | Rotation              | A circular movement about a fixed point   |            |   |             |
| 5.   | Centre of rotation    | The fixed point that the shape has been rotated about                                 |            |   |             |
|      |                       | Written as a coordinate $(x, y)$  |            |   |             |
| 6.   | Direction             | Clockwise or anticlockwise  |            |   |             |
| 7.   | Reflection            | An image as it would be seen in a mirror  |            |   |             |
| 8.   | Line of reflection    | The "mirror line" used to perform reflections.  |            |   |             |
|      |                       | Written using algebraic notation e.g. $y = 3$ , $x = -2$ , $y = x$ or $x/y$ axis      |            |   |             |
| 9.   | Translation           | The movement of a shape without rotating or flipping it                               |            |   |             |
| 10.  | Column vector         | Notation used to represent translations   |            | $\begin{pmatrix} x \\ - \\ y \end{pmatrix}$ |             |
|      |                       | x is the horizontal movement  |            |   |             |
|      |                       | y is the vertical movement  |            |   |             |
| 11.  | Resultant vector      | The vector that moves the shape to its final position after more than one translation |            |   |             |
| 12.  | Enlargement           | A change in size of a shape (can be bigger or smaller)                                |            |   |             |
| 13.  | Scale factor          | The proportions by which the dimensions of an object will increase/decrease by        |            |   |             |
|      |                       | If fractional then the image will be smaller than the object                          |            |   |             |
| 14.  | Centre of enlargement | A fixed point to enlarge an object from   |            |   |             |
|      |                       | Written as a coordinate $(x, y)$  |            |   |             |
| 15.  | Single transformation | Where the object is only transformed once   |            |   |             |
| 16.  | Combination           | Where the object is transformed multiple times  |            |   |             |
| 17.. | Origin                | The point $(0,0)$ ; where the x and y axis intersect                                  |            |   |             |
| 18.  | Similar               | Same shape but different sizes  |            |   |             |
|      |                       | e.g. similar shapes are enlargements of one another                                   |            |   |             |

|     |           |  |
|-----|-----------|--|
| 19. | Congruent | Shapes that are the same shape and size  |
| 20. | Describe  | Use key words to accurately state what has happened to an object to make the resulting image |

### Transformations

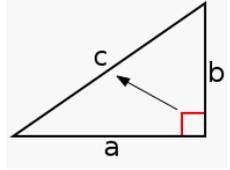
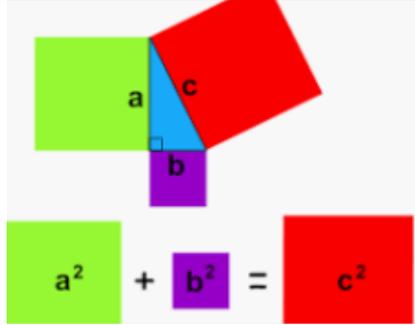
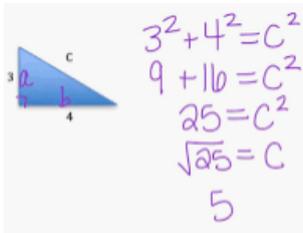
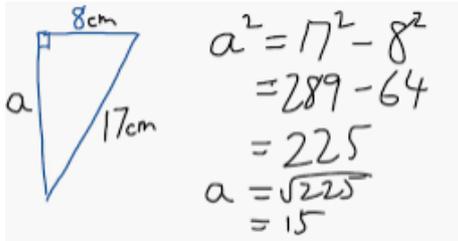
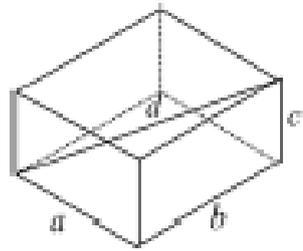
|     |             |   |  |
|-----|-------------|---|--|
| 21. | Rotation    | <p>To carry out you need to:</p> <ol style="list-style-type: none"> <li>1. Draw object on tracing paper</li> <li>2. Place pencil on 'centre of rotation' and carry out the motion</li> <li>3. Draw your image on the grid</li> </ol>  | <p>To describe you need to write:</p> <ol style="list-style-type: none"> <li>a) "rotation"</li> <li>b) angle of rotation</li> <li>c) direction of rotation</li> <li>d) centre of rotation</li> </ol> |
| 22. | Reflection  | <p>To carry out you need to:</p> <ol style="list-style-type: none"> <li>1. If required draw the 'line of reflection'</li> <li>2. Count squares from object to line and repeat the other side of the line for all corners of the object</li> <li>3. Join points up to create the image</li> </ol>  | <p>To describe you need to write:</p> <ol style="list-style-type: none"> <li>a) "reflection"</li> <li>b) the equation of the line of reflection</li> </ol>   |
| 23. | Translation | <p>To carry out you need to:</p> <ol style="list-style-type: none"> <li>1. Use vector notation to work out the horizontal and vertical movement</li> <li>2. Count squares to carry out movement on all corners of the object</li> <li>3. Join up points to create the image</li> </ol>  | <p>To describe you need to write:</p> <ol style="list-style-type: none"> <li>a) "translation"</li> <li>b) the column vector</li> </ol>   |
| 24. | Enlargement | <p>To carry out you need to:</p> <ol style="list-style-type: none"> <li>1. If required cross the coordinate that is the centre of enlargement</li> <li>2. For each corner count from the line of reflection to the object</li> <li>3. Multiply this movement by the required scale factor</li> <li>4. Draw new corners from the centre of enlargement with new horizontal and vertical movement</li> <li>5. Join up points to create image</li> </ol> | <p>To describe you need to write:</p> <ol style="list-style-type: none"> <li>a) "enlargement"</li> <li>b) the scale factor</li> <li>c) the centre of enlargement</li> </ol>                          |

## Ratio and Proportion - definitions

|     |                             |   |  |
|-----|-----------------------------|---|--|
| 1.  | Ratio                       | A relationship between two or more quantities   |  |
| 2.  | Unit ratio                  | Used to compare ratios, one of the parts is 1   |  |
|     |                             | The only time it is permissible to have a decimal in a ratio  |  |
| 3.  | Equivalent                  | Ratios that have the same simplified form are said to be equivalent                                   |  |
| 4.  | Scale                       | A ratio that represents the relationship between a length on a drawing or a map and the actual length |  |
| 5.  | Proportion                  | Compares a part with a whole  |  |
| 6.  | Direct proportion           | Two quantities increase at the same rate  | $y \propto x$<br>$y = kx$ for a constant $k$<br>                     |
|     |                             | Graph is a straight line that goes through the origin   |  |
| 7.  | Inverse/indirect proportion | One variable increases at a constant rate as the second variable decreases                            | $y \propto \frac{1}{x}$<br>$y = \frac{k}{x}$ for a constant $k$<br> |
| 8.  | Proportional                | A change in one is always accompanied by a change in the other  |  |
| 9.  | Constant of proportionality | Represented by $k$  |  |
|     |                             | Its value stays the same  |  |
| 10. | Share                       | Splitting into parts as defined by a ratio  |  |
| 11. | Unitary method              | Finding the value of 1 item then using this to find the value of any number of that item              |  |



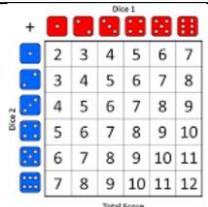
**Pythagoras' Theorem**

|    |                            |   |   |
|----|----------------------------|---|---|
| 1. | Hypotenuse                 | The longest side of a right-angled triangle   |                    |
|    |                            | It is always opposite the right angle   |   |
| 2. | Right- angled triangle     | A triangle that contains a right angle  |   |
| 3. | Pythagoras' Theorem        | $a^2 + b^2 = c^2$   |                    |
|    |                            | Where c is the hypotenuse   |   |
|    |                            | Where a and b are the two shorter sides   |   |
| 4. | To find the hypotenuse (c) |   | <ul style="list-style-type: none"> <li>• Square</li> <li>• Add</li> <li>• Square root</li> </ul>      |
| 5. | To find a short side (a/b) |  | <ul style="list-style-type: none"> <li>• Square</li> <li>• Subtract</li> <li>• Square root</li> </ul> |
| 6. | Pythagoras' in 3D          | $a^2 + b^2 + c^2 = d^2$   |                  |
|    |                            | $d^2 - b^2 - c^2 = a^2$   |   |

# Trigonometry - Right angled – SOH CAH TOA

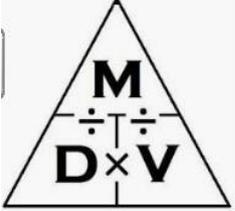
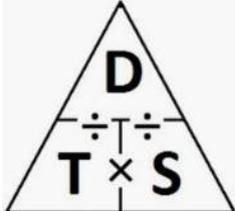
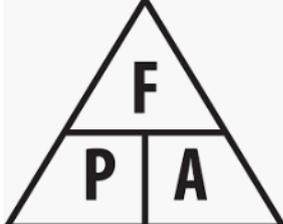
| 7.                                      | Trigonometry           | The ratios between the sides and angles of triangles   |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|---|------------------------|--|-----------|--|----------------------|----------------------|------------|------------|------------|------------|------------|--------------|---|---------------|----------------------|----------------------|---|--------------|---|----------------------|----------------------|---------------|---|--------------|---|----------------------|---|------------|--|
| 8.                                      | Labelling the triangle | $\theta$ is the angle involved   |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        | H is the hypotenuse  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        | O is the opposite  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        | A is the adjacent  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| 9.                                      | Sine                   | SOH  |           | $\sin \theta = \frac{Opp}{Hyp}$ $\theta = \sin^{-1} \frac{Opp}{Hyp}$ |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| 10.                                     | Cosine                 | CAH  |           | $\cos \theta = \frac{Adj}{Hyp}$ $\theta = \cos^{-1} \frac{Adj}{Hyp}$ |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| 11.                                     | Tangent                | TOA  |           | $\tan \theta = \frac{Opp}{Adj}$ $\theta = \tan^{-1} \frac{Opp}{Adj}$ |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| 12.                                     | Exact Values           | <table border="1"> <thead> <tr> <th><math>\theta</math></th> <th><math>0^\circ</math></th> <th><math>30^\circ</math></th> <th><math>45^\circ</math></th> <th><math>60^\circ</math></th> <th><math>90^\circ</math></th> </tr> </thead> <tbody> <tr> <td>Sin <math>\theta</math></td> <td>0</td> <td><math>\frac{1}{2}</math></td> <td><math>\frac{\sqrt{2}}{2}</math></td> <td><math>\frac{\sqrt{3}}{2}</math></td> <td>1</td> </tr> <tr> <td>Cos <math>\theta</math></td> <td>1</td> <td><math>\frac{\sqrt{3}}{2}</math></td> <td><math>\frac{\sqrt{2}}{2}</math></td> <td><math>\frac{1}{2}</math></td> <td>0</td> </tr> <tr> <td>Tan <math>\theta</math></td> <td>0</td> <td><math>\frac{\sqrt{3}}{3}</math></td> <td>1</td> <td><math>\sqrt{3}</math></td> <td style="background-color: black;"></td> </tr> </tbody> </table> |           |  |                      | $\theta$             | $0^\circ$  | $30^\circ$ | $45^\circ$ | $60^\circ$ | $90^\circ$ | Sin $\theta$ | 0 | $\frac{1}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{\sqrt{3}}{2}$ | 1 | Cos $\theta$ | 1 | $\frac{\sqrt{3}}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{1}{2}$ | 0 | Tan $\theta$ | 0 | $\frac{\sqrt{3}}{3}$ | 1 | $\sqrt{3}$ |  |
|   |                        | $\theta$   | $0^\circ$ | $30^\circ$   | $45^\circ$           | $60^\circ$           | $90^\circ$ |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        | Sin $\theta$   | 0         | $\frac{1}{2}$  | $\frac{\sqrt{2}}{2}$ | $\frac{\sqrt{3}}{2}$ | 1          |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        | Cos $\theta$   | 1         | $\frac{\sqrt{3}}{2}$   | $\frac{\sqrt{2}}{2}$ | $\frac{1}{2}$        | 0          |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| Tan $\theta$                            | 0                      | $\frac{\sqrt{3}}{3}$   | 1         | $\sqrt{3}$   |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| These can be found using the triangles: |                        |  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        |  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        |  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
| 13.                                     | Angle of elevation     | Angle of depression  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |
|   |                        |  |           |  |                      |                      |            |            |            |            |            |              |   |               |                      |                      |   |              |   |                      |                      |               |   |              |   |                      |   |            |  |

## Probability - definitions

|     |                          |   |   |
|-----|--------------------------|---|---|
| 1.  | Probability              | The extent to which an event is likely to occur                                       | For equally likely outcomes the probability that an event will happen is<br>$P = \frac{\text{number of successful outcomes}}{\text{total number of possible outcomes}}$ |
|     |                          | Written as a fraction, decimal or percentage  |   |
| 2.  | Theoretical probability  | Calculated without doing an experiment  |   |
| 3.  | Experimental probability | Probabilities based on the data collected during an experiment                        | $\text{estimated probability} = \frac{\text{frequency of event}}{\text{total frequency}}$   |
|     |                          | Also known as estimated probability   |   |
|     |                          | The more trials you do the more reliable your set of results                          |   |
| 4.  | P( ) notation            | P( ) means the probability of the thing inside the brackets happening e.g. P(tails)   |   |
| 5.  | Experiment               | A repeatable process that gives rise to a number of outcomes                          |   |
| 6.  | Relative frequency       | In an experiment, how often something happens as a proportion of the number of trials | $\text{Relative frequency} = \frac{\text{how often something happens}}{\text{all outcomes}}$  |
|     |                          | You can predict the number of outcomes you will get using relative frequency          |   |
| 7.  | Predictions              | Predicted number of outcomes = probability x number of trials                         |   |
| 8.  | Event                    | A collection of one or more outcomes  |   |
| 9.  | Independent              | When one event has no effect on another   | Here $P(A \text{ and } B) = P(A) \times P(B)$   |
| 10. | Dependent                | When the outcome of one event, changes the probability of the next event              |   |
| 11. | Exhaustive               | Events are exhaustive if they cover all possible outcomes                             |   |
| 12. | Biased                   | Unfair  |   |
| 13. | Unbiased                 | Fair  |   |
| 14. | Sample space             | The set of all possible outcomes  |   |
| 15. | Sample space diagram     | A diagram showing all possible outcomes from an experiment                            |    |

|     |                         |   |                                    |  |
|-----|-------------------------|---|------------------------------------|--|
| 16. | Venn diagram            | Can be used to represent events graphically   |                                    |  |
|     |                         | Frequencies or probabilities can be placed in the regions                                     |                                    |  |
| 17. | $A \cap B$              | A intersection B  | All elements in A and B            |  |
| 18. | $A \cup B$              | A union B   | All the elements in A OR B OR both |  |
| 19. | $A'$                    | Complement of A   | Not in A                           |  |
| 20. | Mutually exclusive      | Events that have no outcomes in common  |                                    |  |
|     |                         | Here $P(A \text{ or } B) = P(A) + P(B)$   |                                    |  |
| 21. | Tree diagram            | Used to show the outcomes of two (or more) events happening in succession                     |                                    |  |
| 22. | AND rule                | Multiply the probabilities  |                                    |  |
| 23. | OR rule                 | Add the probabilities   |                                    |  |
| 24. | Conditional probability | The probability of a dependent event  |                                    |  |
|     |                         | The probability of a second outcome depends on what has already happened in the first outcome |                                    |  |

**Multiplicative reasoning – definitions and formulae**

|    |                  |  |   |
|----|------------------|--|---|
| 1. | Proportion       | Compares a part with a whole                                 |   |
| 2. | Proportional     | A change in one is always accompanied by a change in another |   |
| 3. | Ratio            | A relationship between two or more quantities                |   |
| 4. | Compound measure | Combine measures of two different quantities                 |   |
| 5. | Density          | The mass of a substance contained in a certain volume        |    |
|    |                  | Usually measured in g/cm <sup>3</sup> or kg/m <sup>3</sup>   |   |
|    |                  | $density = \frac{mass}{volume}$                              |   |
| 6. | Velocity         | Speed in a given direction                                   | Usually measured in m/s   |
| 7. | Acceleration     | The rate of change of velocity                               | Usually measured in m/s <sup>2</sup>  |
| 8. | Speed            | The distance travelled in an amount of time                  |  |
|    |                  | Usually measured in m/s, mph or km/h                         |   |
|    |                  | $speed = \frac{distance}{time}$                              |   |
| 9. | Pressure         | The force applied over an area                               |  |
|    |                  | $pressure = \frac{force}{area}$                              |   |
|    |                  | Usually measured in N/m <sup>2</sup>                         |   |

**Percentages**

|     |            |  |
|-----|------------|--|
| 10. | Percentage | Means 'out of 100'   |
| 11. | Multiplier | A decimal you multiply by to represent a percentage  |
|     |            | To use a multiplier to find a percentage, divide your percentage by 100, then multiply the amount by this value. |

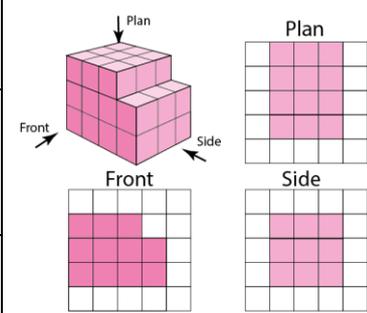
|     |   |  |   |
|-----|---|--|---|
| 12. | Percentage increase                           | Calculate the percentage and add onto the original   |   |
|     |   | Or use a multiplier  | $amount \times \frac{100 + \% \text{ increase}}{100}$                                     |
| 13. | Percentage decrease                           | Calculate the percentage and subtract from the original  |   |
|     |   | Or use a multiplier  | $amount \times \frac{100 - \% \text{ increase}}{100}$                                     |
| 14. | Percentage change                             | $\frac{\text{Change}}{\text{Original}} \times 100$   |   |
| 15. | Express one number as a percentage of another | $\frac{\text{Number 1}}{\text{Number 2}} \times 100$   |   |
| 16. | Reverse percentage                            | Use when asked to find the original amount after a percentage increase or decrease.  |   |
|     |   | $\text{Original Value} \times \text{Multiplier} = \text{New Value}$ $\text{Original Value} = \frac{\text{New Value}}{\text{Multiplier}}$ |   |
| 17. | Interest                                      | A fee paid for borrowing money or money earned through investing.  |   |
| 18. | Simple interest                               | Interest that is calculated as a percentage of the original  | $I = Prt$   |
|     |   |  | I – Interest<br>P – Original amount<br>r – interest rate<br>t – time                      |
| 19. | Compound interest                             | When interest is calculated on the original amount and any previous interest   | $P \left( 1 + \frac{R}{100} \right)^n$  |
|     |   | Or $Original \times Multiplier^{time}$   | P – Original amount<br>R – Interest rate<br>n – the number of interest periods (e.g. yrs) |
| 20. | Tax   | A financial charge placed on sales or savings by the government e.g. VAT   |   |
| 21. | Loss  | Income minus all expenses, resulting in a negative value   |   |
| 22. | Profit  | Income minus all expenses, resulting in a positive value   |   |
| 23. | Depreciation                                  | A reduction in the value of a product over time  |   |

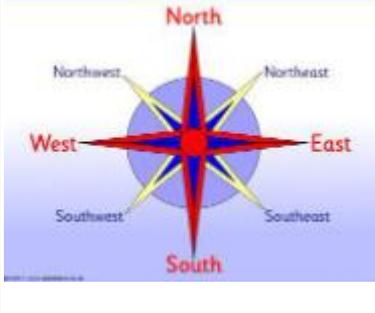
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|-----|-----------|---|
| 24. | Annual    | Means yearly                                |
| 25. | Per annum | Means per year                              |
| 26. | Salary    | A fixed regular payment, often paid monthly |

## 2D shapes and 3D solids - definitions

|     |                   |   |
|-----|-------------------|---|
| 1.  | Face              | A flat surface of a 3D shape  |
| 2.  | Edge              | A line segment where two faces meet   |
| 3.  | Vertex            | A point where two or more edges meet  |
| 4.  | Vertices          | The plural of vertex  |
| 5.  | Dimension         | The size of something in a particular directions e.g. length, width, height, diameter, depth  |
| 6.  | Plane             | A flat 2D surface   |
| 7.  | Plane of symmetry | When a solid can be cut exactly in half and a part on one side of the plane is an exact reflection of the part on the other side of the plane |
| 8.  | Prism             | A 3D shape with a uniform cross section   |
| 9.  | Pyramid           | A 3D shape with a polygon as a base and triangular sides that meet at the top   |
| 10. | Arc               | A section from the circumference (outside) of a circle  |
| 11. | Sector            | A region of a circle bound by two radii and an arc  |
| 12. | Congruent         | Exactly the same shape and size e.g. identical  |
| 13. | Regular           | A shape where all the sides and angles are the same   |

## Plans and elevations

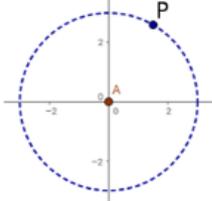
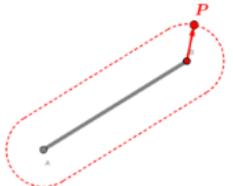
|     |                 |   |   |
|-----|-----------------|---|---|
| 14. | Plan            | The view from above a solid                 |  |
| 15. | Front elevation | The view from the front of a solid          |   |
| 16. | Side elevation  | The view from a side of the solid           |   |
| 17. | Clockwise       | Following the direction of a clock          |   |
| 18. | Anticlockwise   | Following the opposite direction of a clock |   |

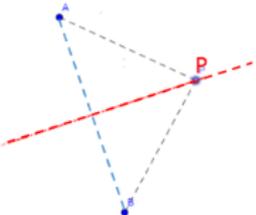
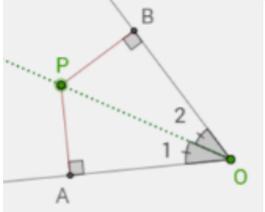
|     |                    |   |   |
|-----|--------------------|---|---|
| 19. | Compass directions | Terminology needed to accurately describe a location or directions                          |  |
| 20. | Sketch             | An approximate drawing of an object   |   |
| 21. | Scale              | A ratio that shows the relationship between a length on a drawing/map and the actual length |   |

### Constructions and loci

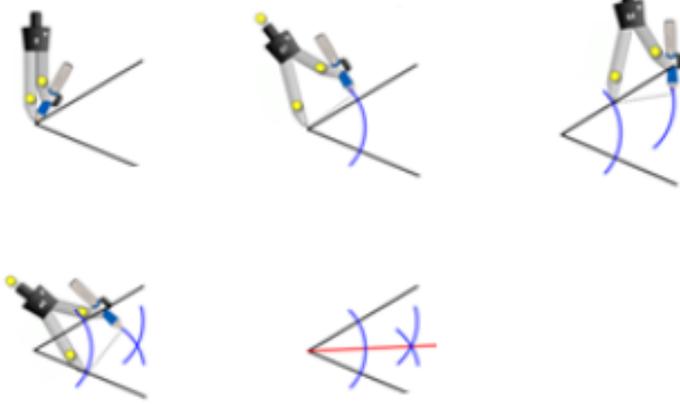
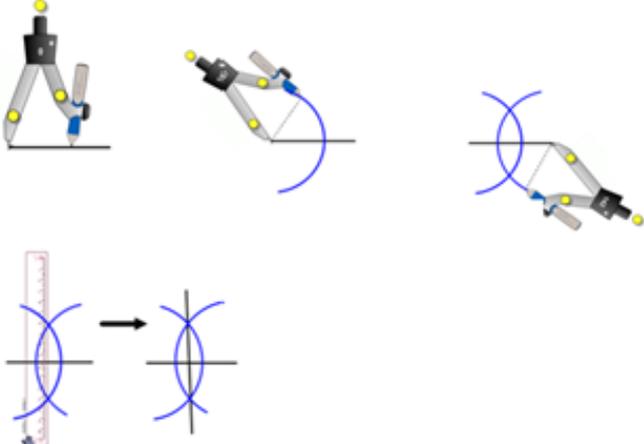
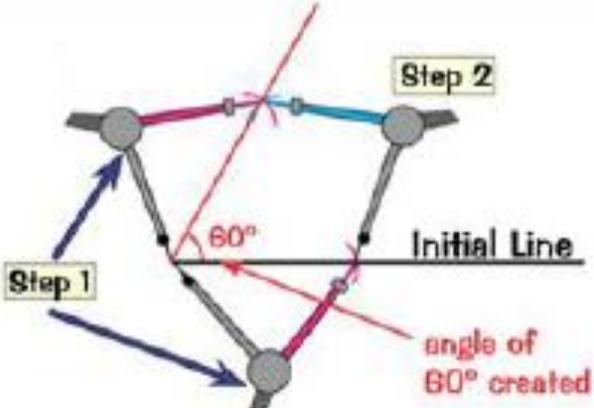
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|-----|------------------------|--|--|
| 22. | Construct              | Draw accurately using a ruler and a pair of compasses.           |  |
| 23. | Construction lines     | Lines or arcs drawn as part of working out                       |  |
|     |                        | They must not be rubbed out as they show the working             |  |
| 24. | Equidistant            | The same distance from each other or in relation to other things |  |
| 25. | Bisect                 | Cut in half  |  |
| 26. | Perpendicular          | At a 90 degree angle (right angle)                               |  |
| 27. | Perpendicular bisector | A line that cuts another in half at a right angle                |  |
| 28. | Angle bisector         | A line that cuts an angle exactly in half                        |  |
| 29. | Locus                  | The set of all points that fulfil a certain rule                 |  |
|     |                        | Often drawn as a continuous path                                 |  |
| 30. | Loci                   | The plural of locus  |  |
| 31. | Region                 | An area bounded by a loci  |  |

### Loci

|     |               |  |   |
|-----|---------------|--|---|
| 32. | Circle        | Locus of points that are a fixed distance from a fixed point |  |
| 33. | Parallel line | Locus of points a fixed distance from a fixed line           |  |

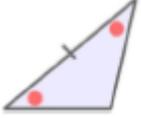
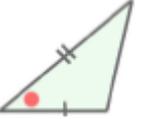
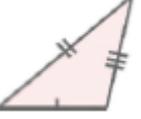
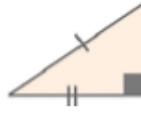
|     |                        |   |   |
|-----|------------------------|---|---|
| 34. | Perpendicular bisector | The line that cuts another in half at a right angle       |  |
| 35. | Angle bisector         | The locus of points equidistant between two fixed points. |  |

### Constructions

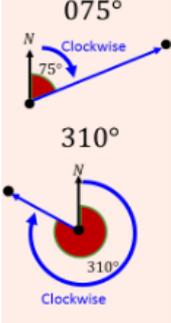
|     |                         |  |
|-----|-------------------------|--|
| 36. | Angle bisector          |   |
| 37. | Perpendicular bisector  |  |
| 38. | Constructing 60° angles |  |

## Constructing triangles

You can draw an accurate triangle when you are given:

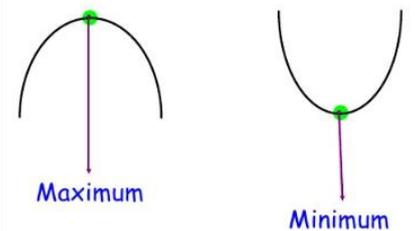
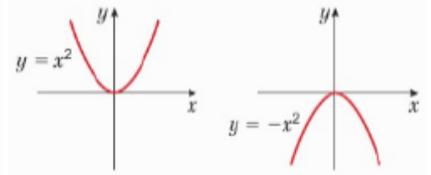
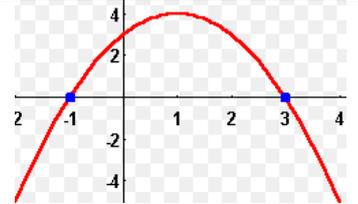
|     |     |  |   |
|-----|-----|--|---|
| 39. | ASA | an angle, side, angle                                      |  |
| 40. | SAS | a side, angle, side  |  |
| 41. | SSS | all three sides  |  |
| 42. | RHS | that it has a right angle, the hypotenuse and another side |  |

## Bearings

|     |         |   |  |
|-----|---------|---|--|
| 43. | Bearing | The direction of a line in relation to the North-South line |  |
|     |         | It is always measured clockwise                             |  |
|     |         | Always measured from the North line                         |  |
|     |         | Always written using 3 digits                               |  |

**Quadratics - definitions**

|    |                      |  |
|----|----------------------|--|
| 1. | Expression           | One or a group of terms  |
| 2. | Quadratic expression | An expression where the highest index is 2<br>e.g. $2x^2 + 2x + 2$   |
| 3. | Function             | A relation of expression involving one or more variables<br>Also a rule for working out values of y given values for x |
| 4. | Roots                | Solutions to a quadratic equation/function<br>$ax^2 + bx + c = 0$  |
|    |                      | The x values where the graph crosses the x axis  |
|    |                      | A quadratic can have 0, 1 or 2 roots   |
| 5. | Quadratic graph      | Curved shaped called a parabola  |
|    |                      | A positive $x^2$ will give a 'U' shape   |
|    |                      | A negative $x^2$ will give a '∩' shape   |
| 6. | Turning points       | The point where a curve turns in the opposite direction  |
|    |                      | Can be called a minimum or maximum   |



**Expanding double brackets**

|    |   |      |   |    |   |   |       |      |  |    |      |    |  |   |
|----|---|------|---|----|---|---|-------|------|--|----|------|----|--|---|
| 7. | Everything in the first bracket must be multiplied by everything in the second  |      |   |    |   |   |       |      |  |    |      |    |  |   |
| 8. | <p><b>Grid method</b></p> <p><math>(x+4)(x+7)</math></p> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 5px;">x</td> <td style="padding: 5px;">x</td> <td style="padding: 5px;">+4</td> <td style="padding: 5px;">.</td> </tr> <tr> <td style="padding: 5px;">x</td> <td style="padding: 5px;"><math>x^2</math></td> <td style="padding: 5px;"><math>4x</math></td> <td></td> </tr> <tr> <td style="padding: 5px;">+7</td> <td style="padding: 5px;"><math>7x</math></td> <td style="padding: 5px;">28</td> <td></td> </tr> </table> <p><math>= x^2 + 4x + 7x + 28</math><br/><math>= x^2 + 11x + 28</math></p> | x    | x | +4 | . | x | $x^2$ | $4x$ |  | +7 | $7x$ | 28 |  | <p><b>FOIL method</b></p> <p>FIRST : <math>(x+3)(x-4)</math> gives <math>x \times x = x^2</math></p> <p>OUTER : <math>(x+3)(x-4)</math> gives <math>x \times (-4) = -4x</math></p> <p>INNER : <math>(x+3)(x-4)</math> gives <math>3 \times x = 3x</math></p> <p>LAST : <math>(x+3)(x-4)</math> gives <math>3 \times (-4) = -12</math></p> |
| x  | x   | +4   | . |    |   |   |       |      |  |    |      |    |  |   |
| x  | $x^2$   | $4x$ |   |    |   |   |       |      |  |    |      |    |  |   |
| +7 | $7x$  | 28   |   |    |   |   |       |      |  |    |      |    |  |   |

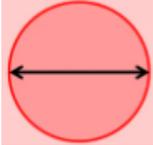
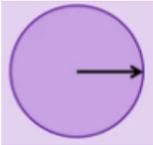
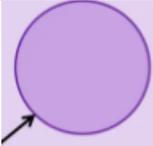
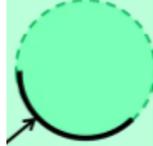
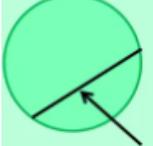
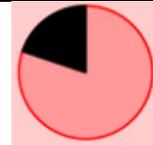
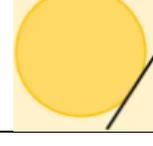
## Factorising a quadratic expression

|     |   |   |
|-----|---|---|
| 9.  | Factorising a quadratic in the form $ax^2 + bx + c$ | <p style="text-align: center;">Multiply to 5<br/>↙</p> <p>Factorise <math>x^2 + 5x + 6</math> ← Add to 6</p> <p>2 and 3 add to 5<br/>2 and 3 multiply to 6</p> <p><math>(x + 2)(x + 3)</math></p> <p>Check: <math>(x + 2)(x + 3) = x^2 + 5x + 6</math></p>                          |
| 10. | Difference of two squares                           | <p>A special type of quadratic which only has two terms.</p> <p>One term is subtracted from the other</p> <p><math>x^2 - 25 = x^2 - 5^2 = (x + 5)(x - 5)</math><br/> <math>y^2 - 49 = y^2 - 7^2 = (y + 7)(y - 7)</math><br/> <math>a^2 - 16 = a^2 - 4^2 = (a + 4)(a - 4)</math></p> |

## Solving quadratic equations/functions

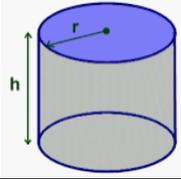
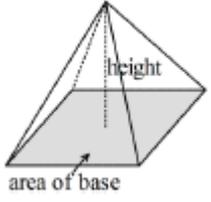
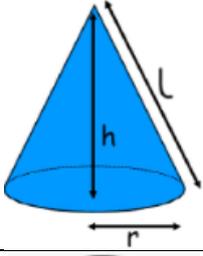
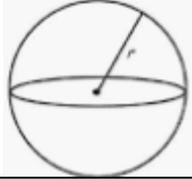
|     |                |   |   |
|-----|----------------|---|---|
| 11. | By factorising | <p>Take you factorised form and set each bracket equal to zero</p> <hr/> <p>Solve each separate linear equation to find the solutions/roots</p> | <p style="text-align: center;"><math>x^2 + 4x + 3 = 0</math><br/> <math>(x + 3)(x + 1) = 0</math></p> <p style="text-align: center;">↙                      ↘</p> <p><math>x + 3 = 0</math>                      <math>x + 1 = 0</math><br/>     So                                      So<br/> <math>x = -3</math>                                      <math>x = -1</math></p> |
|-----|----------------|---|---|

**Circles - definitions and formulae**

|   |               |   |   |
|---|---------------|---|---|
| 1.  | Diameter      | A straight line from edge to edge passing through the centre                |    |
|   |               | Double the size of the radius   |   |
| 2.  | Radius        | A straight line from the centre to the edge                                 |    |
|   |               | Half the size of the diameter   |   |
| 3.  | Radii         | The plural of radius  |   |
| 4.  | Circumference | Distance around the outside of the circle                                   |    |
| 5.  | Arc           | Part of the circumference   |   |
| 6.  | Chord         | A line within a circle where each end touches the edge                      |  |
| 7.  | Sector        | The region created by two radii and an arc                                  |  |
| 8.  | Segment       | The region created by a chord and an arc                                    |  |
| 9.  | Tangent       | A line outside the circle which only touches the circumference at one point |  |
| 10.   | Semi -circle  | Half a full circle  |   |
| <b>Area and circumference of circles formulae</b> |               |   |   |
| 11.   | Pi ( $\pi$ )  | Constant ratio linking the circumference and diameter of a circle           |   |
|   |               | 3.14159265...   |   |

|     |                           |  |   |
|-----|---------------------------|--|---|
| 12. | Circumference of a circle | $C = \pi d$                                    | Alternatively, using relationship between $r$ and $d$<br>$C = 2\pi r$ |
| 13. | Arc length                | $\frac{x}{360} \times \pi d$                   | Where $x$ is the angle at the centre                                  |
| 14. | Perimeter of a sector     | $\left(\frac{x}{360} \times \pi d\right) + 2r$ | This represents the arc length plus the two radii                     |
| 15. | Area of a circle          | $A = \pi r^2$                                  |   |
| 16. | Area of a sector          | $\frac{x}{360} \times \pi r^2$                 |   |

### Cylinders, pyramids, cones and spheres

|     |                            |   |   |
|-----|----------------------------|---|---|
| 17. | Volume of a cylinder       | $V = \pi r^2 h$   |    |
| 18. | Surface area of a cylinder | $Total\ surface\ area = 2\pi r^2 + \pi dh$                                      |   |
| 19. | Volume of a pyramid        | $V = \frac{1}{3} \times area\ of\ base \times perpendicular\ height$            |   |
| 20. | Volume of a cone           | $V = \frac{1}{3} \times \pi r^2 h$  |  |
| 21. | Surface area of a cone     | $Curved\ surface\ area = \pi r l$<br>$Total\ surface\ area = \pi r^2 + \pi r l$ |   |
| 22. | Volume of a sphere         | $V = \frac{4}{3} \times \pi r^3$  |  |
| 23. | Surface area of a sphere   | $Total\ surface\ area = 4\pi r^2$   |   |

## Fractions

|                   |   |   |   |
|-------------------|---|---|---|
| 1.                | Improper fraction                           | A fraction where the numerator is larger than the denominator.  | e.g. $\frac{4}{3}$  |
| 2.                | Mixed number                                | A number made from integer and fraction parts.  | e.g. $2\frac{2}{3}$                                       |
| 3.                | Unit fraction                               | A fraction that has a numerator of 1  |   |
| 4.                | Reciprocal                                  | The reciprocal of a number is 1 divided by the number.  | e.g. the reciprocal of 3 is $\frac{1}{3}$                 |
|                   |   | Dividing by a number is the same as multiplying by its reciprocal   | e.g. $\times$ by $\frac{1}{3}$ is the same as $\div$ by 3 |
| 5.                | Convert improper fractions to mixed numbers | <ul style="list-style-type: none"> <li>Divide the numerator by the denominator</li> <li>The answer gives the whole number part.</li> <li>The remainder becomes the numerator of the fraction part with the same denominator.</li> </ul>   | $\frac{43}{6} = 7\frac{1}{6}$                             |
| 6.                | Convert mixed numbers to improper fractions | <ul style="list-style-type: none"> <li>Multiply the denominator by the whole number part.</li> <li>Add the numerator to this.</li> <li>Put the answer to this back over the denominator</li> </ul>  | $7\frac{1}{6} = \frac{6 \times 7 + 1}{6} = \frac{43}{6}$  |
| 7.                | Adding and subtracting mixed numbers        | <ul style="list-style-type: none"> <li>Convert mixed numbers to improper fractions</li> <li>Transform both fractions so they have the same denominator</li> <li>Add or subtract the numerators</li> <li>Convert back to mixed number if applicable</li> </ul>                           |   |
| 8.                | Multiplying mixed numbers                   | <ul style="list-style-type: none"> <li>Convert mixed numbers to improper fractions</li> <li>Multiply numerators and multiply the denominators</li> <li>Convert back to mixed number if applicable</li> </ul>  |   |
| 9.                | Dividing mixed numbers                      | <ul style="list-style-type: none"> <li>Convert mixed numbers to improper fractions</li> <li>Flip the second fraction (find the reciprocal)</li> <li>Change the divide sign to a multiply</li> <li>Multiply the fractions</li> <li>Convert back to mixed number if applicable</li> </ul> |   |
| <b>Index laws</b> |   |   |   |
| 10.               | Index                                       | A small number to the upper right of a base number that shows how many times the base number is multiplied by itself.   |   |
| 11.               | Power                                       | Another word for an index.  |   |
| 12.               | Indices                                     | The plural of index.  |   |

|     |               |  |                                     |
|-----|---------------|--|-------------------------------------|
| 13. | Index form    | A number written to the power of an index. |                                     |
| 14. | Multiplying   | Add the powers                             | $x^7 \times x^6 = x^{13}$           |
| 15. | Dividing      | Subtract the powers                        | $x^5 \div x^6 = x^{-1}$             |
| 16. | Brackets      | Multiply the powers                        | $(x^2)^3 = x^6$                     |
| 17. | Power of 0    | Always = 1                                 | $x^0 = 1$                           |
| 18. | Negative      | Means "1 over"                             | $x^{-n} = \frac{1}{x^n}$            |
| 19. | Unit Fraction | Means root                                 | $x^{\frac{1}{n}} = \sqrt[n]{x}$     |
| 20. | Fractional    | Means root and bracket                     | $x^{\frac{a}{n}} = (\sqrt[n]{x})^a$ |

### Standard form

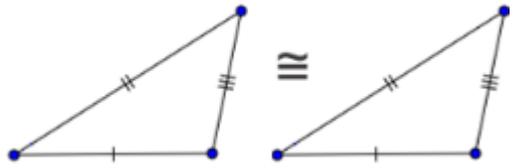
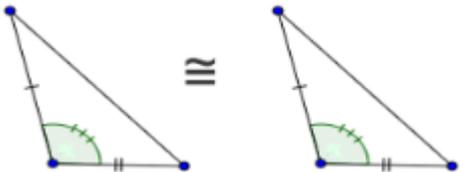
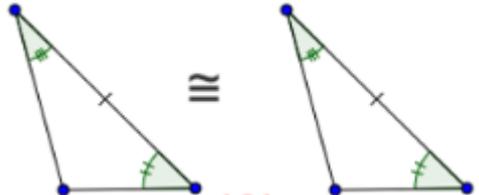
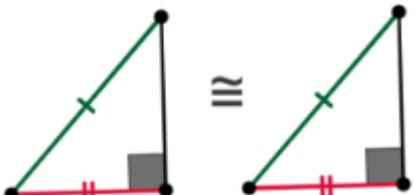
|     |  |   |  |
|-----|--|---|--|
| 21. | Standard form                                  | A number written in the form: $A \times 10^n$ , where $A$ is between 1 and 10.  |  |
| 22. | Scientific notation                            | Another name for standard form  |  |
| 23. | Convert a small number to standard form        | <ul style="list-style-type: none"> <li>Count the number of zero's in front of the first significant figure (including the one in front of the decimal point).</li> <li>The power of ten is negative followed by this number.</li> </ul>             | e.g. $0.00000037 = 3.7 \times 10^{-7}$   |
| 24. | Convert a large number into standard form      | <ul style="list-style-type: none"> <li>Count the number of place value position there are after the first significant figure.</li> <li>The power of ten is positive followed by this number.</li> </ul>   | e.g. $147\,100\,000\,000 = 1.47 \times 10^{11}$  |
| 25. | Converting to a small ordinary number          | <ul style="list-style-type: none"> <li>Look at the digit after the negative in the power of 10.</li> <li>Write this many zero's in front of the first sig. fig.</li> <li>Reposition the decimal place between the first and second zero.</li> </ul> | e.g. $2.4 \times 10^{-6} = 0.0000024$  |
| 26. | Adding or subtracting numbers in standard form | <ul style="list-style-type: none"> <li>Convert the numbers to ordinary numbers.</li> <li>Add.</li> <li>Convert the sum to standard form.</li> </ul>   | e.g. $(2.3 \times 10^4) + (6.4 \times 10^3) = 23000 + 6400 = 29400 = 2.94 \times 10^4$ |

|     |                                      |  |  |
|-----|--------------------------------------|--|--|
| 27. | Multiplying numbers in standard form | <ul style="list-style-type: none"> <li>• Multiply the numbers between one and 10 at the front.</li> <li>• Use index law for multiplication for the powers of 10.</li> <li>• If necessary increase the power of ten by one to ensure the initial number is between 1 and 10.</li> </ul> | <p>e.g. <math>(4.5 \times 10^3) \times (3 \times 10^5)</math></p> $= 13.5 \times 10^{3+5}$ $= 13.5 \times 10^8$ $= 1.35 \times 10^9$ |
| 28. | Dividing numbers in standard form    | <ul style="list-style-type: none"> <li>• Divide the numbers between one and 10 at the front.</li> <li>• Use index law for division for the powers of 10.</li> <li>• If necessary, decrease the power of ten by one to ensure the initial number is between 1 and 10.</li> </ul>        | <p>e.g. <math>(2.5 \times 10^{11}) \div (5 \times 10^{13})</math></p> $= 0.5 \times 10^{-2}$ $= 5 \times 10^{-3}$                    |

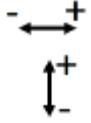
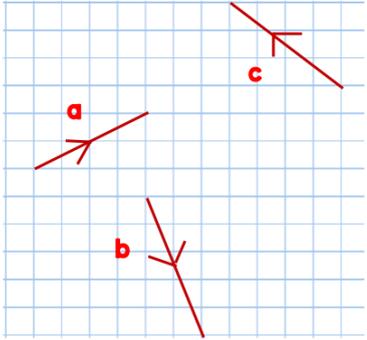
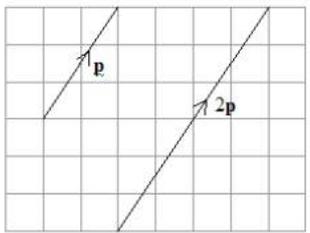
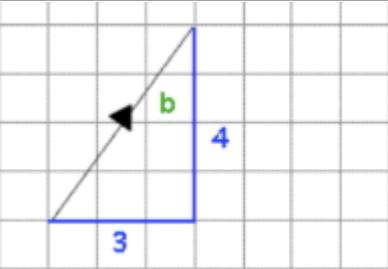
### Similarity and Congruence in 2D

|    |                           |  |   |
|----|---------------------------|--|---|
| 1. | Congruent                 | Exactly the same shape and size  |   |
| 2. | Similar                   | Two shapes where one is an enlargement of another                                |   |
|    |                           | Corresponding angles are equal   | Corresponding sides are in the same ratio                                     |
| 3. | Scale factor              | The proportion by which the dimensions of an object will increase or decrease by |   |
| 4. | Linear scale factor (LSF) | The scale factor/ratio of sides of two similar shapes                            | $LSF = \frac{\text{length from large shape}}{\text{length from small shape}}$ |
| 5. | Area scale factor (ASF)   | The scale factor ratio of areas/surface areas of two similar shapes              | $ASF = \frac{\text{Area of large shape}}{\text{Area of small shape}}$         |
| 6. | Volume scale factor (VSF) | The scale factor/ratio of volumes of two similar shapes                          | $VSF = \frac{\text{volume of large shape}}{\text{volume of small shape}}$     |

### Two triangles are congruent if...

|     |     |  |   |
|-----|-----|--|---|
| 7.  | SSS | All 3 sides are equal                                    |   |
| 8.  | SAS | 2 sides and the included angle are equal                 |  |
| 9.  | ASA | 2 angles and the corresponding side are equal            |  |
| 10. | RHS | The right angle, hypotenuse and one other side are equal |  |

# Vectors

|     |   |   |   |
|-----|---|---|---|
| 11. | Magnitude                                 | Size  |   |
| 12. | Scalar                                    | A quantity has a magnitude  |   |
| 13. | Vector                                    | A quantity that has direction and magnitude   |   |
| 14. | Column vector                             | x denotes the horizontal movement   | $\begin{pmatrix} x \\ y \end{pmatrix}$   |
|     |   | y denotes the vertical movement   |   |
| 15. | Written vectors                           | Can be written in bold $\mathbf{a}$ or with underlining $\underline{a}$   |   |
| 16. | Vector between two points                 | A vector between any two given points   | e.g. vector between A and B could be written as $\vec{AB}$  |
| 17. |   | Column vectors can be represented on grids  | $\mathbf{a} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 2 \\ -5 \end{pmatrix}$ $\mathbf{c} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$<br> |
| 18. | Adding vectors                            | $\begin{pmatrix} 2 \\ 3 \end{pmatrix} + \begin{pmatrix} 1 \\ -4 \end{pmatrix} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$  |   |
| 19. | Subtracting vectors                       | $\begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} 1 \\ -4 \end{pmatrix} = \begin{pmatrix} 1 \\ 7 \end{pmatrix}$   |   |
| 20. | Multiplying a vector by a scalar quantity | $\mathbf{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ . Then $2\mathbf{p} = 2 \times \begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 4 \\ 6 \end{pmatrix}$ . |    |
| 21. | Magnitude of a vector                     |    | $\mathbf{b} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$<br>$b^2 = 3^2 + 4^2$ $b = \sqrt{3^2 + 4^2}$ $b = 5$   |
| 22. | Unit vector                               | Has a magnitude of 1  |   |



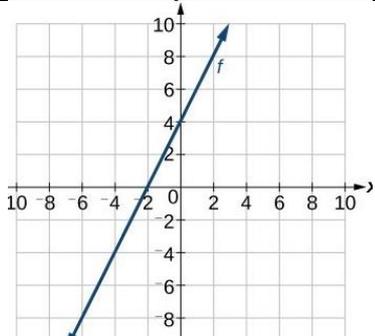
### Algebra definitions

|    |            |   |                        |
|----|------------|---|------------------------|
| 1. | Equation   | A mathematical statement containing an equals sign (=) to show that two expressions are equal   |                        |
| 2. | Formula    | A rule describing the relationship between different variables                                  |                        |
| 3. | Formulae   | The plural of formula   |                        |
| 4. | Function   | A relation involving one or more variables  |                        |
| 5. | Roots      | Solutions to an equation  |                        |
|    |            | In graphs, the values of x where the graph crosses the x axis                                   |                        |
| 6. | Identity   | An equation that is true for any value of x   | Denoted using $\equiv$ |
| 7. | Substitute | Replace a variable with a number  |                        |
| 8. | Subject    | The variable on its own on one side of the equals sign is said to be the 'subject' of a formula |                        |
| 9. | Rearrange  | Change positions of terms using inverse operations  |                        |

### Changing the subject of a formula (rearranging)

|     |  |   |  |
|-----|--|---|--|
|     | Always use inverse operations to isolate the term you have been asked to make the subject        |   |  |
| 10. | <p>Make <math>u</math> the subject:</p> $v = u + at$ $(-at)$ $v - at = u$ <p>So</p> $u = v - at$ | <p>Make <math>u</math> the subject:</p> $v^2 = u^2 + 2as$ $(-2as)$ $v^2 - 2as = u^2$ $(\sqrt{\quad})$ $\sqrt{v^2 - 2as} = u$ <p>So</p> $u = \sqrt{v^2 - 2as}$ |  |

### Types of graphs/functions

|     |        |  |  |
|-----|--------|--|--|
| 11. | Linear | Represented by a straight line         | $y = 2x + 4$  |
|     |        | Usually represented by $y = mx + c$    |  |
|     |        | Can also be given as $ax + by + c = 0$ |  |

| 12.                                    | Quadratic  | General form of<br>$ax^2 + bx + c = 0$                   | <p>Equation <math>y = 2x^2 + 6x</math></p> <p>Graph </p> <p>Table of Values</p> <table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>-3</td> <td>0</td> </tr> <tr> <td>-2</td> <td>-4</td> </tr> <tr> <td>-1</td> <td>-4</td> </tr> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>8</td> </tr> </tbody> </table> | x | y | -3 | 0 | -2 | -4 | -1 | -4 | 0 | 0 | 1 | 8 |
|--|------------|--|--|---|---|----|---|----|----|----|----|---|---|---|---|
|  |            | x  |  | y |   |    |   |    |    |    |    |   |   |   |   |
|  |            | -3   |  | 0 |   |    |   |    |    |    |    |   |   |   |   |
| -2                                     | -4         |  |  |   |   |    |   |    |    |    |    |   |   |   |   |
| -1                                     | -4         |  |  |   |   |    |   |    |    |    |    |   |   |   |   |
| 0                                      | 0          |  |  |   |   |    |   |    |    |    |    |   |   |   |   |
| 1                                      | 8          |  |  |   |   |    |   |    |    |    |    |   |   |   |   |
| A positive $x^2$ will give a 'U' shape |            |  |  |   |   |    |   |    |    |    |    |   |   |   |   |
| A negative $x^2$ will give a 'n' shape |            |  |  |   |   |    |   |    |    |    |    |   |   |   |   |
| 13.                                    | Cubic      | General form of<br>$ax^3 + bx^2 + cx + d = 0$            | <p>Graph of <math>f(x) = 2x^3 - 3x^2 + 5</math>.<br/><math>b^2 - 3ac = 9</math></p> <p>Graph of <math>f(x) = -8(x-3)^3 + 27</math>.<br/><math>b^2 - 3ac = 0</math></p>   |   |   |    |   |    |    |    |    |   |   |   |   |
|  |            | Can have 1, 2 or 3 roots                                 |  |   |   |    |   |    |    |    |    |   |   |   |   |
| 14.                                    | Asymptote  | A line a graph will get very close to but will not touch |  |   |   |    |   |    |    |    |    |   |   |   |   |
| 15.                                    | Reciprocal | General form of $y = \frac{k}{x}$ where k is a number    | <p><math>y = \frac{k}{x}</math> (positive)</p> <p><math>y = \frac{-k}{x}</math> (negative)</p>   |   |   |    |   |    |    |    |    |   |   |   |   |
|  |            | Has two asymptotes                                       |  |   |   |    |   |    |    |    |    |   |   |   |   |

## Simultaneous equations

|     |                        |   |
|-----|------------------------|---|
| 16. | Simultaneous equations | Two equations where there are two unknown which have the same value in each |
|-----|------------------------|---|

## Solving simultaneous equations

|     |              |   |  |
|-----|--------------|---|--|
| 17. | Elimination  | Add or subtract one equation from another to eliminate a variable   | <p>If the matching coefficients have the same sign then subtract the equations</p> <ul style="list-style-type: none"> <li>✓ Same</li> <li>✓ Subtract</li> <li>✓ Substitute</li> </ul> <p>If the matching coefficients have different signs then add the equations</p> <ul style="list-style-type: none"> <li>✓ Different</li> <li>✓ Add</li> <li>✓ Substitute</li> </ul> |
|     |              | <p>If the matching coefficients have the same sign then subtract the equations</p> <ul style="list-style-type: none"> <li>✓ Same</li> <li>✓ Subtract</li> <li>✓ Substitute</li> </ul> |  |
| 18. | Substitution | Rearrange so the subject of one equation is a single variable   | Substitute this into the second equation   |
|     |              | Substitute this into the second equation  |  |
| 19. | Graphically  | The points of intersection of two graphs are the solutions to the simultaneous equations  |  |

