## KNOWLEDGE ORGANISER GUIDANCE

It is advised that you print the relevant subject knowledge organisers and have them available to you when needed at all times.

An alternative recommendation would be to download the knowledge organisers for your subjects onto your electronic devices so you can access them when needed.

With the knowledge organiser you should make revision cards to help revise and build in time during independent study to test yourself weekly on the content.

While you have independent study, you should use your Knowledge Planner to study the relevant subject's Knowledge Organiser and learn the information provided.

Haggerston School

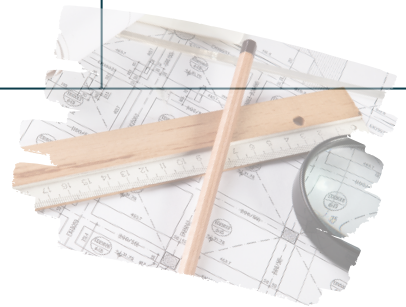
# SIXTH FORM KNOWLEDGE ORGANISER

# Maths

2023/2024

Aspiration Creativity Character

| Year 1: 1. Modeling in Mechanics | | | | | |
|---|---|---|---|---|---|
| Particle | Dimensions of the object are negligible<br>· Mass of the object is concentrated at a single point<br>· Rotational forces and air resistance can be ignored | Rough surface | · Objects in contact with the surface experience a frictional force if they are moving or acted on by a force | Friction | A force which opposes the motion between two rough surfaces |
| Rod | All dimensions but one are negligible, like a pole or a beam<br>· No thickness<br>· Ridged (does not bend or buckle) | Wire | Rigid thin length of material<br>· Treated as one dimensional | Tension | The force acting on an object if it is being pulled by string/rod |
| Lamina | Object with area but negligible thickness, like a sheet of paper<br>· Mass is distributed across a flat surface | Bead | Particle with a hole in it for threading on a wire or string<br>· Moves freely along a wire or string<br>· Tension is the same on either side of the bead | Thrust/ compression | The force acting on an object if it is being pushed by a rod |
| Centre of Mass | The geometrical centre of an object | Peg | A support from which a body can be suspended or rested<br>· Dimensionless and fixed<br>· Can be rough or smooth as specified in question | Buoyancy | The upward force on a body that allows it to float or rise when submerged in a liquid |
| Uniform body | Mass is distributed evenly<br>· Mass of the object is concentrated at a single point at the centre of mass | Air resistance | Resistance experienced as an object moves through the air<br>· Usually modeled as being negligible | Vector | A quantity that has both magnitude and direction |
| Light object | Mass is small compared to other masses, like string or a pulley<br>· Treat object as having zero mass<br>· Tension the same at both ends of a light string | Gravity | Force of attraction between all objects, acceleration due to gravity is denoted by g<br>· All objects with mass are attracted towards the Earth<br>· Earth's gravity is uniform and acts vertically downwards<br>· g is constant and is taken as 9.8ms-2, unless otherwise stated in the question | Scalar | A quantity that has magnitude only |
| Inextensible string/rod | A string/rod that does not stretch under load<br>· Acceleration is the same in objects connected by a taught inextensible string/rod | Weight | Gravitational force of an object which acts vertically downwards | | |
| Smooth surface | · Assume that there is no friction between the surface and any object on it | Normal reaction | The force which acts perpendicular to a surface when an object is in contact with the surface | | |



Mechanics

Mathematics

| 2. Constant Acceleration | |
|---|---|
| Velocity is the rate of change of … | Displacement |
| Acceleration is the rate of change of … | Velocity |
| $v =$ | $u + at$ |
| $s =$ | $\left(\frac{u+v}{2}\right)t$ |
| $v^2 =$ | $u^2 + 2as$ |
| $s =$ | $ut + \frac{1}{2}at^2$ |
| $s =$ | $vt - \frac{1}{2}at^2$ |
| g = | 9.8 m $s^{-2}$ |

| 4. Variable Acceleration | |
|---|---|
| $v =$ | $\frac{ds}{dt}$ |
| $a =$ | $\frac{dv}{dt} = \frac{d^2s}{dt^2}$ |
| $s =$ | $\int v\,dt$ |
| $v =$ | $\int a\,dt$ |

| 3. Forces and Motion | |
|---|---|
| F = | ma |
| W = | mg |
| Newton's 1st law | An object at rest will stay at rest and an object moving with constant velocity will continue to move with constant velocity unless an unbalanced force acts on an object. |
| Newton's 2nd law | The force needed to accelerate a particle is equal to the product of the mass of the particle and the acceleration produced. (F=ma) |
| Newton's 3rd law | For every action there is an equal and opposite reaction. |

| Year 2: 1. Moments | |
|---|---|
| Clockwise moment of F about P = | \|F\| x d |
| Clockwise moment of F about P = | \|F\| sin θ x d |
| Coplanar forces | Forces that act in the same plane |
| Resultant moment | The sum of the moments acting on a body |
| When a rigid body is in equilibrium… | The resultant force in any direction is 0N and the resultant moment about any point is 0N |
| Non-uniform rod | The centre of mass is not at midpoint of the rod |
| When a body is on the point of tilting about a pivot… | The reaction at any other support (or the tension in any other wire or string) is 0 |

| 2. Forces & Friction | |
|---|---|
| The component of a force | The effect of the force in the direction of motion |
| The component of a force magnitude F in a certain direction is… | Fcos θ , where θ is the size of angle between the force and the direction |
| Fmax= | μR<br>μ is the coefficient of friction, R is the normal reaction between the two surfaces |
| Resultant moment | The sum of the moments acting on a body |

Mechanics

Mathematics

| 3. Projectiles | |
|---|---|
| The horizontal motion of a projectile is modeled as having... | Constant velocity (a = 0) |
| You can use the formula s= | vt |
| The vertical motion of a projectile is modeled as having... | Constant acceleration doe to gravity (a=g) |
| Horizontal component of the initial velocity for projected particle | Ucos α |
| Vertical component of the initial velocity for projected particle | Usin α |
| U= | Initial velocity |
| α = | Angle above horizontal |
| A projectile reaches its point of greatest height when the... | Vertical component of its velocity is equal to 0 |
| Time of flight= | $\frac{2Usin\alpha}{g}$ |
| Time to reach greatest height= | $\frac{Usin\alpha}{g}$ |
| Range on horizontal plane= | $\frac{U^2 sin2\alpha}{g}$ |
| Equation of trajectory | $y = xtan\alpha - \frac{gx^2(1+tan\,\alpha^2)}{2U^2}$ |
| y | Vertical height of particle |
| x | Horizontal distance from point of projection |
| g | Acceleration due to gravity |

| 4. Application of Forces | |
|---|---|
| A particle or rigid body is in static equilibrium if... | It is at rest and the resultant force acting on the particle is 0 |
| Limiting equilibrium | When a body is on the point of moving |
| Fmax is reached when... | The body is in limiting equilibrium |
| The force of friction F is such that | $F \leq \mu R$ |
| The direction of the frictional force is opposite to... | The direction in which the body would move if the frictional force were absent |
| For a rigid body in static equilibrium | ● The body is stationary ● The resultant force in any direction is 0 ● The resultant moment is 0 |

| 5. Further Kinematics | |
|---|---|
| Position vector for particle r = | $r_o + vt$ |
| $r_o$= | Position vector for starting point |
| v= | Constant velocity |
| Displacement from initial position at time t | vt |
| Object moving in plane with constant acceleration v= | u + at |
| Object moving in plane with constant acceleration r= | $\mathbf{ut} + \frac{1}{2}\mathbf{at}^2$ |
| u= | Initial velocity |
| a= | Acceleration |
| v= | Velocity at time t |
| r= | Displacement at time t |
| If r = xi + yj, v= | $r\ i\ yj\ \frac{dr}{dt} = \dot{} = x\dot{} + \dot{}$ |
| If r = xi + yj, a= | $\frac{dr^2}{} = \ddot{} = x\ddot{} + \ddot{}$ $r\ i\ yj\ \frac{dv}{dt} = _{dt^2}$ |
| v= | $\int a\ dt$ |
| r= | $\int v\ dt$ |

# SIXTH FORM KNOWLEDGE ORGANISER

Haggerston School

Aspiration Creativity Character

Mathematics

## Statistics

| 1. Data Collection | |
|---|---|
| Population | The whole set of items that are of interest |
| Census | Observes or measures every member of the population |
| Sample | A selection of observations taken from a subset of the population |
| Sampling Unit | Individual units of a population |
| Sampling Frame | A list of sampling units which are named or numbered |
| Random Sample | Every member of the population or sample has an equal chance of being selected |
| Systematic Sampling | The population is placed in an ordered list and the sample is chosen at regular intervals, choosing the start position randomly |
| Stratified Sample | The population is proportionally divided into mutually exclusive groups and a random sample is taken from each group |
| Quota Sampling (non-random) | An interviewer or researcher selects a sample until each quota is filled that represents the characteristics of the whole population |
| Opportunity Sampling (non-random) | Sample is taken from people who are available at the time the study is carried out and who fit the criteria you are looking for |

| Year 1: 0. Large Data Set | |
|---|---|
| Trace (Tr) | Rainfall less than 0.05 mm |
| Beaufort Scale | Another measure for mean wind speed |
| Knot | A nautical mile per hour (1kn = 1.15mph) |
| Oktas | Measures cloud cover, eighths of the sky covered by cloud |
| Decametres (Dm) | Measures daily mean visibility, greatest horizontal distance at which an object can be seen in daylight |
| Hectopascals (hPa) | Measures mean pressure |

| 2. Measures of Location & Spread | |
|---|---|
| Mean (Population) | $\mu$ |
| Mean (Sample) | $\bar{x} = \frac{\Sigma x}{n}$ |
| $S_{xx}$ = | $\Sigma(x-\bar{x})^2 = \Sigma x^2 - \frac{(\Sigma x)^2}{n}$ |
| Variance $\sigma^2$ = | $\frac{s_{xx}}{n} = \frac{\Sigma x^2}{n} - \bar{x}^2$ |
| Standard Deviation $\sigma$ = | $\sqrt{Variance}$ |
| General formula for coded data | $y = \frac{x-a}{b}$ |
| Mean (coded) | $\bar{y} = \frac{\bar{x}-a}{b}$ |
| Standard deviation (coded) | $\sigma_y = \frac{\sigma_x}{b}$ |

| 3. Representations of Data | |
|---|---|
| Common Definition for Outlier | Greater than $Q_3 + k(Q_3 - Q_1)$ Less than $Q_1 - k(Q_3 - Q_1)$ |
| Cleaning Data | The process of removing anomalies from data set |

| 4. Correlation | |
|---|---|
| Interpolation | Making an estimate of values within the range of the given data |
| Extrapolation | Making a prediction based on a value outside the range of the given data |

| 5. Probability | |
|---|---|
| Event | A collection of one or more outcomes |
| Sample Space | The set of all possible outcomes |
| Mutually Exclusive | Two events that cannot occur at the same time |
| Independent events | Events that have no effect on one another |
| P(A') | Probability A does not occur |
| P(A \| B) | Probability A occurs given that B has occurred |
| P(A $\cup$ B) for mutually exclusive events | P(A) + P(B) |
| P(A $\cap$ B) for independent events only | P(A) x P(B) |

# SIXTH FORM KNOWLEDGE ORGANISER

Haggerston School

Aspiration Creativity Character

Mathematics

Statistics

| 6. Statistical Distributions | |
|---|---|
| Criteria for Binomial Distribution: | • Fixed number of trials<br>• Two possible outcomes (success or failure)<br>• Fixed probability of success<br>• Trials are independent of each other |
| Binomial Function P(X = x) | $\binom{n}{x} p^x (1-p)^{n-x}$<br>n = number of trials, p = probability of success |

| 7. Hypothesis Testing | |
|---|---|
| $H_0$ | The null hypothesis |
| $H_1$ | The alternative hypothesis |
| Critical Region | A region of the probability distribution which, if the test statistic falls within it, would cause you to reject the null hypothesis |
| Critical Value | The first value to fall within the critical region |
| Significance Level | The probability of incorrectly rejecting the null hypothesis |
| Step 1 | Define test statistic ***X***, write its distribution and define the meaning of ***p*** in context |
| Step 2 | Write null and alternative hypotheses |
| Step 3 | Assume $H_0$ is true and determine probability of observed test statistic |
| Step 4 | Two-part conclusion: 1. Do we reject $H_0$ or not? 2. Put in context of original problem. |

| 3. The Normal Distribution | |
|---|---|
| The area under a continuous probability distribution is equal to... | 1 |
| Normally distributed random variable X~ | $N(\mu, \sigma^2)$ |
| The normal distribution has | • Parameters μ , the population mean and $\sigma^2$,the population variance<br>• Is symmetrical (mean=median=mode)<br>• Has a bell shaped curve with asymptotes at each end<br>• Has total area under the curve equal to 1<br>• Has points of inflection at<br>μ + σ *and* μ − σ |

| Year 2: 1. Regression, Correlation & Hypothesis Testing | |
|---|---|
| $y = kx^n$ | log *log y* = log *log a* + *n(logx)*, n=gradient, log a=constant |
| $y = ka^x$ | log *log y* = log *log a* + *logb(x)*, log b=gradient, log a=constant |
| The PMCC takes values between... | -1 and 1 |

| 2. Conditional Probability | |
|---|---|
| ∩ | Intersection (both must happen) |
| ∪ = | Union (either or both can happen) |
| A' | The complement of A (not A) |
| P(B I A) | Probability of B given that A has already occurred |
| For independent events P(A I B)= | P(A I B') = P(A) |
| For independent events P(B I A)= | P(B I A') = P(B) |
| P(A ∪ B) = | P(A) + P(B) - P(A ∩ B) |
| P(B I A)= | $\frac{P(A \cap B)}{P(A)}$ |
| P(A ∩ B) = | P(B I A) x P(A) |

| | |
|---|---|
| The standard normal distribution has mean= | 0 |
| The standard normal distribution has standard deviation= | 1 |
| Normal approximation for Binomial μ | np |
| Normal approximation for Binomial σ | $\sqrt{np(1-p)}$ |
| Sample mean $\overline{X}$ | $N(\mu, \frac{\sigma^2}{n})$ |
| For Z = $\frac{\overline{X}-\mu}{\frac{\sigma}{\sqrt{n}}}$, Z ~ | N(0,1) |

# SIXTH FORM KNOWLEDGE ORGANISER

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Aspiration Creativity Character

Mathematics

Year 1 & 2:
MEMORISE THESE

| Trigger words | Annotate |
|---|---|
| **Discriminant rule** | |
| no real solutions | $b^2 - 4ac < 0$ |
| repeated root | $b^2 - 4ac = 0$ |
| two equal roots | $b^2 - 4ac = 0$ |
| real solutions | $b^2 - 4ac \geqslant 0$ |
| distinct real solutions | $b^2 - 4ac > 0$ |

| Trigger words | Annotate |
|---|---|
| **Coordinate axis** | |
| At x-axis | y = 0 |
| At y-axis | x = 0 |

| Trigger words | Annotate |
|---|---|
| **Trig identities** | |
| $sin^2x + cos^2x \equiv 1$ | $\tan\theta = \frac{\sin\theta}{\cos\theta}$ |
| **Trig graphs** | |
| **Sine** |  |
| **Cosine** |  |
| **Tan** |  |

| Trigger words | Annotate |
|---|---|
| **Modelling** | |
| Linear | $y = ax + b$ |
| Quadratic | $y = a(x + b)^2 + c$ |
| | $y = ax^2 + bx + c$ |
| | $y = a(x + b)(x + c)$ |
| Trigonometry | $y = Rsin(ax + b)$ |
| | $y = Rcos(ax + b)$ |
| Exponential | $y = ab^x$ |
| Logs | $\ln y = \ln a + x\ln b$ |

| Trigger words | Annotate |
|---|---|
| **Nature of stationary point** | |
| Minimum point | $d^2y/dx^2 > 0$ |
| Maximum point | $d^2y/dx^2 < 0$ |
| Inflection point | $d^2y/dx^2 = 0$ |

| Trigger words | Annotate |
|---|---|
| **Gradient** | |
| Increasing function | $dy/dx > 0$ |
| Decreasing function | $dy/dx < 0$ |
| Stationary point | $dy/dx = 0$ |
| Minimum / maximum | $dy/dx = 0$ |
| Tangent | same gradient |
| Normal | perp. gradient |

| Trigger words | Annotate |
|---|---|
| **Intersections** | |
| intersect | substitute / sim. eqs. |
| meet | substitute / sim. eqs. |
| crosses | substitute / sim. eqs. |
| ...at one point | $b^2 - 4ac = 0$ |
| tangent | $b^2 - 4ac = 0$ |
| ...at two points / twice | $b^2 - 4ac > 0$ |
| ...never | $b^2 - 4ac < 0$ |

| Action words to BOX | | | |
|---|---|---|---|
| Exact | e, π, √, trig, a/b, logs | State | Just answer needed |
| Show that | Every step needed | Determine | Justification required |
| Prove | Formal, rigorous steps | Find / Solve / Calculate | Normal working required |
| Hence | Use part a) or b) | Show detailedreasoning | Every step needed, justification required |
| Verify | Sub values to show | Sketch | Shape, intersections |

# SIXTH FORM KNOWLEDGE ORGANISER

Haggerston School

Aspiration Creativity Character

Mathematics

Year 2 additions:
MEMORISE THESE

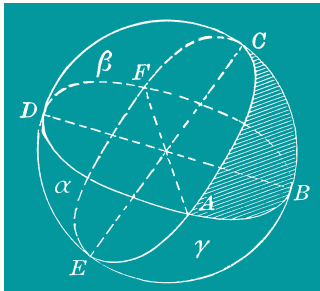
| Trigger words | Annotate |
|---|---|
| **Statistics** | |
| Probability distribution | A table of probabilities |

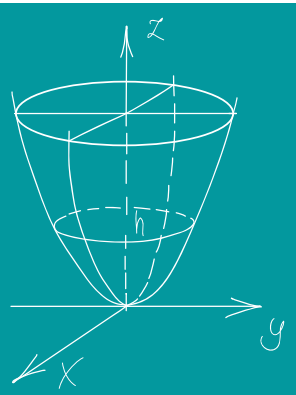
| Trigger words | Annotate |
|---|---|
| **Mechanics** | |
| Speed | Pythagoras, magnitude |

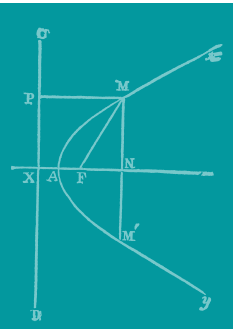
| Trigger words | Annotate |
|---|---|
| **Vectors** | |
| $\overrightarrow{AB} =$ | $\overrightarrow{OB} - \overrightarrow{OA}$ |
| Unit vector | $\hat{\mathbf{u}} = \frac{\mathbf{u}}{\lvert\mathbf{u}\rvert}$ |

**Formulas to know off by heart**

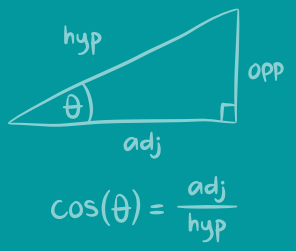
| | | | |
|---|---|---|---|
| $sin^2x + cos^2x \equiv 1$ | $\tan\theta = \frac{\sin\theta}{\cos\theta}$ | Chain rule $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ | Reciprocal $\frac{dy}{dx} = \frac{1}{\frac{dx}{dy}}$ |
| $\sec x = \frac{1}{\cos x}$ | $\sin 2A \equiv 2\sin A \cos B$ | Parametric diff. $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$ | Parametric integration $\int y \frac{dx}{dt} dt$ |
| $\operatorname{cosec} x = \frac{1}{\sin x}$ | $\cos 2A \equiv \cos^2 A - \sin^2 A$ | Product rule $\frac{dy}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$ | Quotient rule $\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ |
| $\cot x = \frac{1}{\tan x}$ | $\cos 2A \equiv 2\cos^2 A - 1$ | $y = \sin x$ | $\frac{dy}{dx} = \cos x$ |
| $1 + tan^2x \equiv sec^2x$ | $\cos 2A \equiv 1 - 2\sin^2 A$ | $y = \cos x$ | $\frac{dy}{dx} = -\sin(x)$ |
| $1 + cot^2x \equiv cosec^2x$ | $\tan 2A \equiv \frac{2\tan A}{1-\tan^2 A}$ | $y = e^x$ | $\frac{dy}{dx} = e^x$ |
| $\int \frac{1}{x} dx =$ | $\boldsymbol{\ln \lvert x\rvert + c}$ | $y = \ln x$ | $\frac{dy}{dx} = \frac{1}{x}$ |
| Integration by parts $\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$ LATE | $\int \frac{f'(x)}{f(x)}dx =$ | $\ln\lvert f(x)\rvert$ | $y = a^x$ $\frac{dy}{dx} = a^x \ln a$ |

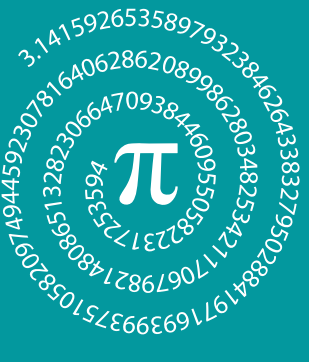






Literacy Knowledge Organiser

**SPaG**

**Grammar: Write in Sentences**

A sentence is a group of words that make sense. Sentences start with a capital letter and end with a full stop, question mark or exclamation mark. All sentences contain clauses. You should try to use a range of sentences when writing. There are three main types of sentences.

Simple sentence: A sentence containing one main clause with a **subject** and a **verb**.
**He reads**.
**Literacy is** important.

Compound sentence: Two simple sentences joined with a conjunction. Both of these simple sentences would make sense on their own. Varying conjunctions makes your writing more interesting.
**He read** his book because **it was written** by his favourite author.
**Literacy is** important so **students had** an assembly about reading.

Complex sentence: A longer sentence containing a main clause and one or more subordinate clause(s) used to add more detail. The main clause makes sense on its own. However, a subordinate clause would not make sense on its own, it needs the main clause to make sense. The subordinate clause is separated by a comma (s) and/or conjunction. The clause can go at the beginning, middle or end of the sentence.
**He read his book even though it was late.**
**Even though it was late, he read his book.**
**He read his book, even though it was late, because it was written by his favourite author.**

How can you develop your sentences?
1. Start sentences in different ways. For example, you can start sentences with adjectives, adverbs or verbs.
**Adjective: Funny** books are my favourite!
**Adverb: Regularly** reading helps me develop a reading habit.
**Verb: Looking** at the front cover is a good way to choose a reading book.
2. Use a range of **punctuation**.
3. **Nominalisation**
Nominalisation is the noun form of verbs; verbs become concepts rather than actions. Nominalisation is often used in academic writing. For example:
It is important to read because it helps you in lots of ways.
Becomes: Reading is beneficial in many ways.
Germany invaded Poland in 1939. This was the immediate cause of the Second World War breaking out. Becomes:
Germany's invasion of Poland in 1939 was the immediate cause of the outbreak of the Second World War.

| Connectives and Conjunctions | |
|---|---|
| Cause And Effect | Because<br>So<br>Consequently<br>Therefore<br>Thus |
| Addition | And<br>Also<br>In addition<br>Further (more) |
| Comparing | Whereas<br>However<br>Similarly<br>Yet<br>As with/ equally/Likewise |
| Sequencing | Firstly<br>Initially<br>Then<br>Subsequently<br>Finally<br>After |
| Emphasis | Importantly<br>Significantly<br>In particular<br>Indeed |
| Subordinate | Who, despite, until, if, while, as, although, even though, that, which |

## SPaG: Spelling and Punctuation

### Punctuation

**Use a range of punctuation accurately when you are writing.**

**. Full stop** Marks the end of a sentence.

**, Comma** Separates the items on a list or the clauses in a sentence.

**‘ Apostrophe** Shows possession (belonging) or omission (letters tak en away).

**“ ” Quotation marks** Indicate a quotation or speech.

**‘ ’ Inverted commas** Indicate a title.

**? Question mark** Used at the end of a sentence that asks a question.

**! Exclamation mark** Used at the end of a sentence to show surprise or shock.

**: Colon** Used to introduce a list or an explanation/ elaboration/ answer to what preceded. A capital letter is only needed after a colon if you are writing a proper noun (name of person or place) or two or more sentences.

**; Semi-colon** Joins two closely related clauses that could stand alone as sentences. Also used to separate items on a complicated list. A capital letter is not needed after a semi-colon unless you are writing a proper noun (name of person or place).

**Brackets** Used to add extra information which is not essential in the sentence.

### Spelling

**Use the following strategies to help you spell tricky words.**

1. Break it into sounds (d-i-a-r-y)

2. Break it into syllables (re-mem-ber)

3. Break it into affixes (dis + satisfy)

4. Use a mnemonic (necessary - one collar, two sleeves)

5. Refer to word in the same family (muscle - muscular)

6. Say it as it sounds - spell speak (Wed-nes day)

7. Words within words (Parliament - I AM parliament)

8. Refer to etymology (bi + cycle = two + wheels)

9. Use analogy (bright, light, night, etc)

10. Use a key word to remember a spelling rule (horrible/drinkable for -ible & -able / advice/advise for -ice & -ise)

11. Apply spelling rules (writing, written)

12. Learn by sight (look-cover-say-write check)