# Highsted Knowledge Organiser

## Mathematics

## Year 11: Graphs and their Transformations

| What I need to know: | Key Vocabulary: |
|---|---|
| Be able to sketch quadratic graphs<br>Be able to apply graph transformations<br>Be able to find the gradient of a curve<br>Be able to find the area under a curve<br>Know the equation of a circle | Quadratic<br>Graph<br>Translate/stretch/reflect<br>Gradient<br>Area<br>Radius/Centre of a circle |

Student Reference Point:

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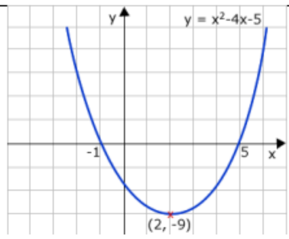
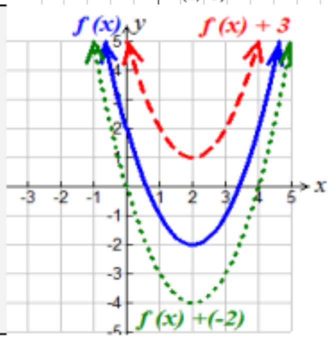
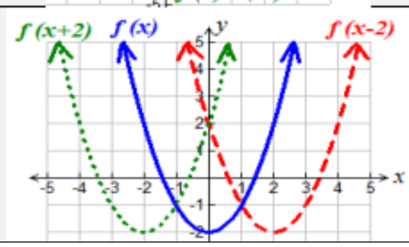
| 3. Quadratic Graph | A '**U-shaped**' curve called a **parabola**. The equation is of the form $y = \boldsymbol{ax^2 + bx + c}$, where $a$, $b$ and $c$ are numbers, $\boldsymbol{a \neq 0}$. If $\boldsymbol{a < 0}$, the parabola is **upside down**. |  |
| $f(x) + a$ | **Vertical translation** up a units. $\begin{pmatrix} 0 \\ a \end{pmatrix}$ |  |
| $f(x + a)$ | **Horizontal translation** <u>left</u> a units. $\begin{pmatrix} -a \\ 0 \end{pmatrix}$ |  |

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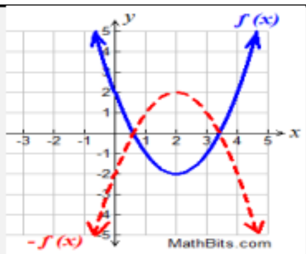
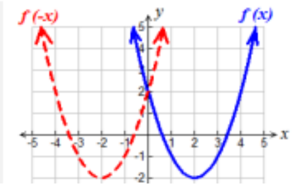
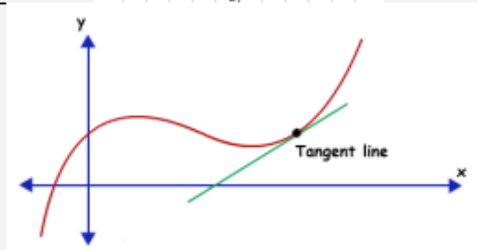
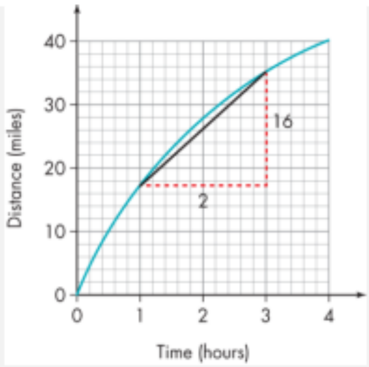
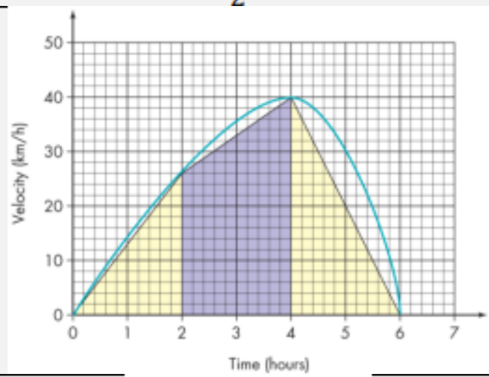
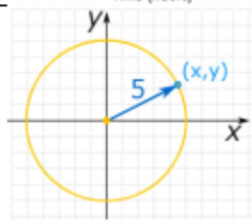
| $-f(x)$ | **Reflection** over the **x-axis**. |  |
| $f(-x)$ | **Reflection** over the **y-axis**. |  |
| 2. Tangent to a Curve | A straight **line** that **touches** a curve at **exactly one point**. |  |
| 3. Gradient of a Curve | The **gradient of a curve** at a point is the same as the **gradient of the tangent** at that point.<br><br>1. Draw a tangent carefully at the point.<br>2. Make a right-angled triangle.<br>3. Use the measurements on the axes to calculate the rise and run (change in y and change in x)<br>4. Calculate the gradient. | <br>$Gradient = \frac{Change\ in\ y}{Change\ in\ x}$<br>$= \frac{16}{2} = 8$ |
| 1. Area Under a Curve | To find the area under a curve, **split it up into simpler shapes** – such as rectangles, triangles and trapeziums – that approximate the area. |  |
| 1. Equation of a Circle | The equation of a **circle**, **centre (0,0), radius r**, is:<br><br>$x^2 + y^2 = r^2$ | <br>$x^2 + y^2 = 25$ |

**Highsted Knowledge Organiser**

**Mathematics**

**Year 11: Proof and Congruency**

| What I need to know: | Key Vocabulary: |
|---|---|
| Be able to construct algebraic agruments and proofs<br>Be able to find congruent triangles | Algebra<br>Proof<br>Arguements<br>Congruent<br>Similarity |

Student Reference Point:

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| 6. Odds and Evens | An **even** number is a **multiple of 2**<br>An **odd** number is an integer which is **not a multiple of 2**. | If n is an integer (whole number):<br><br>An even number can be represented by **2n** or **2m** etc.<br><br>An odd number can be represented by **2n-1** or **2n+1** or **2m+1** etc. |
| 7. Consecutive Integers | Whole numbers that follow each other in order. | If n is an integer:<br><br>**n, n+1, n+2** etc. are consecutive integers. |
| 8. Square Terms | A term that is produced by multiply another term by itself. | If n is an integer:<br><br>$n^2, m^2$ etc. are square integers |
| 9. Sum | The sum of two or more numbers is the value you get when you add them together. | The sum of 4 and 6 is 10 |
| 10. Product | The product of two or more numbers is the value you get when you multiply them together. | The product of 4 and 6 is 24 |
| 11. Multiple | To show that an expression is a **multiple** of a number, you need to show that you can **factor out the number**. | $4n^2 + 8n - 12$ is a multiple of 4 because it can be written as:<br><br>$4(n^2 + 2n - 3)$ |

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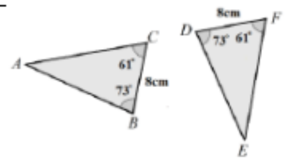
| 1. Congruent Shapes | Shapes are congruent if they are **identical** - **same shape** and **same size**.<br><br>Shapes can be rotated or reflected but still be congruent. |  |
| 2. Congruent Triangles | 4 ways of proving that two triangles are congruent:<br><br>1. **SSS** (Side, Side, Side)<br>2. **RHS** (Right angle, Hypotenuse, Side)<br>3. **SAS** (Side, Angle, Side)<br>4. **ASA** (Angle, Side, Angle) or **AAS**<br><br><u>ASS does not prove congruency.</u> | <br>$BC = DF$<br>$\angle ABC = \angle EDF$<br>$\angle ACB = \angle EFD$<br>$\therefore$ The two triangles are congruent by AAS. |
| 3. Similar Shapes | Shapes are similar if they are the **same shape but different sizes**.<br><br>The proportion of the matching sides must be the same, meaning the ratios of corresponding sides are all equal. |  |

## Highsted Knowledge Organiser

## Mathematics

## Year 11: Vectors

| What I need to know: | Key Vocabulary: |
|---|---|
| Understand and combine vectors<br>Solve simple 2D problems | Vector<br>Magnitude<br>Direction |

Student Reference Point:

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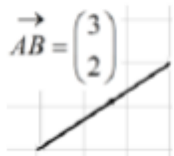
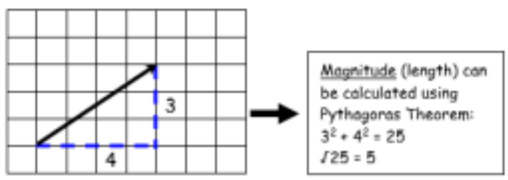
|---|---|---|
| 2. Vector Notation | A vector can be written in 3 ways:<br>**a** or $\overrightarrow{\boldsymbol{AB}}$ or $\begin{pmatrix} \mathbf{1} \\ \mathbf{3} \end{pmatrix}$ | |
| 3. Column Vector | In a column vector, the **top** number moves **left (-) or right (+)** and the **bottom** number moves **up (+) or down (-)** | $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$ means '2 right, 3 up'<br>$\begin{pmatrix} -1 \\ -5 \end{pmatrix}$ means '1 left, 5 down' |
| 4. Vector | A **vector** is a quantity represented by an arrow with both **direction** and **magnitude**.<br>$\overrightarrow{AB} = -\overrightarrow{BA}$ |  |
| 5. Magnitude | Magnitude is defined as the **length** of a vector. |  |
| 6. Equal Vectors | If two vectors have the **same magnitude and direction**, they are **equal**. |  |

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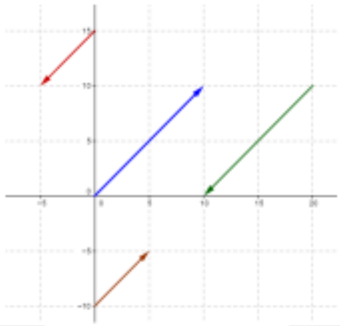
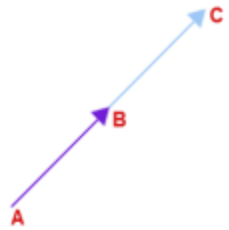
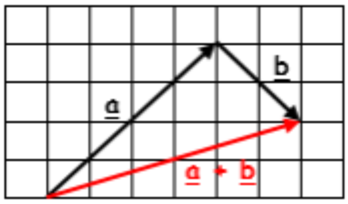
| 7. Parallel Vectors | **Parallel** vectors are **multiples** of each other. | 2**a**+**b** and 4**a**+2**b** are parallel as they are multiple of each other.  |
| 8. Collinear Vectors | **Collinear** vectors are vectors that are on the **same line**. To show that two vectors are **collinear**, show that one vector is a **multiple** of the other (parallel) **AND** that both vectors **share a point**. |  |
| 9. Resultant Vector | The **resultant** vector is the vector that results from **adding** two or more vectors together.<br><br>The resultant can also be shown by **lining up** the **head** of one vector with the **tail** of the other. | if $\underline{a} = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$ and $\underline{b} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$<br><br>then $\underline{a} + \underline{b} = \begin{pmatrix} 4 \\ 4 \end{pmatrix} + \begin{pmatrix} 2 \\ -2 \end{pmatrix} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$<br><br> |

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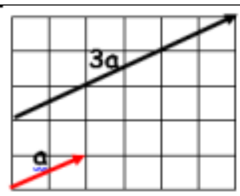
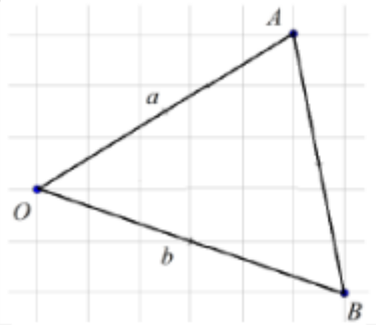
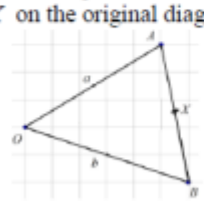
| 10. Scalar of a Vector | A **scalar** is the **number** we **multiply** a vector by. | <br>Example:<br>3a + 2b =<br>$= 3\begin{pmatrix}2\\1\end{pmatrix} + 2\begin{pmatrix}4\\-1\end{pmatrix}$<br>$= \begin{pmatrix}6\\3\end{pmatrix} + \begin{pmatrix}8\\-2\end{pmatrix}$<br>$= \begin{pmatrix}14\\1\end{pmatrix}$ |
| 11. Vector Geometry | <br>$\vec{OA} = a$ $\vec{AO} = -a$<br>$\vec{OB} = b$ $\vec{BO} = -b$<br>$\vec{AB} = \vec{AO} + \vec{OB} = -a + b = b - a$<br>$\vec{BA} = \vec{BO} + \vec{OA} = -b + a = a - b$ | **Example 1:** $X$ is the midpoint of $AB$. Find $\vec{OX}$<br>**Answer:** Draw $X$ on the original diagram<br><br>Now build up a journey.<br>You could use $\vec{OX} = \vec{OA} + \frac{1}{2}\vec{AB}$.<br>This will give: $\vec{OX} = a + \frac{1}{2}(b-a)$.<br>This will simplify to $\frac{1}{2}a + \frac{1}{2}b$ or $\frac{1}{2}(a+b)$ |