Highsted Knowledge Organiser

Mathematics

Year 10:

Quadratics

What I need to know:	Key Vocabulary:
Be able to factorise quadratics Be able to solve by factorising Be able to solve using quadratic formula Be able to solve by completing the square	Quadratic Coefficients Solve Discriminant Completing the square substitution

Student Reference Point:

When a quadratic expression is in the form $x^2 + bx + c$ find the two numbers that **add to give b** and **multiply to give c**.	$x^2 + 7x + 10 = (x + 5)(x + 2)$ (because 5 and 2 add to give 7 and multiply to give 10) $x^2 + 2x - 8 = (x + 4)(x - 2)$ (because +4 and -2 add to give +2 and multiply to give -8)
An expression of the form $\boldsymbol{a^2 - b^2}$ can be factorised to give $\boldsymbol{(a + b)(a - b)}$	$x^2 - 25 = (x + 5)(x - 5)$ $16x^2 - 81 = (4x + 9)(4x - 9)$
When a quadratic is in the form $ax^2 + bx + c$ 1. Multiply a by c = ac 2. Find two numbers that add to give b and multiply to give ac. 3. Re-write the quadratic, replacing bx with the two numbers you found. 4. Factorise in pairs – you should get the same bracket twice 5. Write your two brackets – one will be the repeated bracket, the other will be made of the factors outside each of the two brackets.	Factorise $6x^2 + 5x - 4$ 1. $6 \times -4 = -24$ 2. Two numbers that add to give +5 and multiply to give -24 are +8 and -3 3. $6x^2 + 8x - 3x - 4$ 4. Factorise in pairs: $2x(3x + 4) - 1(3x + 4)$ 5. Answer = $(3x + 4)(2x - 1)$
Factorise the quadratic in the usual way. **Solve = 0** Make sure the equation = 0 before factorising.	Solve $x^2 + 3x - 10 = 0$ Factorise: $(x + 5)(x - 2) = 0$ $x = -5$ *or* $x = 2$

A quadratic in the form $ax^2 + bx + c = 0$ can be solved using the formula: $$\boldsymbol{x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$$ Use the formula if the quadratic does not factorise easily.	Solve $3x^2 + x - 5 = 0$ Answer: $a = 3, b = 1, c = -5$ $$x = \frac{-1 \pm \sqrt{1^2 - 4 \times 3 \times -5}}{2 \times 3}$$ $$x = \frac{-1 \pm \sqrt{61}}{6}$$ $x = 1.14 \text{ or } -1.47 \text{ (2 d.p.)}$
A quadratic in the form $x^2 + bx + c$ can be written in the form $\boldsymbol{(x + p)^2 + q}$ 1. Write a set of brackets with x in and **half** the value of b. 2. Square the bracket. 3. Subtract $\left(\frac{b}{2}\right)^2$ and add c. 4. Simplify the expression. You can **use the completing the square form** to help **find the maximum or minimum** of quadratic graph.	Complete the square of $y = x^2 - 6x + 2$ Answer: $(x - 3)^2 - 3^2 + 2$ $= (x - 3)^2 - 7$ The minimum value of this expression occurs when $(x - 3)^2 = 0$, which occurs when $x = 3$ When $x = 3$, $y = 0 - 7 = -7$ Minimum point = $(3, -7)$
Complete the square in the usual way and **use inverse operations to solve**.	Solve $x^2 + 8x + 1 = 0$ Answer: $(x + 4)^2 - 4^2 + 1 = 0$ $(x + 4)^2 - 15 = 0$ $(x + 4)^2 = 15$ $(x + 4) = \pm\sqrt{15}$ $x = -4 \pm \sqrt{15}$

Highsted Knowledge Organiser

Mathematics

Year 10: Sequences

What I need to know:	Key Vocabulary:
Be able to find nth term of arithmetic sequences Be able to find the nth term of a quadratic sequence Be able to use geometric sequences Recognise and use fibonacci sequences	Nth term Sequence Arithmetic Quadratic Geometrc fibonacci

Student Reference Point:

1. Find the **difference**. 2. **Multiply that by n.** 3. Substitute $n = 1$ to **find out what number you need to add or subtract to get the first number in the sequence.**	Find the nth term of: 3, 7, 11, 15… 1. Difference is +4 2. Start with $4n$ 3. $4 \times 1 = 4$, so we need to subtract 1 to get 3. nth term = $4n - 1$
1. Find the first and second differences. 2. Halve the second difference and multiply this by n^2. 3. Substitute $n = 1,2,3,4$ ... into your expression so far. 4. Subtract this set of numbers from the corresponding terms in the sequence from the question. 5. Find the nth term of this set of numbers. 6. Combine the nth terms to find the overall nth term of the quadratic sequence. Substitute values in to check your nth term works for the sequence.	Find the nth term of: 4, 7, 14, 25, 40.. Answer: Second difference = +4 → nth term = $2n^2$ Sequence: 4, 7, 14, 25, 40 $2n^2$ 2, 8, 18, 32, 50 Difference: 2, -1, -4, -7, -10 Nth term of this set of numbers is $-3n + 5$ Overall nth term: $2n^2 - 3n + 5$

7. Geometric Sequence	A sequence of numbers where each term is found by **multiplying the previous one** by a number called the **common ratio, r**.	An example of a geometric sequence is: $2, 10, 50, 250 \ldots$ The common ratio is 5 Another example of a geometric sequence is: $81, -27, 9, -3, 1 \ldots$ The common ratio is $-\frac{1}{3}$
6. Fibonacci type sequences	A sequence where the next number is found by **adding up the previous two terms**	The Fibonacci sequence is: $1,1,2,3,5,8,13,21,34 \ldots$ An example of a Fibonacci-type sequence is: $4, 7, 11, 18, 29 \ldots$

Highsted Knowledge Organiser

Mathematics

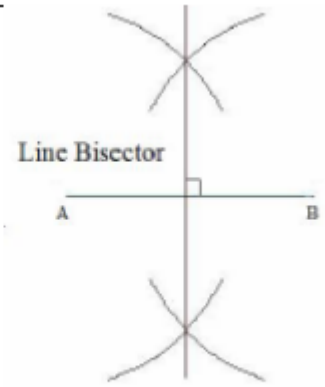
Year 10: Construction

What I need to know:	Key Vocabulary:
Be able to construct perpendicular bisectors Be able to construct angle bisectors Be able to solve loci problems Be able to use plans and elevations Be able to use bearings	Construct Perpendicular bisector Angle bisector Loci Plans/elevations bearings

Student Reference Point:

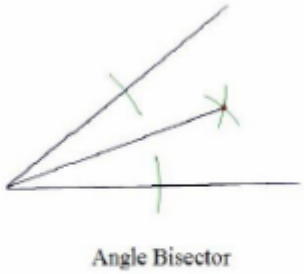
Perpendicular Bisector: Cuts a line in half and at right angles.

1. Put the sharp point of a pair of compasses on A.
2. Open the compass over half way on the line.
3. Draw an arc above and below the line.
4. Without changing the compass, repeat from point B.
5. Draw a straight line through the two intersecting arcs.



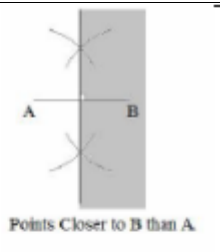
Angle Bisector: Cuts the angle in half.

1. Place the sharp end of a pair of compasses on the vertex.
2. Draw an arc, marking a point on each line.
3. Without changing the compass put the compass on each point and mark a centre point where two arcs cross over.
4. Use a ruler to draw a line through the vertex and centre point.

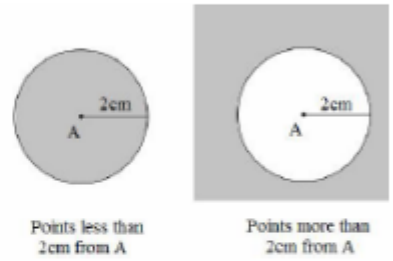


A **locus** is a **path of points that follow a rule**.

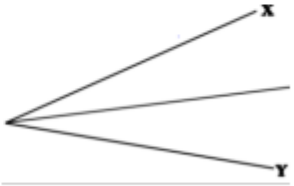
For the locus of points **closer to B than A**, create a **perpendicular bisector** between A and B and shade the side closer to B.



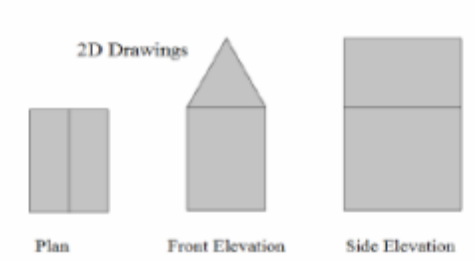
For the locus of points **equidistant from A**, use a compass to draw a **circle**, centre A.



For the locus of points **equidistant to line X and line Y**, create an **angle bisector**.



For the locus of points a set **distance from a line**, create **two semi-circles** at either end joined by **two parallel lines**.

3. Plans and Elevations	This takes 3D drawings and produces 2D drawings. **Plan View**: from **above** **Side Elevation**: from the **side** **Front Elevation**: from the **front**	 
Bearings	1. Measure from **North** (draw a North line) 2. Measure **clockwise** 3. Your answer must have **3 digits** (eg. 047°) Look out for where the bearing is measured <u>from</u>.