An tSraith Shóisearach do Mhúinteoirí

Junior CYCLE for teachers

Resource Booklet

Mathematics

Cluster Workshop

2017-18

Ionad Oideachais Mhuineacháin

AN ROINN OIDEACHAIS AGUS SCILEANNA | DEPARTMENT OF EDUCATION AND SKILLS

Contents

Principles of Junior Cycle

Learning to Learn

High quality curriculum, assessment, teaching and learning supporting students in developing greater independence and in meeting the challenges of life beyond school.

Choice & Flexibility

The school's Junior Cycle programme is broad enough to offer a wide range of learning experiences to all, and flexible enough to offer choice to meet the needs of students.

Quality

All students experience a high quality education, characterised by high expectations of learners and the pursuit of excellence.

Creativity & Innovation

Curriculum, assessment, teaching and learning provide opportunities for students to be creative and innovative.

Engagement & Participation

The experience of curriculum, assessment, teaching and learning encourages participation, generates engagement and enthusiasm, and connects with life outside the school.

Continuity & Development

Curriculum, assessment, teaching and learning enables students to build on their learning to date, recognises their progress in learning and supports their future learning.

Inclusive Education

The educational experience is inclusive of all students and contributes to equality of opportunity, participation and outcomes for all.

Wellbeing

The student experience contributes directly to their physical, mental, emotional and social wellbeing and resilience. Learning takes place in a climate focused on collective wellbeing of school, community and society.

Statements of Learning (Mathematics specification P. 6-7)

Mathematics supports a broad range of learning experiences at Junior Cycle. Table 1 below shows how Junior Cycle Mathematics is linked to central features of learning and teaching in junior cycle.

Table 1: Links between Junior Cycle Mathematics and the statements of learning

The student…

1. communicates effectively using a variety of means in a range of contexts in L1. Students organise, consolidate and communicate numerical and mathematical thinking clearly and coherently to peers, teachers and others verbally, and in written form using diagrams, graphs, tables and mathematical symbols.
14. makes informed financial decisions and develops good consumer skills Students learn to develop their critical thinking and reasoning skills by making value-for-money calculations and judgements which will enable them to make informed financial decisions.
15. recognises the potential uses of mathematical knowledge, skills and understanding in all areas of learning Students apply their mathematical knowledge and skills to a wide variety of problems across different subjects, including gathering, analysing, and presenting data, and using mathematics to model real-world situations.
16. describes, illustrates, interprets, predicts and explains patterns and relationships Students develop techniques to explore and understand patterns and relationships in both mathematical and non-mathematical contexts.
17. devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills Students develop problem-solving strategies through engaging in tasks for which the solution is not immediately obvious. They reflect on their own solution strategies to such tasks and compare them to those of others as part of a collaborative learning cycle.

18. observes and evaluates empirical events and processes and draws valid deductions and conclusions

Students generate and summarise data, select appropriate graphical or numerical methods to describe it, and draw conclusions from graphical and numerical summaries of the data. As part of their understanding of mathematical proof they come to appreciate the distinction between contingent deductions from cases, and deductions which can be proved to be universally true.

24. uses technology and digital media tools to learn, communicate, work and think collaboratively and creatively in a responsible and ethical manner

Students engage with digital technology to analyse and display data numerically and graphically; to display and explore algebraic functions and their graphs; to explore shapes and solids; to investigate geometric results in a dynamic way; and to communicate and collaborate with others.

- Developing my understanding and enjoyment of words and language
- Reading for enjoyment and with critical understanding
- Writing for different purposes
- Expressing ideas clearly and accurately
- Developing my spoken language
- Exploring and creating a variety of texts, including multi-modal texts.

- Knowing myself
- Making considered decisions
- Setting and achieving personal goals
- Being able to reflect on my own learning
- Using digital technology to manage myself and my learning

- Being healthy and physically active
- Being social
- Being safe
- Being spiritual
- Being confident
- Being positive about learning
- Being responsible, safe and ethical in using digital technology

- Being curious
- Gathering, recording, organising and evaluating information and data
- Thinking creatively and critically
- Reflecting on and evaluating my learning
- Using digital technology to access, manage and share content

- Expressing ideas mathematically
- Estimating, predicting and calculating
- Developing a positive disposition towards investigating, reasoning and problem-solving
- Seeing patterns, trends and relationships
- Gathering, interpreting and representing data
- Using digital technology to develop numeracy skills and understanding

- Imagining
- Exploring options and alternatives
- Implementing ideas and taking action
- Learning creatively
- Stimulating creativity using digital technology

- Developing good relationships and dealing with conflict
- Co-operating
- Respecting difference
- Contributing to making the world a better place
- Learning with others
- Working with others through digital technology

- Using language
- Using number
- Listening and expressing myself
- Performing and presenting
- Discussing and debating
- Using digital technology to communicate

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NCCA
An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

www.juniorcycle.ie

Rationale (Mathematics specification P. 4)

The mathematics specification provides students with access to important mathematical ideas to develop the mathematical knowledge and skills that they will draw on in their personal and work lives. This specification also provides students, as lifelong learners, with the basis on which further study and research in mathematics and many other fields are built.

Mathematical ideas have evolved across societies and cultures over thousands of years, and are constantly developing. Digital technologies are facilitating this expansion of ideas and provide new tools for mathematical exploration and invention. While the usefulness of mathematics for problem solving is well known, mathematics also has a fundamental role in both enabling and sustaining cultural, social, economic and technological advances and empowering individuals to become critical citizens.

The specification is underpinned by the conception of mathematics as an interconnected body of ideas and reasoning processes that students negotiate collaboratively with teachers and their peers and as independent learners. Number, measurement and geometry, statistics and probability are common aspects of most people's mathematical experiences in everyday personal, study and work situations. Equally important are the essential roles that algebra, functions and relations, logic, mathematical structure and working mathematically play in people's understanding of the natural and social worlds, and the interaction between them.

The mathematics specification builds on students' prior learning and focuses on developing increasingly sophisticated and refined mathematical understanding, fluency, reasoning, computational thinking and problem solving. These capabilities enable students to respond to familiar and unfamiliar situations by employing mathematics to make informed decisions and solve problems efficiently.

The specification supports student learning across the whole educational system by ensuring that the links between the various components of mathematics, as well as the relationship between mathematics and other subjects, are emphasised. Mathematics is composed of multiple but interrelated and interdependent concepts and structures which students can apply beyond the mathematics classroom. For example, in science, understanding sources of error and their impact on the confidence of conclusions is vital; in geography, interpretation of data underpins the study of human populations and their physical environments; in history, students need to be able to imagine timelines and time frames to reconcile related events; and in English, deriving quantitative, logical and spatial information is an important aspect of making meaning of texts. Thus the understanding of mathematics developed through study at junior cycle can inform and support students' learning across the whole educational system.

Aim (Mathematics specification P. 5)

The aim of junior cycle mathematics is to provide relevant and challenging opportunities for all students to become mathematically proficient so that they can cope with the mathematical challenges of daily life and enable them to continue their study of mathematics in senior cycle and beyond. In this specification, mathematical proficiency is conceptualised not as a one-dimensional trait but as having five interconnected and interwoven components:

- conceptual understanding—comprehension of mathematical concepts, operations, and relations
- procedural fluency—skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- strategic competence—ability to formulate, represent, and solve mathematical problems in both familiar and unfamiliar contexts
- adaptive reasoning—capacity for logical thought, reflection, explanation, justification and communication
- productive disposition—habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence, perseverance and one's own efficacy.

Learning Outcomes

Learning outcomes are statements in curriculum specifications to describe the **knowledge**, **understanding**, **skills** and **values** students should be able to demonstrate after a period of learning

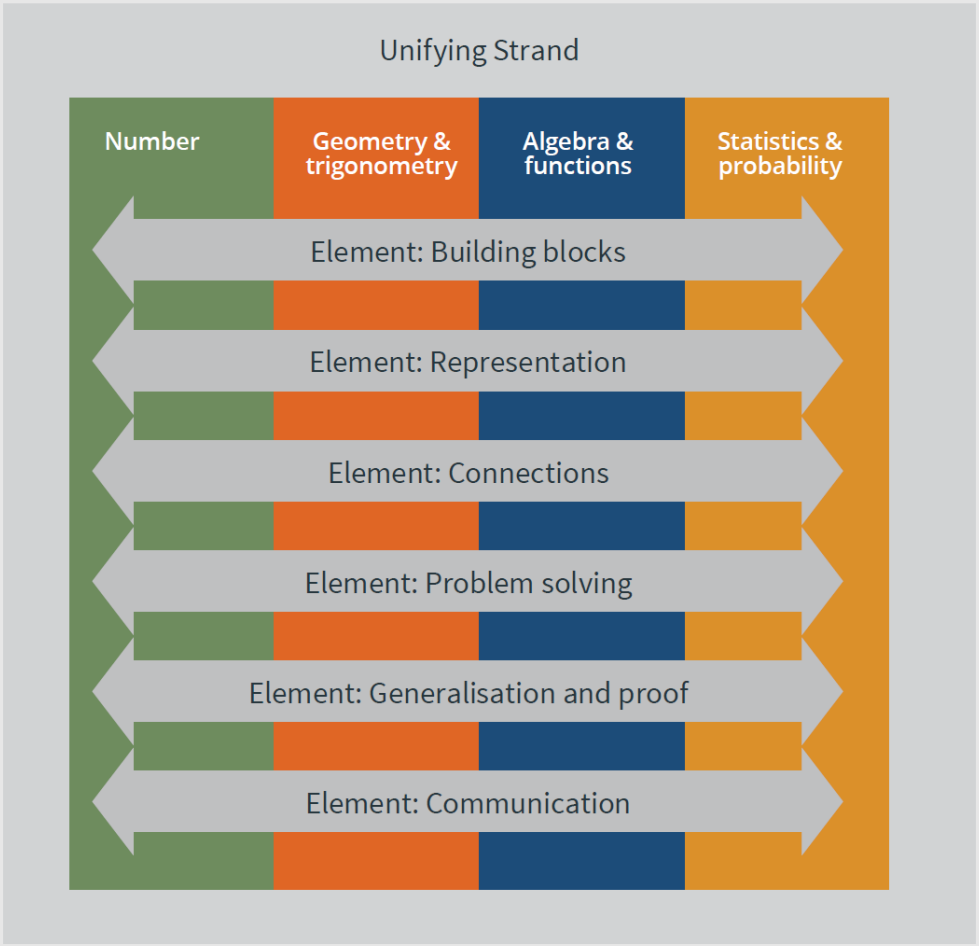
- Junior Cycle Framework (2015, p10)

GT.2: Students should be able to investigate 2D shapes and 3D solids

Knowledge	Skills	Understanding	Value
Students should know the properties of the specified 2D shapes and 3D solids. Students should be able to calculate the perimeter and area of specified 2D shapes and volume and surface area of 3D solids as specified. Students should be able to draw and interpret scaled diagrams.	Students should be able to physically manipulate 2D shapes to create 3D solids. Students should be able to use mathematical language appropiately and accuartely. Students should be able to visualise and cognitively manipulate 2D shapes and 3D solids. [Spatial Thinking]. Students should begin to develop their ability to reason geometrically.	Students should understand that not all compound shapes form nets. Students should understand the complex relationship between perimeter and area, and volume and surface area. Students should understand that 2D shapes and 3D solids are related to each other. Students should begin to understand the key geometric ideas of symmetry, invariance, similarity, congruence (and transformation) in 2D shapes and in 3D solids where appropriate.	Students should value and appreciate the importance and significance of 2D shapes and 3D solids in the context of the real world and their lives generally. Students should value the the study 2D shapes and 3D solids in terms of their connections to other areas of mathematics i.e. students should come to value the interconnectedness of mathematics as a body of ideas.

Unifying Strand – Elements (Mathematics specification P.12)

Elements	
Building blocks	Students should understand and recall the concepts that underpin each strand, and be able to carry out the resulting procedures accurately, effectively, and appropriately.
Representation	Students should be able to represent a mathematical situation in a variety of different ways and translate flexibly between them.
Connections	Students should be able to make connections within strands and between strands, as well as connections between mathematics and the real world.
Problem solving	Students should be able to investigate patterns, formulate conjectures, and engage in tasks in which the solution is not immediately obvious, in familiar and unfamiliar contexts.
Generalisation and Proof	Students should be able to move from specific instances to general mathematical statements, and to present and evaluate mathematical arguments and proofs.
Communication	Students should be able to communicate mathematics effectively in verbal and written form.



Action Verb	Students should be able to
	work out a numerical answer
	use properties of shapes and geometric results to draw accurately, using only the prescribed geometrical tools
	change from one form to another
	give the number in the required form (for example a multiple of 100, or a number with three significant figures) that is closet in absolute terms to a particular number
	use knowledge and understanding to explain the meaning of something in context
	have detailed knowledge of, be able to use appropriately, and see the connections between parts
	demonstrate that a statement is true
	give a deductive argument to demonstrate that a particular statement is true, including reasons for each step in the argument
	offer a considered, balanced review that includes a range of arguments, factors or hypotheses; opinions or conclusions should be presented clearly and supported by appropriate evidence
	give an account of the similarities and (or) differences between two (or more) items or situations, referring to both (all) of them throughout
	generate a mathematical representation (e.g. graph, equation, geometric figure) to describe a particular aspect of a phenomenon
	give a reasoned account, showing how causes lead to outcomes
	provide a concise statement with little or no supporting argument

Match the action verb to the correct statement:

interpret **prove** **understand** **round** **calculate** **mathematise**

compare **state** **explain** **discuss** **verify** **convert** **construct**

Action Verb	Students should be able to
	state or calculate a rough value for a particular quantity
	[a set]: give a rule that identifies the elements of a set
	work out an answer or solution to
	select and use knowledge and/or skills to solve a problem in a new situation
	give valid reasons or evidence to support an answer or conclusion
	judge the relative quality or validity of something, which may include analysing, comparing and contrasting, criticising, defending or judging
	observe, study or make a detailed and systematic examination to establish facts and reach new conclusions
	draw a rough diagram or graph without using geometrical tools
	study or examine something in detail, break down to bring out the essential elements or structure; identify parts and relationships, and to interpret information to reach conclusions
	group things based on common characteristics
	produce or create
	apply knowledge or rules to put theory into practice
	generate a general statement based on specific instances

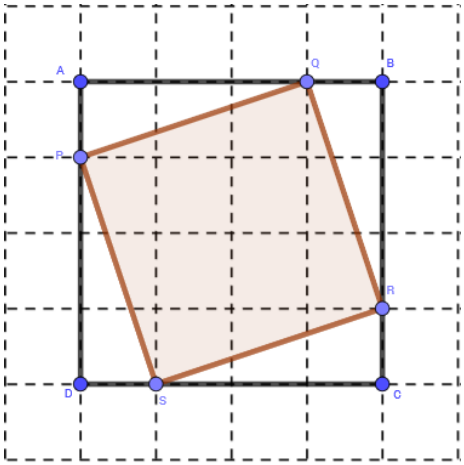
Match the action verb to the correct statement:

define **analyse** **classify** **evaluate** **apply** **investigate**

solve **justify** **sketch** **estimate** **generalise** **generate** **use**

Finding the area of the quadrilateral PQRS

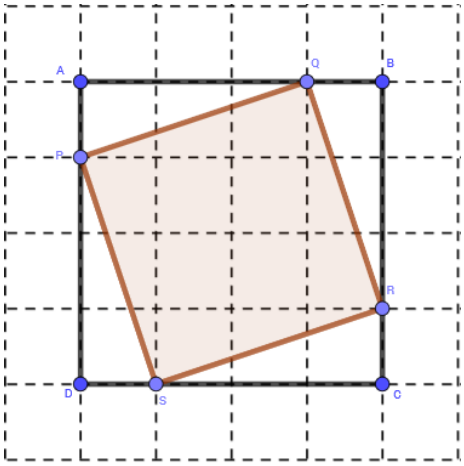
ABCD is a square. Find the area of the quadrilateral PQRS in as many ways as possible



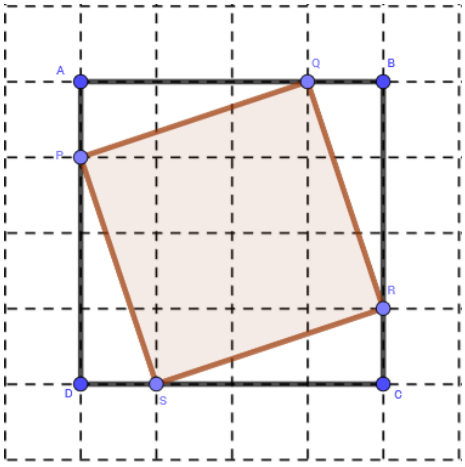
1 unit

http://www.projectmaths.ie/for-teachers/conferences/maths-counts-2015/

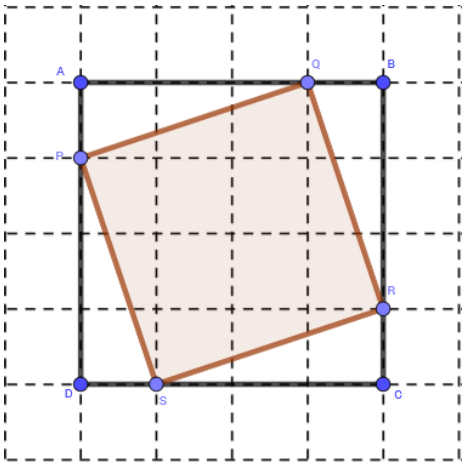
Solution 1



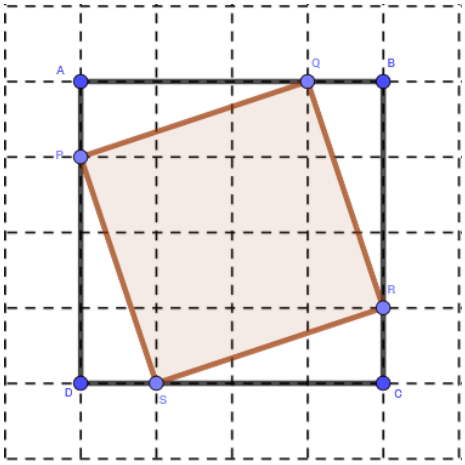
Solution 2



Solution 3



Solution 4



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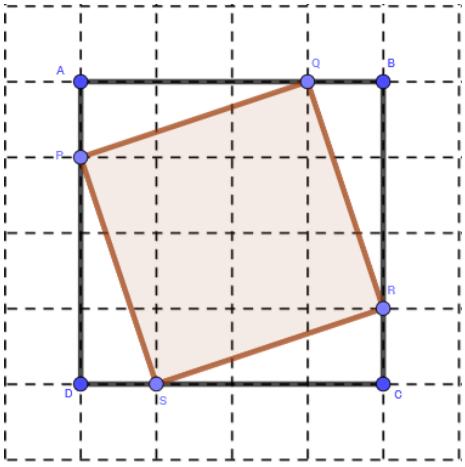
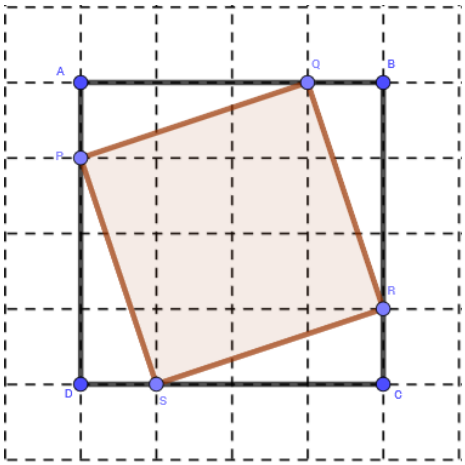
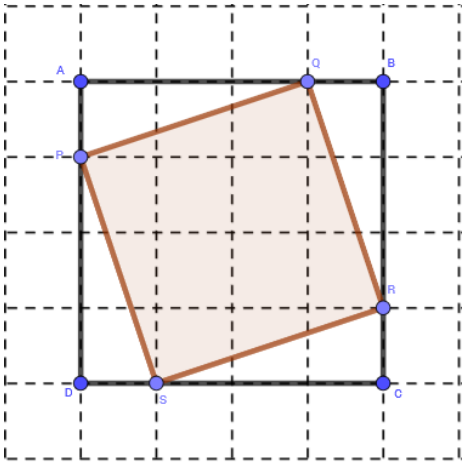


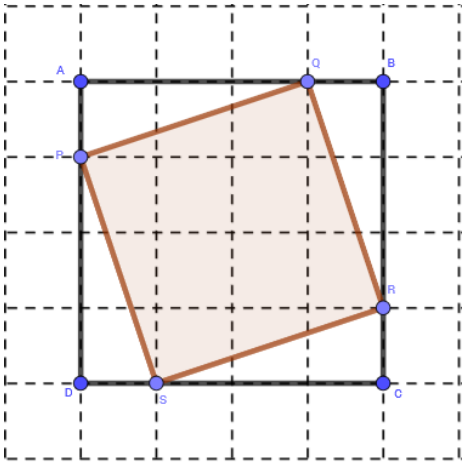
Solution 6



Solution 7



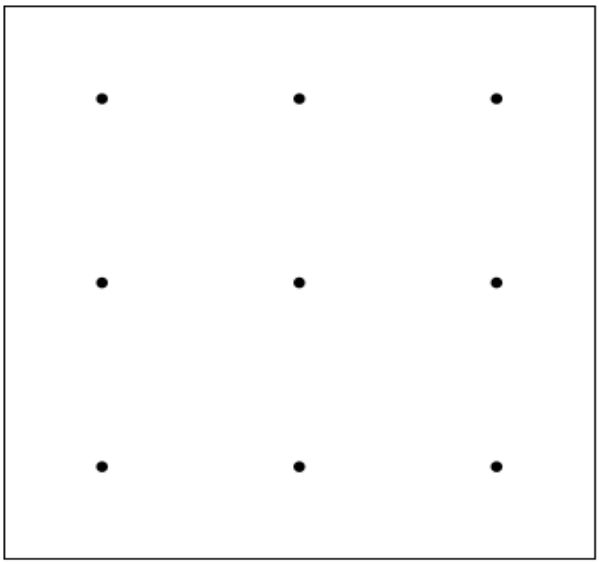
Solution 8

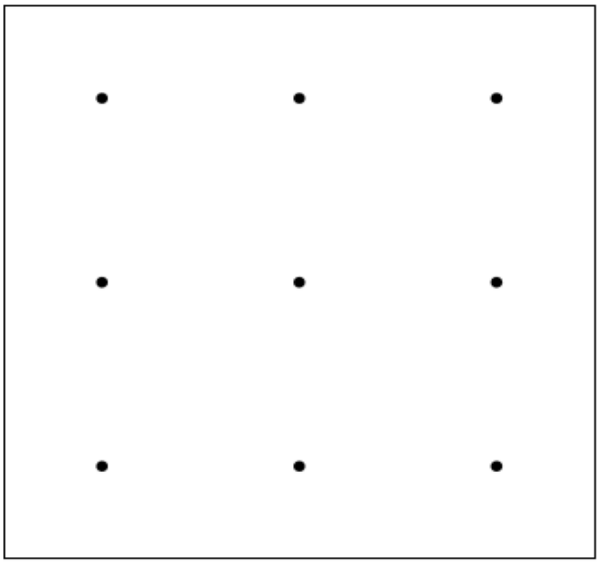


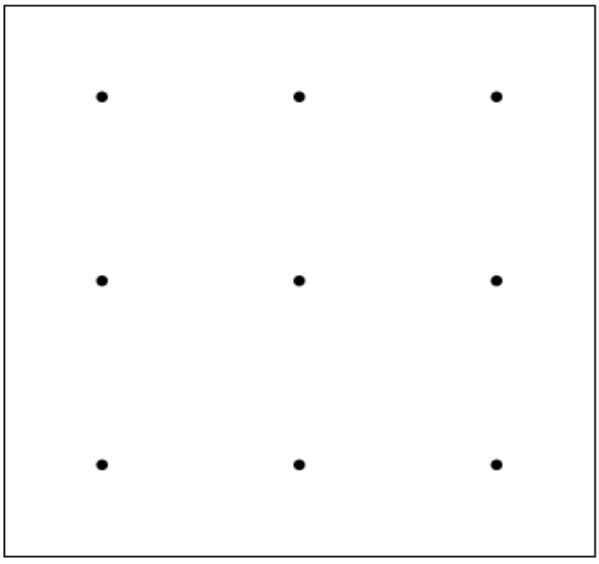
Working with Geoboards

Sketch your triangles here

Write your area calculations here







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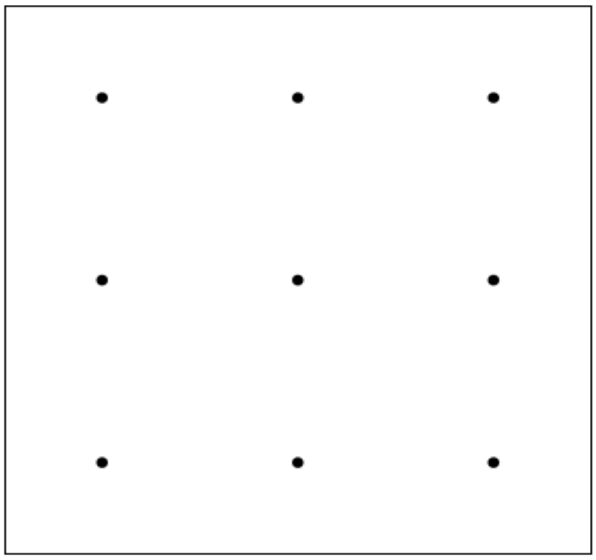

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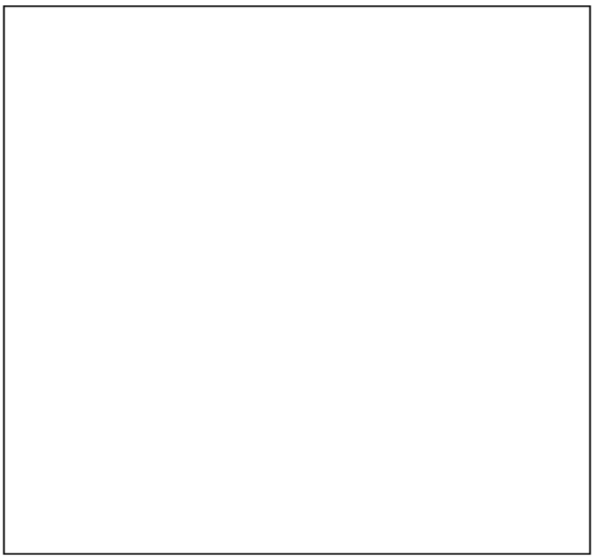
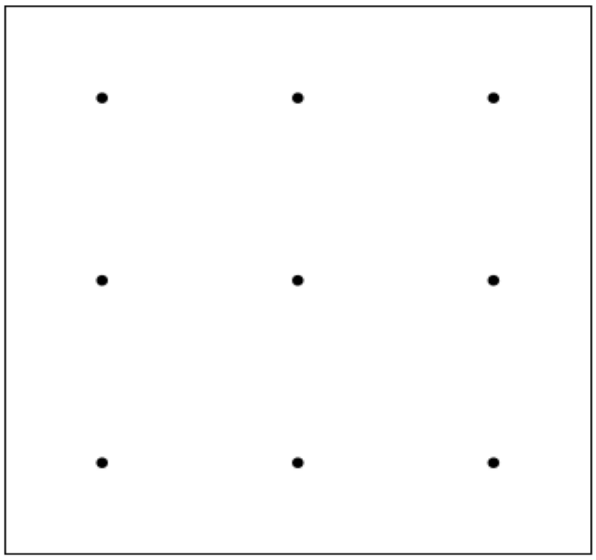
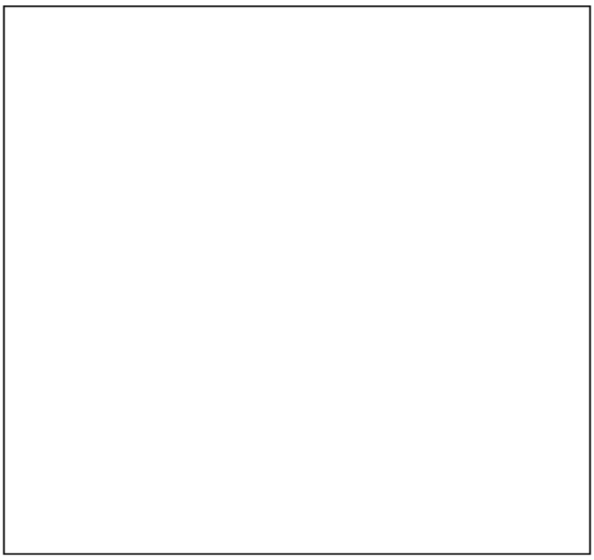
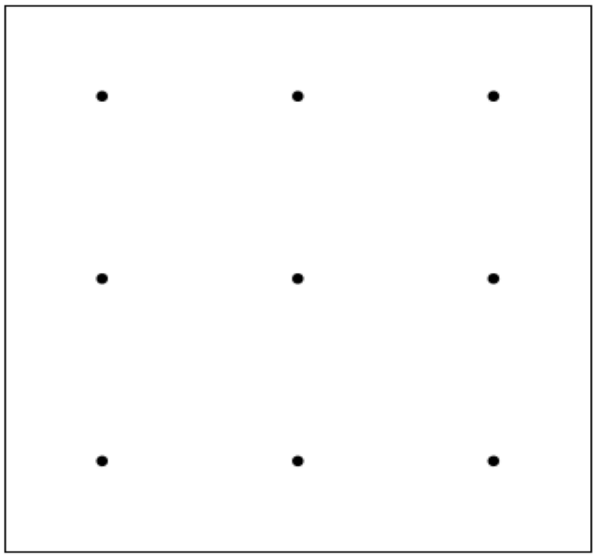
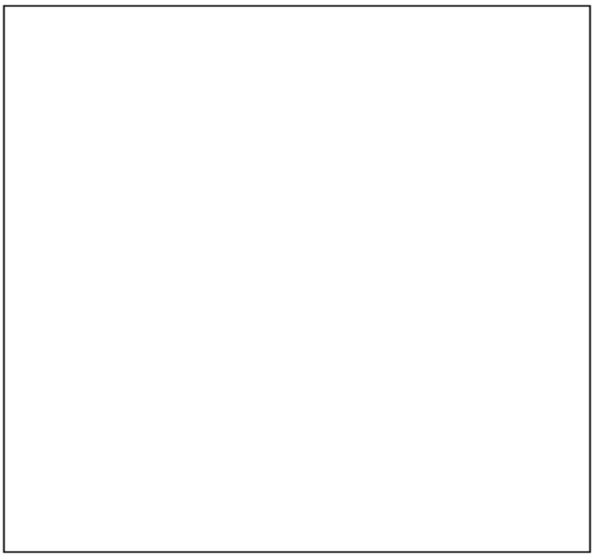
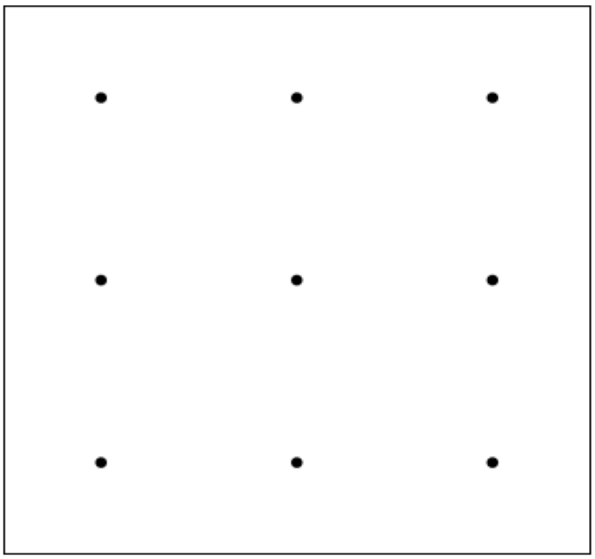


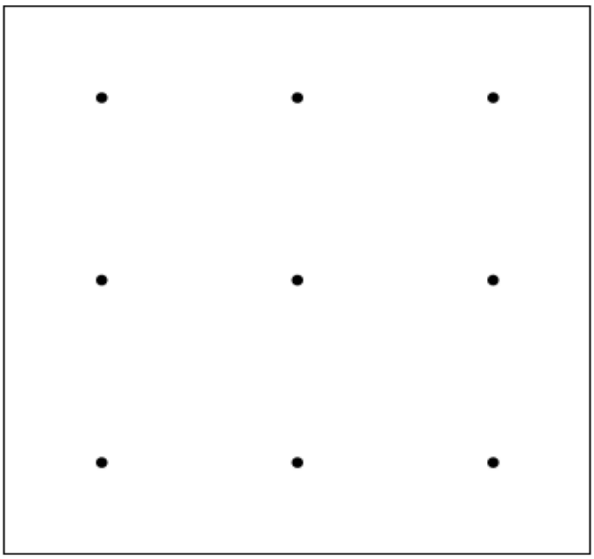


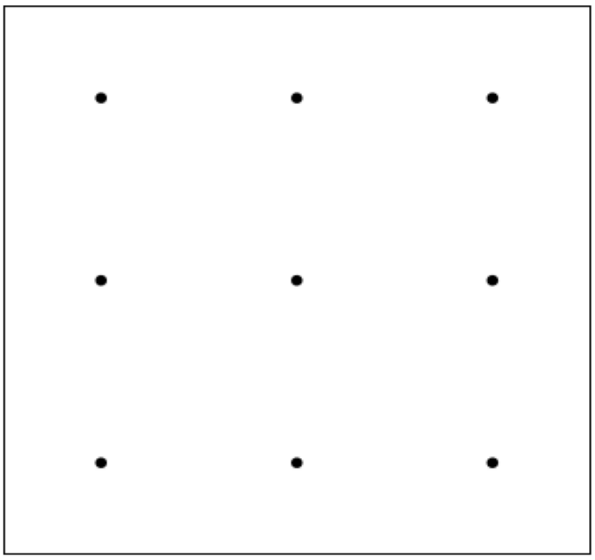


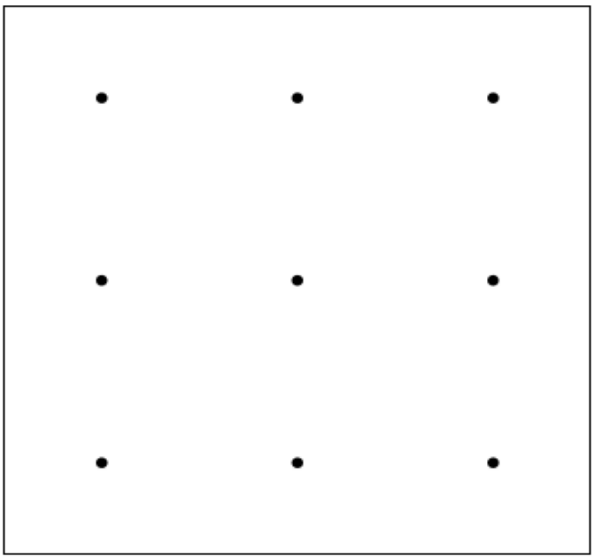


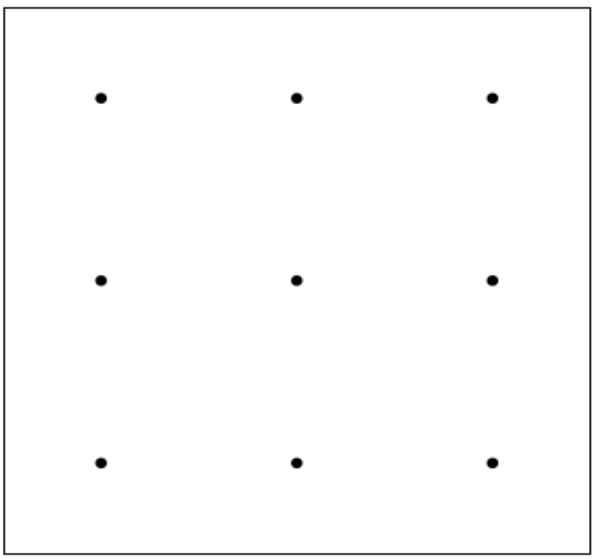


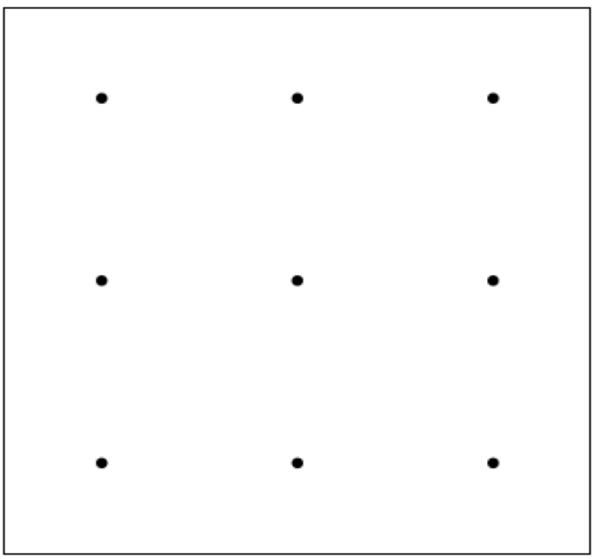












Unifying Strand

Element: Building blocks

Students should be able to:

U.1 recall and demonstrate understanding of the fundamental concepts and procedures that underpin each strand

U.2 apply the procedures associated with each strand accurately, effectively, and appropriately

U.3. recognise that equality is a relationship in which two mathematical expressions have the same value

Element: Representation

Students should be able to:

U.4 represent a mathematical situation in a variety of different ways, including: numerically, algebraically, graphically, physically, in words; and to interpret, analyse, and compare such representations

Element: Connections

Students should be able to:

U.5 make connections within and between strands

U.6 make connections between mathematics and the real world

Element: Problem solving

Students should be able to:

U.7 make sense of a given problem, and if necessary mathematise a situation

U.8 apply their knowledge and skills to solve a problem, including decomposing it into manageable parts and/or simplifying it using appropriate assumptions

U.9 interpret their solution to a problem in terms of the original question

U.10 evaluate different possible solutions to a problem, including evaluating the reasonableness of the solutions, and exploring possible improvements and/or limitations of the solutions (if any)

Element: Generalisation and proof

Students should be able to:

U.11 generate general mathematical statements or conjectures based on specific instances

U.12 generate and evaluate mathematical arguments and proofs

Element: Communication

Students should be able to:

U.13 communicate mathematics effectively: justify their reasoning, interpret their results, explain their conclusions, and use the language and notation of mathematics to express mathematical ideas precisely

Number Strand

Students should be able to:

N.1 investigate the representation of numbers and arithmetic operations so that they can

a) represent the operations of addition, subtraction, multiplication, and division in $\mathbb{N}$, $\mathbb{Z}$, and $\mathbb{Q}$ using models including the number line, decomposition, and accumulating groups of equal size

b) perform the operations of addition, subtraction, multiplication, and division and understand the relationship between these operations and the properties: commutative, associative and distributive in $\mathbb{N}$, $\mathbb{Z}$, and $\mathbb{Q}$ (**and in $\mathbb{R} \setminus \mathbb{Q}$ at HL, including operating on surds**)

c) explore numbers written as a^b (in index form) so that they can

I. flexibly translate between whole numbers and index representation of numbers

II. use and apply generalisations such as $a^p\, a^q = a^{p+q}$; $(a^p)/(a^q) = a^{p-q}$; $(a^p)^q = a^{pq}$; and $n^{1/2} = \sqrt{n}$, for $a \in \mathbb{Z}$, and p, q, $p-q$, $\sqrt{n} \in \mathbb{N}$ **(and for a, a^p, a^q, $\sqrt{n} \in \mathbb{R}$, and p, $q \in \mathbb{Q}$ at HL)**

III. use and apply the rules $\boldsymbol{a^0 = 1}$; $\boldsymbol{a^{p/q} = \sqrt[q]{a^p} = (\sqrt[q]{a})^p}$; $\boldsymbol{a^{-r} = 1/(a^r)}$; $\boldsymbol{(ab)^r = a^r\, b^r}$; **and** $\boldsymbol{(a/b)^r = (a^r)/(b^r)}$**, for** $\boldsymbol{a}$, $\boldsymbol{a^p}$, $\boldsymbol{a^q} \in \mathbb{R}$; $\boldsymbol{p}$, $\boldsymbol{q} \in \mathbb{Z}$; **and** $\boldsymbol{r} \in \mathbb{Q}$

IV. generalise numerical relationships involving operations involving numbers written in index form

V. correctly use the order of arithmetic and index operations including the use of brackets

d) calculate and interpret factors (including the highest common factor), multiples (including the lowest common multiple), and prime numbers

e) present numerical answers to the degree of accuracy specified, for example, correct to the nearest hundred, to two decimal places, or to three significant figures

f) convert the number p in decimal form to the form $a \times 10^n$, where $1 \leq a < 10$, $n \in \mathbb{Z}$, $p \in \mathbb{Q}$, and $p \geq 1$ **(and $\boldsymbol{0 < p < 1}$)**

N.2 investigate equivalent representations of rational numbers so that they can:

a) flexibly convert between fractions, decimals, and percentages

b) use and understand ratio and proportion

c) solve money-related problems including those involving bills, VAT, profit or loss, % profit or loss (on the cost price), cost price, selling price, compound interest for not more than 3 years, income tax (standard rate only), net pay (including other deductions of specified amounts), value for money calculations and judgements, **mark up (profit as a % of cost price), margin (profit as a % of selling price), compound interest, income tax and net pay (including other deductions)**

N.3 investigate situations involving proportionality so that they can:

a) use absolute and relative comparison where appropriate

b) solve problems involving proportionality including those involving currency conversion and those involving average speed, distance, and time

N.4 analyse numerical patterns in different ways, including making out tables and graphs, and continue such patterns

N.5 explore the concept of a set so that they can:

a) understand the concept of a set as a well-defined collection of elements, and that set equality is a relationship where two sets have the same elements

b) define sets by listing their elements, if finite (including in a 2-set or **3-set** Venn diagram**)**, or by generating rules that define them

c) use and understand suitable set notation and terminology, including null set, $\varnothing$, subset, $\subset$, complement, universal set, cardinal number, #, intersection, $\cap$, union, $\cup$, set difference, \ , $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, and $\mathbb{R} \setminus \mathbb{Q}$

d) perform the operations of intersection and union on 2 sets **(and on 3 sets)**, set difference, and complement, including the use of brackets to define the order of operations
e) **investigate whether the set operations of intersection, union, and difference are commutative and/or associative**

Geometry and Trigonometry Strand

Students should be able to:

GT.1 calculate, interpret, and apply units of measure and time

GT.2 investigate 2D shapes and 3D solids so that they can:

a) draw and interpret scaled diagrams
b) draw and interpret nets of rectangular solids, **prisms (polygonal bases), cylinders**
c) find the perimeter and area of plane figures made from combinations of discs, triangles, and rectangles, including relevant operations involving pi
d) find the volume of rectangular solids, cylinders, **triangular-based prisms, spheres**, and combinations of these, including relevant operations involving pi
e) find the surface area and **curved surface area (as appropriate)** of rectangular solids, **cylinders, triangular-based prisms, spheres,** and combinations of these

GT.3 investigate the concept of proof through their engagement with geometry so that they can:

a) perform constructions 1 to 15 in *Geometry for Post-Primary School Mathematics* **(constructions 3 and 7 at HL only)**
b) recall and use the concepts, axioms, theorems, corollaries and converses, specified in *Geometry for Post-Primary School Mathematics* (section 9 for OL **and section 10 for HL**)
    I. axioms 1, 2, 3, 4 and 5
    II. theorems 1, 2, 3, 4, 5, 6, 9, 10, 13, 14, 15 **and 11, 12, 19,** and appropriate converses, including relevant operations involving square roots
    III. corollaries 3, 4 **and 1, 2, 5** and appropriate converses
c) use **and explain** the terms: theorem, proof, axiom, corollary, converse, and implies
d) create and critique proofs of geometrical propositions
e) display understanding of the proofs of theorems 1, 2, 3, 4, 5, 6, 9, 10, 14, 15, **and 13**, **19;** and of corollaries 3, 4, **and 1, 2, 5** (full formal proofs are not examinable)

GT.4 find the value of and use trigonometric ratios (sin, cos, and tan, defined in terms of right-angled triangles) and their inverses, involving angles between 0° and 90° at integer values **and in decimal form**

GT.5 investigate properties of points, lines and line segments in the co-ordinate plane so that they can:

a) find and interpret: distance, midpoint, slope, point of intersection, and slopes of parallel **and perpendicular** lines
b) draw graphs of line segments and interpret such graphs in context, including discussing the rate of change (slope) and the y intercept
c) find and interpret the equation of a line in the form $y = mx + c$; $y - y_1 = m(x - x_1)$; **and $ax + by + c = 0$** (for $a, b, c, m, x_1, y_1 \in \mathbb{Q}$); including finding the slope, the y intercept, and other points on the line

GT.6 investigate transformations of simple objects so that they can:

a) recognise and draw the image of points and objects under translation, central symmetry, axial symmetry, and rotation
b) draw the axes of symmetry in shapes

Algebra and Functions Strand

Students should be able to:

AF.1 investigate patterns and relationships (linear, quadratic, doubling and tripling) in number, spatial patterns and real-world phenomena involving change so that they can:

a) represent these patterns and relationships in tables and graphs
b) write a generalised expression for linear **(and quadratic)** patterns in words and algebraic expressions and fluently convert between each representation
c) categorise patterns as linear, non-linear, **quadratic, and exponential (doubling and tripling)** using their defining characteristics as they appear in the different representations

AF.2 investigate situations in which letters stand for quantities that are variable so that they can:

a) generate and interpret expressions in which letters stand for numbers
b) find the value of expressions given the value of the variables
c) use the concept of equality to generate and interpret equations

AF.3 apply the properties of arithmetic operations and factorisation to generate equivalent expressions so that they can develop and use appropriate strategies to:

a) add, subtract and simplify
   i. linear expressions in one or more variables with coefficients in $\mathbb{Q}$
   ii. quadratic expressions in one variable with coefficients in $\mathbb{Z}$
   iii. **expressions of the form $a / (bx + c)$, where $a, b, c \in \mathbb{Z}$**
b) multiply expressions of the form
   - i. $a(bx + cy + d)$; $a(bx^2 + cx + d)$; and $ax(bx^2 + cx + d)$, where $a, b, c, d \in \mathbb{Z}$
   ii. $(ax + b)(cx + d)$ and **$(ax + b)(cx^2 + dx + e)$**, where $a, b, c, d, e \in \mathbb{Z}$
c) divide quadratic **and cubic expressions** by linear expressions, where all coefficients are integers and there is no remainder
d) flexibly convert between the factorised and expanded forms of algebraic expressions of the form:
   I. axy, where $a \in \mathbb{Z}$
   II. $axy + byz$, where $a, b \in \mathbb{Z}$
   III. $sx - ty + tx - sy$, where $s, t \in \mathbb{Z}$
   IV. $dx^2 + bx$; $x^2 + bx + c$; **(and $ax^2 + bx + c$)**, where $b, c, d \in \mathbb{Z}$ **and $a \in \mathbb{N}$**
   V. $x^2 - a^2$ **(and $a^2x^2 - b^2y^2$)**, where $a, b \in \mathbb{N}$

AF.4 select and use suitable strategies (graphic, numeric, algebraic, trial and improvement, working backwards) for finding solutions to:

a) linear equations in one variable with coefficients in $\mathbb{Q}$ and solutions in $\mathbb{Z}$ **or in $\mathbb{Q}$**
b) quadratic equations in one variable with coefficients and solutions in $\mathbb{Z}$ (**coefficients in $\mathbb{Q}$ and solutions in $\mathbb{R}$)**
c) simultaneous linear equations in two variables with coefficients and solutions in $\mathbb{Z}$ (**or in $\mathbb{Q}$)**
d) linear inequalities in one variable of the form $g(x) < k$, and graph the solution sets on the number line for $x \in \mathbb{N}$, $\mathbb{Z}$, and $\mathbb{R}$

AF.5 **generate quadratic equations given integer roots**

AF.6 **apply the relationship between operations and an understanding of the order of operations including brackets and exponents to change the subject of a formula**

AF.7 investigate functions so that they can:

a) demonstrate understanding of the concept of a function
b) represent and interpret functions in different ways—graphically (for $x \in \mathbb{N}$, $\mathbb{Z}$, and $\mathbb{R}$, [continuous functions only], as appropriate), diagrammatically, in words, and algebraically—

using the language and notation of functions (domain, range, co-domain, *f(x)* = , *f* :*x* ↦, and *y* =) (drawing a graph of a function given its algebraic expression is limited to linear and quadratic at OL)

c) use graphical methods to find and interpret approximate solutions of equations such as *f*(*x*) = *g*(*x*) **(and approximate solution sets of inequalities such as f(x) < g(x))**

d) make connections between the shape of a graph and the story of a phenomenon, including identifying and interpreting maximum and minimum points

Statistics and Probability Strand

Students should be able to:

SP.1 investigate the outcomes of experiments so that they can :

a) generate a sample space for an experiment in a systematic way, including tree diagrams for successive events and two-way tables for independent events

b) use the fundamental principle of counting to solve authentic problems

SP.2 investigate random events so that they can:

a) demonstrate understanding that probability is a measure on a scale of 0-1 of how likely an event (including an everyday event) is to occur

b) use the principle that, in the case of equally likely outcomes, the probability of an event is given by the number of outcomes of interest divided by the total number of outcomes

c) use relative frequency as an estimate of the probability of an event, given experimental data, and recognise that increasing the number of times an experiment is repeated generally leads to progressively better estimates of its theoretical probability

SP.3 carry out a statistical investigation which includes the ability to:

a) generate a statistical question

b) plan and implement a method to generate and/or source unbiased, representative data, and present this data in a frequency table

c) classify data (categorical, numerical)

d) select, draw and interpret appropriate graphical displays of univariate data, including pie charts, bar charts, line plots, histograms (equal intervals), ordered stem and leaf plots, **and ordered back-to-back stem and leaf plots**

e) select, calculate and interpret appropriate summary statistics to describe aspects of univariate data. Central tendency: mean **(including of a grouped frequency distribution)**, median, mode. Variability: range

f) evaluate the effectiveness of different graphical displays in representing data

g) discuss misconceptions and misuses of statistics

h) discuss the assumptions and limitations of conclusions drawn from sample data or graphical/numerical summaries of data

Glossary of Action Verbs (Mathematics specification P. 33)

Action Verb	Students should be able to
Calculate	work out a numerical answer
Construct	use properties of shapes and geometric results to draw accurately, using only the prescribed geometrical tools
Convert	change from one form to another
Round	give the number in the required form (for example a multiple of 100, or a number with three significant figures) that is closet in absolute terms to a particular number
Interpret	use knowledge and understanding to explain the meaning of something in context
Understand	have detailed knowledge of, be able to use appropriately, and see the connections between parts
Verify	demonstrate that a statement is true
Prove	give a deductive argument to demonstrate that a particular statement is true, including reasons for each step in the argument
Discuss	offer a considered, balanced review that includes a range of arguments, factors or hypotheses; opinions or conclusions should be presented clearly and supported by appropriate evidence
Compare	give an account of the similarities and (or) differences between two (or more) items or situations, referring to both (all) of them throughout
Mathematise	generate a mathematical representation (e.g. graph, equation, geometric figure) to describe a particular aspect of a phenomenon
Explain	give a reasoned account, showing how causes lead to outcomes
State	provide a concise statement with little or no supporting argument

Action Verb	Students should be able to
Estimate	state or calculate a rough value for a particular quantity
Define	[a set]: give a rule that identifies the elements of a set
Solve	work out an answer or solution to
Apply	select and use knowledge and/or skills to solve a problem in a new situation
Justify	give valid reasons or evidence to support an answer or conclusion
Evaluate	judge the relative quality or validity of something, which may include analysing, comparing and contrasting, criticising, defending or judging
Investigate	observe, study or make a detailed and systematic examination to establish facts and reach new conclusions
Sketch	draw a rough diagram or graph without using geometrical tools
Analyse	study or examine something in detail, break down to bring out the essential elements or structure; identify parts and relationships, and to interpret information to reach conclusions
Classify	group things based on common characteristics
Generate	produce or create
Use	apply knowledge or rules to put theory into practice
Generalise	generate a general statement based on specific instances

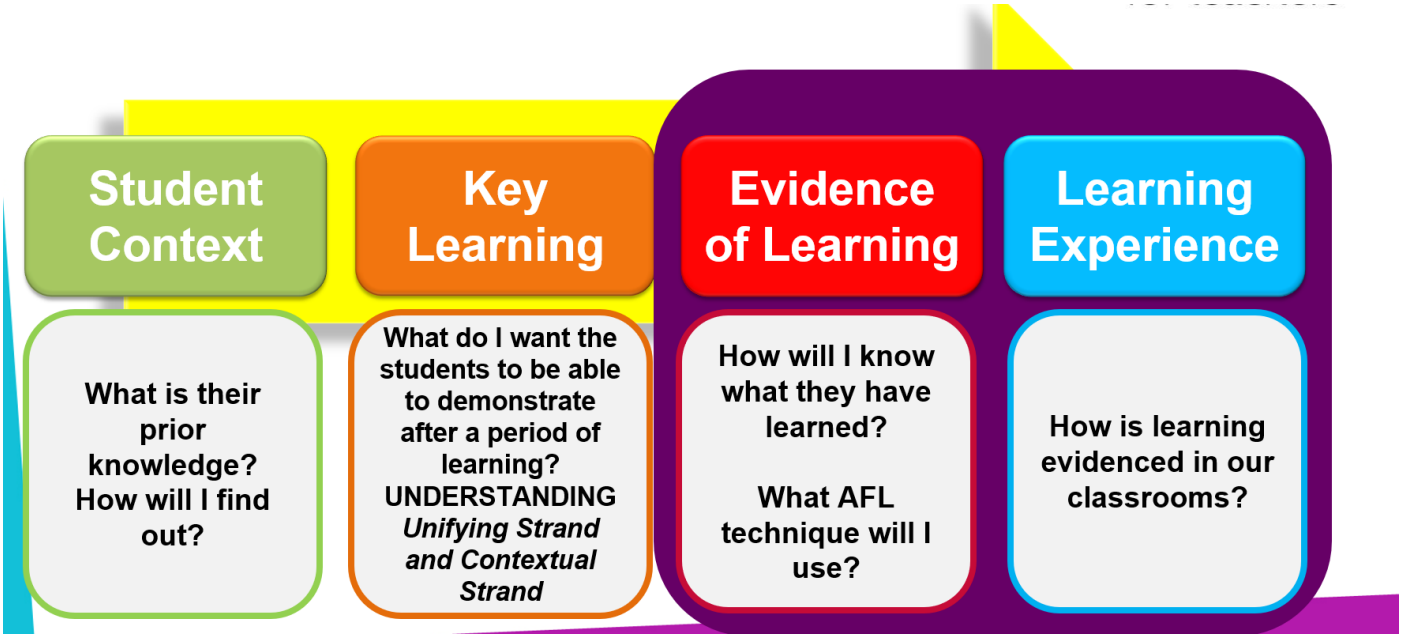
Junior Cycle Terminology

Specification	A subject or short course specification details the intended learning outcomes, and how they can be achieved and demonstrated. The specification outlines how the learning in any subject or short course is linked to particular statements of learning and key skills.
Learning Outcome	Learning outcomes are statements in curriculum specifications to describe the knowledge, understanding, skills and values students should be able to demonstrate after a period of learning
Learning Intention	A learning intention for a lesson or series of lessons is a statement, created by the teacher, which describes clearly what the teacher wants the students to know, understand and be able to do as a result of the learning and teaching activities.
Contextual Strand	The four contextual strands are; Number, Geometry and Trigonometry, Algebra and Functions, and Statistics and Probability.
Unifying Strand	The Unifying Strand permeates all of the contextual strands and is composed of the six elements of the specification. There is no specific content linked to this strand; rather, its learning outcomes underpin the rest of the specification. Each learning outcome in this strand is applicable to all of the activities and content of the other four strands
Action Verb	Each action verb is described in terms of what the learner should be able to do once they have achieved the learning outcome.
L2LP	Level 2 Learning Programmes are designed for a very specific group of students with general learning disabilities in the higher functioning moderate and low functioning mild categories. Level 2 Learning Programmes are based around Priority Learning Units (PLUs).
Priority Learning Unit (PLU)	The PLUs focus on developing the basic social, pre-vocational and life skills of the

	students involved. There are five Level 2 PLUs; Communicating and Literacy, Numeracy, Personal Care, Living in a Community and Preparing for Work.
Summative Assessment	Assessment is summative when it is used to evaluate student learning at the end of the instructional process or of a period of learning. The purpose is to summarise the students' achievements and to determine whether and to what degree the students have demonstrated understanding of that learning by comparing it against agreed success criteria or features of quality.
Formative Assessment	The Junior Cycle will be underpinned by the further integration of formative assessment as a normal part of teaching and learning in classrooms. Formative assessment involves teachers and students reflecting on how learning is progressing and deciding next steps to ensure successful outcomes. A vital part of formative assessment is the feedback that teachers provide to their students. Through a range of assessment activities the teacher helps the student to identify what has been achieved and where there is room for further learning and development. To facilitate the type of learning envisaged above, the role of the teacher and the dynamics of the teacher-student relationship will evolve. Teachers will place a greater emphasis on integrating assessment into their teaching so they can better monitor students' progress in learning and identify how they can support students to reflect on and critically analyse their own learning.
Classroom-Based Assessment (CBA)	Classroom-Based Assessments in subjects and short courses provide students with opportunities to demonstrate their understanding and skills in ways not possible in a formal examination. Classroom-Based Assessments, facilitated by the classroom teacher, are undertaken by students in a defined time period, within class contact time and to a national timetable.
Subject Learning and Assessment Review (SLAR) meeting	Following the completion of a Classroom-Based Assessment, teachers will engage in

	review meetings, where they will share and discuss samples of their assessments of student work and build common understanding about the quality of student learning.
Assessment Task	The Assessment Task is a written task completed by students during class time, and is sent to the State Examinations Commission for marking. The Assessment Task is specified by the NCCA and is related to the learning outcomes of the second Classroom-Based Assessment. The Guidelines for the Classroom-Based Assessments and Assessment Task for each subject will provide all the necessary details.
Junior Cycle Profile of Achievement (JCPA)	The JCPA is the award that students will receive at the end of their junior cycle. The award will reward achievement across all areas of learning and assessment including ongoing, formative assessment; Classroom-Based Assessments; and SEC grades, which include results from the final examinations and the Assessment Tasks.

Planning for Teaching, Learning and Assessment



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An tSraith Shóisearach do Mhúinteoirí

Junior CYCLE for teachers

Contact details:

Administrative Office:

Monaghan Ed. Centre,

Armagh Road,

Monaghan.

www.metc.ie

Director's Office:

LMETB,

Chapel Street,

Dundalk

Lots of information and resources available on our website: www.jct.ie/maths

For any queries, please contact us on one of the following:

Follow us on Twitter @JCTMaths

@JCforTeachers

Email: info@jct.ie

Phone number: 047 74008