

13+ PAST PAPER PACK

Winchester College 13+ Maths 2023

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02 Question Paper

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Name

School

Winchester Entrance and Election

Mathematics I

Thursday 4th May 2023

Time allowed: 1 hour 30 minutes

Total marks: 100

CALCULATORS ARE NOT ALLOWED.

Write your answers in this booklet. If you need additional space, please write on sheets of A4 paper and attach them to this booklet. You should show all your working so that credit may be given for partly correct answers.

Diagrams are not drawn to scale.

Do not be discouraged if you do not finish. If you get more than 60 marks you will have done well.

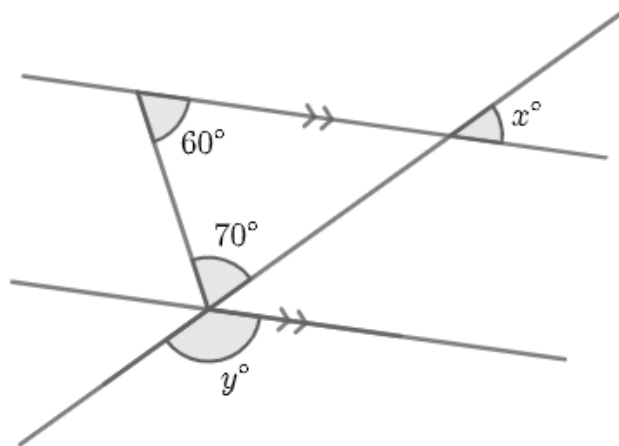
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5.	a) Fully simplify the ratio 72: 54 .	b) Divide 35 in the ratio 5:2 leaving your answer in the form $a: b$.	[2] [2]
	c) Evaluate $\sqrt{\frac{64}{16}}$.	d) Evaluate $\frac{\sqrt[3]{4 \times 6 \times 9}}{\sqrt{20 \times 6 \times 30}}$.	[2] [3]
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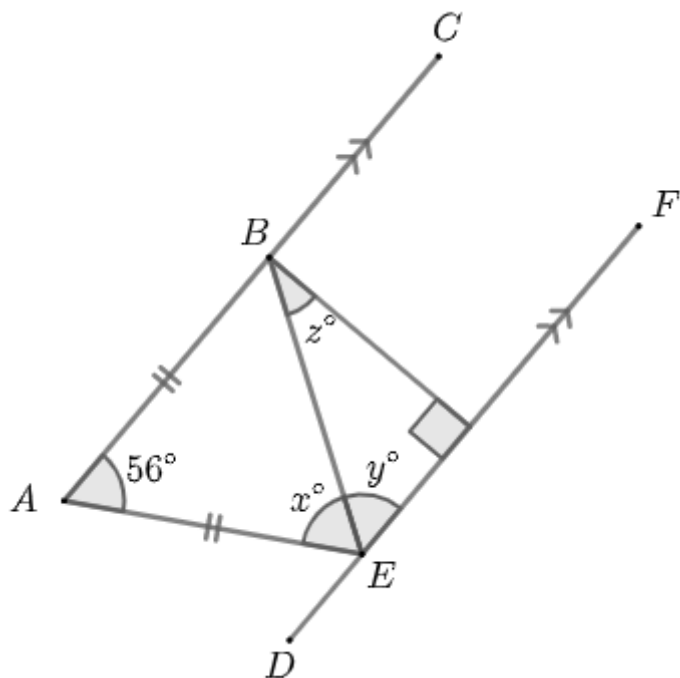
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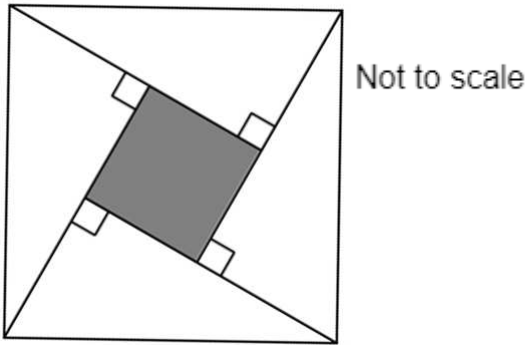
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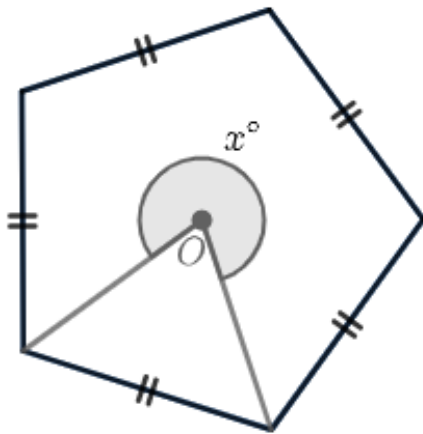
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- b) In the regular pentagon below O is the centre. Find the reflex angle x .

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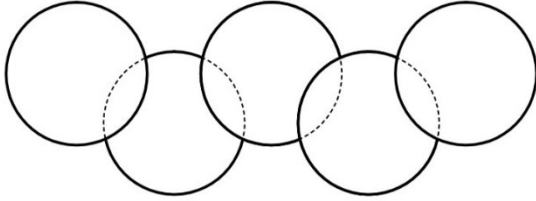


10.	a) Mr McMathma's class of five pupils had a mean score of four out of ten on their latest mathematics test. A pupil joins the class from Dr Cawnish's set and his score brings the class' mean score up to five out of ten. What was that new pupil's score? You must show detailed reasoning.	[3]
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a) What is the total area enclosed by the circles?

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b) If the radius of each circle is enlarged by a scale factor of 100, how many times larger would the area of the entire shape be?

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12. Ada, Blaise, Carl and David are given a collection of marbles to share between them. Ada takes $\frac{1}{7}$ of the marbles. Blaise then takes $\frac{1}{5}$ of the remaining marbles. From those marbles that now remain, Carl then takes $\frac{1}{3}$ of them. David is left with 32 marbles. How many marbles did Ada take?

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13. Each member of a family has the same number of children as they have siblings. For example, Alan has five siblings and also has five children.

a) How many grandchildren does Alan have?

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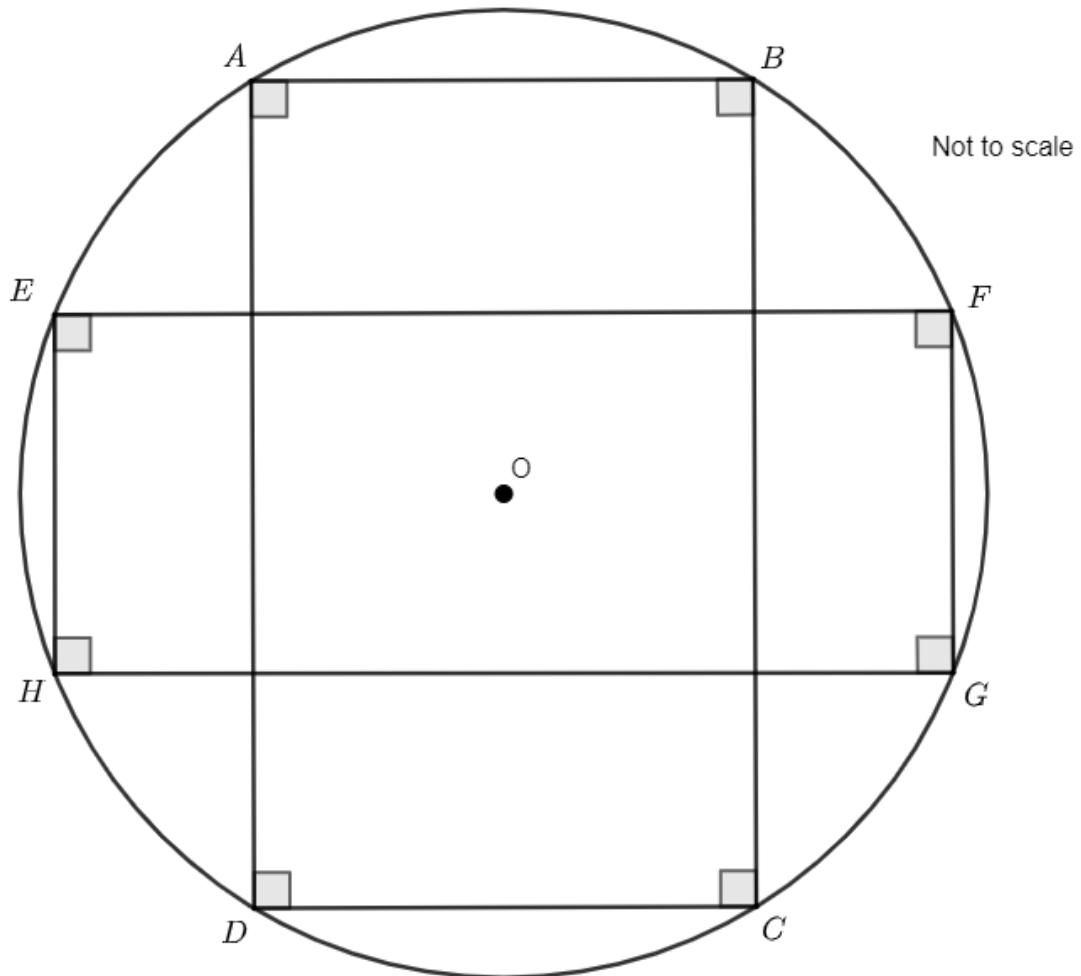
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14. Dominic gets up every day at 0700 to head to work. If he drives at an average speed of 40 mph then he is late by three minutes. If he drives at an average speed of 60 mph then he is early by three minutes. What must be Dominic's average speed in order that he gets to work on time?

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15.	a) Find the prime factorisation of 924.	[2]
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$ABCD$ and $EFGH$ are rectangles on the circumference of the circle with centre O .
 $AB = 10$ cm, $AD = 11$ cm and $EH = 5$ cm.

Find the area of the rectangle $EFGH$.

[5]

Paper Notes: 13+ Maths Question Paper (13+ Maths Past Paper (2023))

Compiled by [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk) to help you get the most from this paper.

Overview

This is a **Winchester College Entrance and Election** Mathematics I paper sat in **May 2023**. It is designed for candidates seeking entry at **13+** (Year 9 entry) and carries a total of **100 marks**, to be completed in **1 hour 30 minutes**. Calculators are not allowed, so candidates must rely on mental arithmetic, written methods, and algebraic manipulation throughout.

The paper tests a broad range of topics including arithmetic (fractions, percentages, decimals, ratios), algebra (solving equations, substitution), geometry (angles, circle theorems, area calculations), statistics (mean, median), and number theory (prime factorisation, square numbers). Questions progress from straightforward calculations in the opening items to multi-step problems requiring geometric insight, algebraic reasoning, and logical deduction later on.

This paper is well suited to strong Year 8 mathematicians preparing for competitive independent school entrance or scholarships. The final note reassures candidates that achieving more than **60 marks** represents a solid performance, signalling that the paper is designed to stretch and discriminate at the top end. Diagrams are explicitly marked as not to scale, emphasising the need for calculation rather than estimation.

How this paper is organised

The paper comprises **16 numbered questions** carrying a total of **100 marks**. Early questions are subdivided into short parts (a), (b), (c), etc., each worth one or two marks, testing basic skills such as fraction arithmetic, percentages, and simple algebra. These warm-up items build fluency and confidence before candidates encounter the more demanding later questions.

From Question 6 onwards, the allocation shifts towards multi-mark items worth three, four, or five marks each. Question 9(a) involves Pythagoras and area of a composite figure (4 marks), Question 12 is a fractional sharing problem (4 marks), and Question 16 is a challenging circle-and-rectangle geometry problem worth 5 marks. This weighting reflects the increasing demand for extended reasoning, accurate calculation, and clear written explanations as the paper progresses.

Candidates are instructed to show all working so that partial credit can be awarded for correct methods even if the final answer is incorrect. Additional A4 sheets may be

attached if needed. The rubric stresses that finishing is not expected and that over 60 marks indicates strong performance, setting realistic expectations for time management under exam conditions.

Topics covered

- Fractions of quantities, addition and subtraction of mixed numbers, division of fractions, and complex fraction expressions
- Percentages and decimal multiplication, including multi-step percentage calculations without a calculator
- Simplifying ratios and dividing quantities in a given ratio, expressed in simplest form
- Mean and median of small data sets, with contextual interpretation of averages
- Square roots and perfect squares, including expressions involving nested roots and fractional bases
- Substitution into algebraic expressions with negative and positive integers, order of operations
- Solving linear equations, including equations with fractional coefficients and nested operations
- Angle properties with parallel lines (alternate, corresponding, co-interior angles) and angle sum in polygons
- Pythagoras' theorem applied to finding missing sides and calculating areas of composite shapes
- Circle theorems, including properties of cyclic quadrilaterals and rectangles inscribed in circles
- Prime factorisation, identifying square factors, and properties of powers of 2 and 5 to determine trailing zeros
- Direct and inverse proportion, including work-rate problems with multiple workers and time constraints
- Multi-step word problems involving ratios, fractions, and arithmetic with money or discrete quantities

How to use this paper for revision

- Practise mental arithmetic with fractions, decimals, and percentages daily, as no calculator is permitted and efficient calculation saves valuable exam time.
- Revise angle theorems systematically (alternate, corresponding, co-interior, angle sum in triangles and polygons) and label diagrams clearly to track known and unknown angles.
- For multi-step word problems, write down what you know and what you need to find, then work backwards or set up an equation to link them.
- Review circle theorems, especially the angle in a semicircle and properties of cyclic quadrilaterals, as these underpin the final geometry question.
- Work through past papers under timed conditions to build stamina and learn which questions to attempt first based on your strengths.
- Show all working legibly, even for questions you find straightforward, so that method marks can be awarded if you make a numerical slip.
- Check your answers by substitution where possible (e.g. plug your solution back into the original equation) to catch arithmetic errors before moving on.

Common mistakes to avoid

- Forgetting to simplify fractions or ratios fully, losing marks for answers left in an incomplete form such as 24:18 instead of 4:3.
- Misapplying the order of operations in nested expressions, particularly when brackets and division appear together (e.g. Question 3f).
- Confusing alternate and corresponding angles when parallel lines are involved, leading to incorrect angle values and lost geometry marks.
- Dropping negative signs when substituting negative numbers into algebraic expressions, especially in products and powers.
- Failing to show intermediate steps in multi-mark questions, which prevents examiners from awarding partial credit for correct methods.
- Rushing through the final high-value questions without reading carefully, missing key information such as 'rectangle on the circumference' or 'reflex angle'.

Exam technique

Begin by scanning the entire paper to identify the questions you feel most confident about, then work through those first to bank marks quickly. The opening questions (1 to 5) are designed to be accessible and build momentum, so aim to complete them

accurately within the first 20 to 25 minutes. This leaves roughly an hour for the remaining eleven questions, which carry higher individual mark values and require more extended reasoning.

For multi-mark questions, write out each step of your working clearly and logically. Even if you cannot complete a question, set up the correct equation or draw a labelled diagram to earn method marks. If you get stuck on a question worth four or five marks, move on and return to it later rather than sacrificing time that could be spent on more accessible items. The rubric explicitly states that over 60 marks is a strong result, so there is no expectation that every candidate will finish or attempt every part.

In the final ten minutes, prioritise checking your arithmetic in the early questions (where errors are often careless) and ensuring that all answers are clearly indicated and expressed in the required form (simplified ratios, exact fractions, or whole numbers as appropriate). If time allows, revisit any high-value geometry or algebra questions where you were uncertain, as a single correct answer here can add several marks to your total.

What to revise alongside this paper

Candidates should consolidate their understanding of **proportion and ratio**, particularly inverse proportion problems involving rates of work or speed, as these appear in Questions 5(e) and 14. Reviewing the **difference of two squares** identity and other algebraic identities will help with substitution questions such as 7(c) and with simplifying expressions efficiently.

Geometry revision should include **properties of quadrilaterals** (especially rectangles and their diagonals) and **circle theorems** beyond the angle in a semicircle, such as the perpendicular from the centre to a chord and the properties of tangents. These underpin the final question and similar problems on other 13+ papers. Familiarity with **Pythagoras in coordinate geometry** and composite area calculations (subtracting or adding shapes) will also prove valuable.

For students aiming at scholarship level, consider extending into **simultaneous equations, quadratic expressions**, and **proof by contradiction or exhaustion**, as these topics occasionally appear in the most challenging items on Winchester and other top independent school papers. Practising **non-calculator arithmetic** with increasingly complex expressions (e.g. nested surds, products of fractions) builds the fluency needed to navigate this paper confidently within the time limit.

Key terms

Prime factorisation, Least common multiple (LCM), Mixed number, Improper fraction, Reciprocal, Median, Mean, Alternate angles, Corresponding angles, Co-interior angles, Cyclic quadrilateral, Pythagoras' theorem, Hypotenuse, Reflex angle, Scale factor

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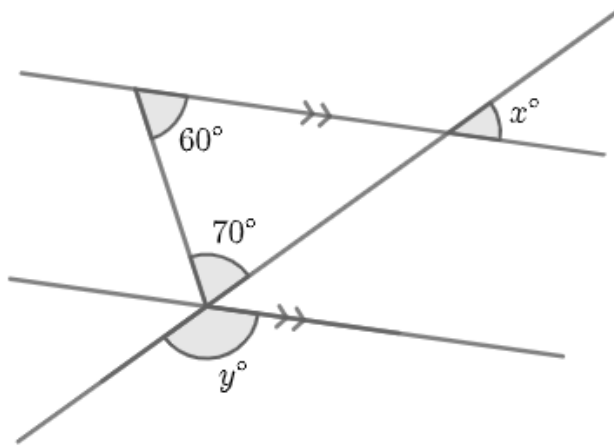
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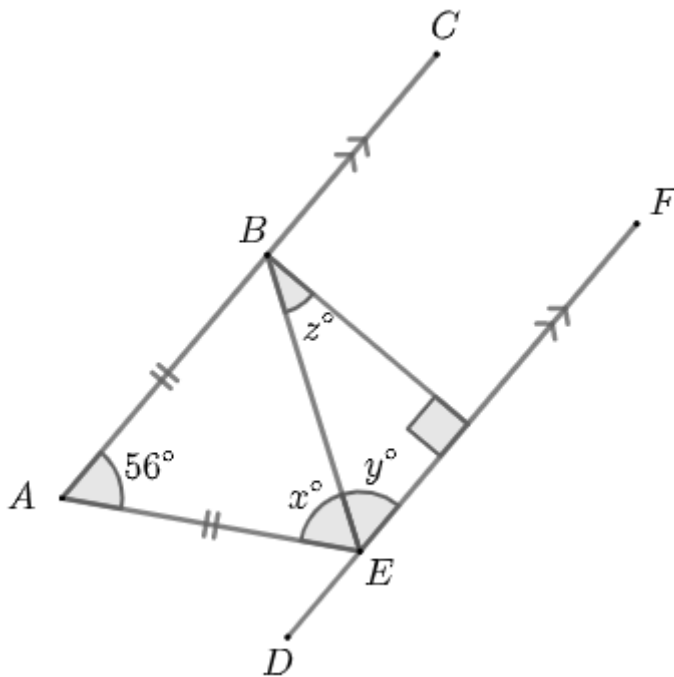
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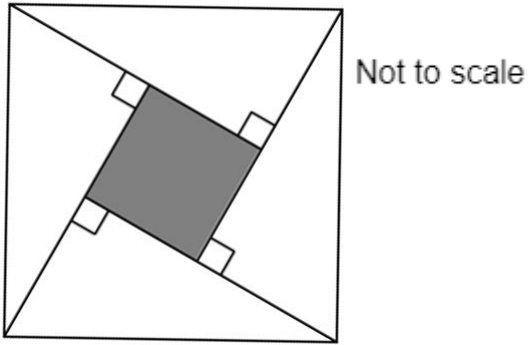
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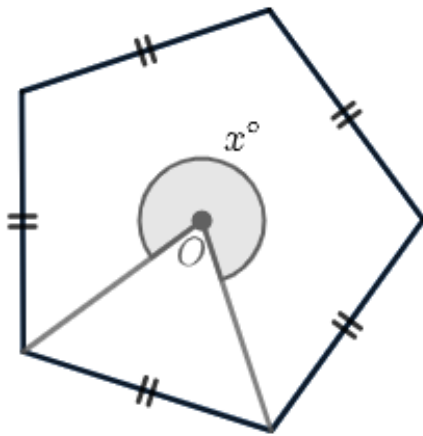
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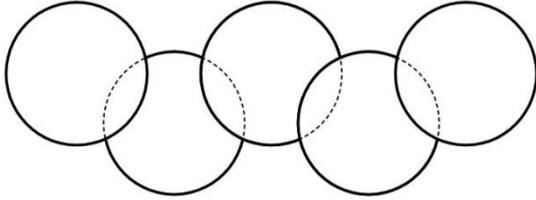


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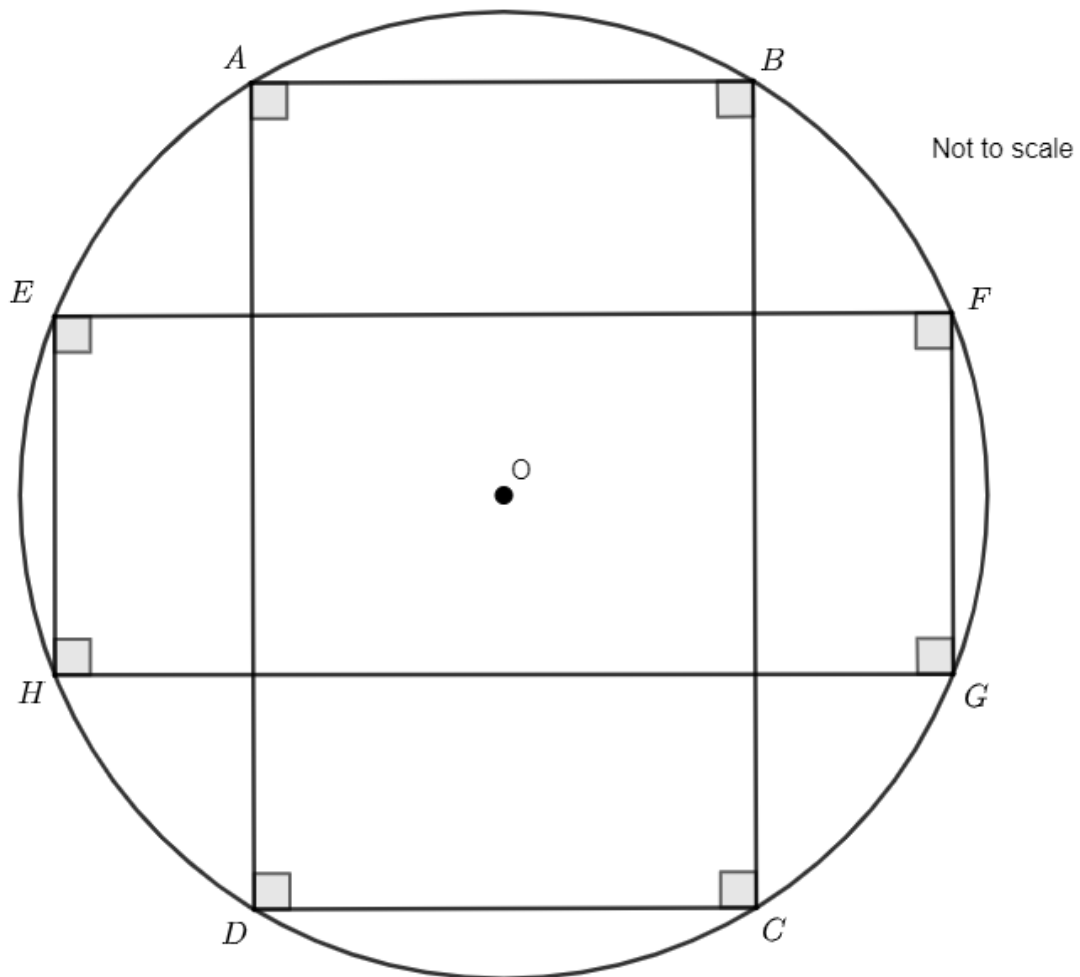
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Overview

This is the **Winchester College Entrance and Election Mathematics I** paper, sat in **May 2023**. It is a formal entrance examination for candidates applying to Winchester College for entry at 13+, one of the most academically selective independent schools in the United Kingdom. The paper assesses mathematical proficiency across a broad curriculum, from basic arithmetic and fractions through to geometry, algebra, and multi-step problem solving.

The examination is **90 minutes** long and carries **100 marks** in total. Calculators are not permitted, which places a premium on mental arithmetic, fluency with fractions and decimals, and careful algebraic manipulation. The paper comprises **16 questions** of varying difficulty, with part-marks available for method even when a final answer is incorrect. The rubric explicitly reassures candidates that scoring over 60 marks is a strong performance, acknowledging the difficulty and breadth of content.

This paper is designed for students in Year 8 preparing for 13+ entry (typically aged 12 to 13 at the time of sitting). It is well suited to high-achieving mathematicians seeking a rigorous and wide-ranging test of technique, reasoning, and problem-solving stamina. The questions span from straightforward recall to intricate geometry and combinatorial reasoning, reflecting Winchester's expectation of deep mathematical maturity.

How this paper is organised

The paper is organised as a single continuous section containing **16 questions**, many subdivided into parts (a, b, c, and so on). Questions vary in length and complexity. Early items (Questions 1 to 3) are short, single-mark calculations testing fundamental skills such as fractions of quantities, percentages, and order of operations. Mid-range questions (4 to 8) build in difficulty, introducing algebraic manipulation, ratio, surds, angle geometry, and linear equations.

From Question 9 onwards, the paper shifts to more substantial multi-step problems. These later questions award between 3 and 5 marks each and require candidates to synthesise techniques from several topics. For example, Question 9a combines Pythagoras' theorem with area subtraction, whilst Question 16 involves circle geometry and the relationship between two inscribed rectangles. Each question clearly states its mark allocation in square brackets to the right of the prompt.

Candidates write their answers directly in the booklet, with space provided below each part. Additional paper may be used if necessary, and all working must be shown to earn method marks. The total of 100 marks is distributed unevenly, with simpler items worth 1 or 2 marks and the most challenging problems worth up to 5 marks. The paper concludes with a reminder that diagrams are not drawn to scale, reinforcing the need for algebraic or logical reasoning rather than measurement by eye.

Topics covered

- Fractions of quantities and mixed-number arithmetic, including subtraction and manipulation of complex fractions
- Percentages and decimal multiplication, applied to straightforward numerical problems
- Subtraction and arithmetic with four-digit integers, testing mental fluency without a calculator
- Mean, median, and mode from small data sets, as illustrated by Percy the cat's nightly mice catch
- Order of operations, including nested brackets, division by decimals, and simplification of expressions involving roots
- Simplification of fractions and ratios, including division of a quantity in a given ratio and reducing ratios to simplest form
- Surds and roots, including evaluation of square roots of large numbers and rationalisation of nested radical expressions
- Angle geometry with parallel lines and transversals, finding unknown angles using alternate, corresponding, and co-interior angle properties
- Properties of regular polygons, including calculation of interior and reflex angles in a regular pentagon from its centre
- Solving linear equations, including fractional and nested equations requiring careful algebraic manipulation and inverse operations
- Area problems involving composite shapes, Pythagoras' theorem, and subtraction of overlapping regions (e.g. circles, rectangles, and triangles)
- Multi-step word problems on mean, percentage remaining after removal of material, and cost allocation in real-world contexts
- Prime factorisation, perfect squares, and determination of trailing zeros in large powers of integers
- Circle geometry and inscribed rectangles, requiring use of Pythagoras in conjunction with symmetry and properties of chords
- Combinatorial and logical reasoning problems, including family tree puzzles with recursive rules and fractional distribution of resources

How to use this paper for revision

- Practise mental arithmetic daily, focusing on fractions, percentages, and decimal multiplication without a calculator, as every question in this paper must be tackled unaided.
- Drill algebraic manipulation of equations with fractions and nested roots; Questions 8c and others require fluency with inverse operations and simplification under pressure.
- Review angle properties thoroughly, including alternate angles, co-interior angles, and the angle sum of polygons; draw clear diagrams and label all known angles as you work.
- Work through multi-step geometry problems from past papers, ensuring you can combine Pythagoras, area formulae, and circle theorems in a single question.
- Time yourself on full past papers to build stamina for 90 minutes of sustained problem solving; aim to attempt every question and allocate time roughly in proportion to marks available.
- Revise prime factorisation and properties of powers of 2, 5, and 10, which underpin questions on trailing zeros and perfect squares.
- Read each question stem carefully and underline key information; many Winchester questions embed subtle conditions (e.g. 'reflex angle', 'inscribed on the circumference') that guide your method.

Common mistakes to avoid

- Forgetting to simplify fractions fully or leaving answers as improper fractions when a mixed number or simplest form is required, costing easy marks.
- Misapplying order of operations, particularly when roots, brackets, and division are combined; candidates often evaluate left to right rather than respecting BIDMAS.
- Confusing alternate and corresponding angles or failing to identify which lines are parallel, leading to incorrect angle equations in Questions 6 and similar.
- Rushing multi-step problems without showing intermediate working; method marks are available even if the final answer is wrong, so every line of reasoning counts.
- Misreading the question stem in word problems, for example calculating Ada's share as a fraction of the original total rather than as an absolute number of marbles.
- Assuming diagrams are to scale and measuring angles or lengths by eye, despite the rubric's explicit warning; all geometric conclusions must be justified algebraically or logically.

Exam technique

Begin by skimming the entire paper to identify which questions look most accessible and which will require extended thinking. Tackle Questions 1 to 3 first to build confidence and secure easy marks quickly; these are designed to be completed in under ten minutes combined. Move methodically through Questions 4 to 8, writing every step of your working clearly. If you become stuck, leave space and move on rather than wasting time; returning with fresh eyes often reveals the missing insight.

Allocate roughly one mark per minute as a baseline, but be prepared to spend longer on 4- and 5-mark questions towards the end of the paper. Questions 14, 15c, and 16 are particularly demanding and may require trial and error, sketching, or setting up simultaneous relationships. Use the mark allocation as a guide: a 5-mark question will not yield to a single-line calculation. Show all working, label diagrams, and write equations in full; partial credit is generous if your method is sound.

In the final ten minutes, revisit any questions you skipped and check your arithmetic on early items. Simple slips in Questions 1 to 3 are easily corrected and cost fewer marks to fix than attempting a question beyond your reach. Remember that scoring over 60 marks is explicitly described as a strong performance, so prioritise accuracy on accessible questions rather than attempting every part at speed. If time permits, verify that each answer is in the form requested (simplest form, ratio notation, or a specific unit) and that all working is legible.

What to revise alongside this paper

Beyond the core content tested here, students should consolidate their understanding of quadratic expressions and factorisation, which underpin many algebraic manipulations at this level. Familiarity with circle theorems (tangents, chords, and angles subtended by arcs) will provide a stronger foundation for questions like 16, where properties of inscribed shapes are central. Revisiting topics such as simultaneous equations and substitution will aid with multi-variable problems, whilst practice with inequalities and algebraic proof will develop the logical rigour expected at Winchester.

Candidates should also explore problems involving sequences, series, and combinatorics, as these appear frequently in 13+ entrance papers and test mathematical reasoning beyond rote technique. Working through additional geometry problems from UKMT Intermediate Challenges or similar competitions will build confidence with unfamiliar diagrams and multi-step deductions. Finally, strengthening mental arithmetic and estimation skills will pay dividends across every section of the paper, allowing more time for the demanding reasoning questions at the end.

For those aiming at scholarship level or seeking to extend beyond this paper, topics such as modular arithmetic, proof by induction (in simple cases), and parametric reasoning offer fertile ground. Regular timed practice under exam conditions remains the most effective preparation, supplemented by careful review of mistakes and discussion of alternative methods with a teacher or tutor.

Key terms

Prime factorisation, Pythagoras' theorem, Alternate angles, Corresponding angles, Co-interior angles, Surd, Rationalisation, Median, Mean, Mixed number, Improper fraction, Reflex angle, Inscribed rectangle, Order of operations (BIDMAS), Scale factor

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