

11+ PAST PAPER PACK

Westminster School 11+ Maths 2022

Complete Past Paper Pack

CONTENTS

01 Question Paper

Westminster School 11+ Maths. Work through this paper first.

Includes Paper Notes: overview, topics, revision tips, common mistakes.

02 Question Paper

Westminster School 11+ Maths. Work through this paper first.

Includes Paper Notes: overview, topics, revision tips, common mistakes.

PRACTISE THE REAL THING

Download more free 11+ past papers at [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk)



WESTMINSTER SCHOOL
THE CHALLENGE 2022

MATHEMATICS II

Tuesday 26 April 2022

Time allowed: 1 hour 30 minutes

You will need a calculator for this paper.

All your working should be clearly shown.

You should attempt all the questions.

Please write in black or blue ink.

- 1 If $a = 6.3$ and $b = -1.4$, use your calculator to work out $(2a)^2 - b^2 - 2(a - b)^2$.
- 2 Boris completes his local Park Run in 33 minutes. Of the 5 km course, 3.7 km is tarmac, on which he was able to run at 13 kilometres per hour. The rest of the course is mud. How fast did Boris run through the mud?

- 3 a i Two quantities sum to 1. If the first quantity is $\frac{n}{n+1}$, what is the second?

ii By what would you divide $\frac{24w^2}{t}$ to get $\frac{8w}{t^2}$?

- b Make T the subject of

$$Q = \frac{H^2}{M - T}.$$

- c Simplify

$$\frac{x^2}{2x} - \frac{1}{2}(x - 3).$$

- d The solution to the equation

$$\frac{x+1}{a} + \frac{3x}{2a} = 5$$

is $x = 7$. Find a .

- 4 One British Pound Sterling is worth 30 194 Vietnamese Dong.

Before my holiday to Vietnam, I convert £30 into Vietnamese Dong. I am given the exact equivalent as a mixture of notes and coins.

In Vietnam, I only spend my Dong on sixteen bowls of Pho from my favourite street stall. Each bowl costs 29 500 Dong.

When I return, I have some 10 000 Dong notes and some Dong coins. I convert the notes back to Sterling and receive £13.91. How many Dong must I have left over in coins?

- 5 Three thieves Arnie, Bert and Clive initially divide their loot in the ratio 5 : 3 : 2. Arnie doesn't want to handle the stolen goods, so he divides his share between Bert and Clive, giving Clive £120 more than Bert. Bert and Clive find that their new shares are in the ratio 29 : 26. What was the total value of the loot?

- 6 Daniel's French teacher has set a number of long vocabulary tests so far this year (each one marked out of 100), and Daniel's average mark is exactly 78%.

Daniel works out that, if he gets 91% on the next test, then his average mark will increase to 79%. In fact, he doesn't revise at all, and his average mark slips to 76%. What mark did he get in the test?

- 7 a Yertie the tortoise's mass increases by 2% each year. If Yertie's mass is 113 kg today, what was it fifty years ago?
- b In a certain list of nine numbers, each number is produced by multiplying the previous number in the list by a fixed quantity p .

The first number in the list is $\frac{243}{2}$, and the last number is $\frac{128}{27}$.

Find the middle number in the list.

- 8 Two thousand steel ball bearings of radius 4 mm are melted down and recast into a solid cylindrical rod. Nine-tenths of the surface area of the rod is curved. Find the length of the rod.

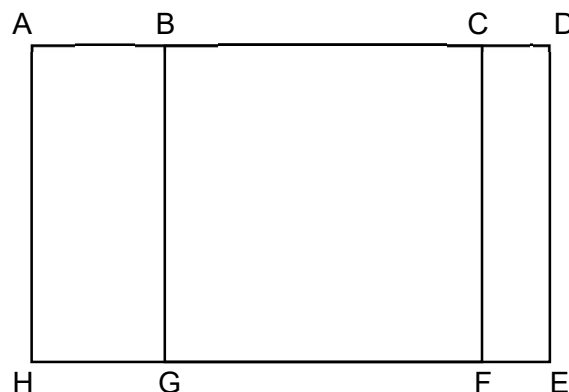
[Reminder: the volume of a sphere of radius r mm is $\frac{4}{3}\pi r^3$ mm³.]

- 9 The price of the cryptocurrency Ethereum fell by 51% during December 2021 and rose by 66% during February 2022. Overall, from the start of December 2021 to the end of February 2022, Ethereum prices fell by 32%. What was the percentage change during January 2022?

- 10 A group of three adults and five children spends £160.05 per week on chocolate. All the adults spend equal amounts, and all the children spend equal amounts.

Financial pressures require the chocolate budget to be changed to £100 per week. Each adult reduces their chocolate consumption by a half; each child, by a third. Find how much each adult and each child spends on chocolate per week after the change.

- 11 In the diagram, ABCDEFGH is a rectangle and BCFG is a square. Length AC is 15 cm and length GE is 12 cm.



- a Find the perimeter of the rectangle ABCDEFGH.
- b If the square occupies two-thirds of the area of the rectangle ABCDEFGH, find the area of the rectangle ABGH.

QUESTIONS CONTINUE OVERLEAF

- 12 A *Prodonacci* list of numbers is formed as follows:
- the first two numbers in the list are given
 - each subsequent number is one more than the product of the previous two

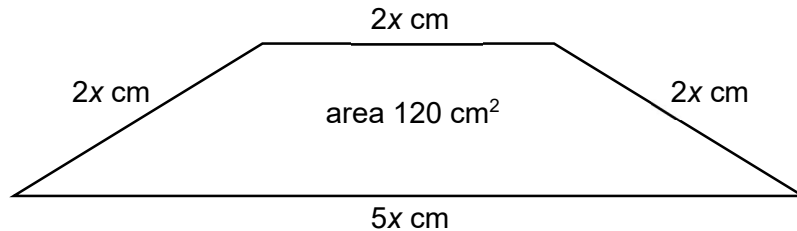
For example, a Prodonacci list might start

5 3 16 49 etc.

because $5 \times 3 + 1 = 16$ and $3 \times 16 + 1 = 49$.

The first number in a different Prodonacci list is 2 and the second is 4.

- Find the next four numbers in the list.
 - Is the 2022nd number in the list even or odd? Justify your answer.
 - Prove that no number in the list is a multiple of 10.
- 13 The diagram shows a trapezium with area 120 cm^2 .
Find x . Give your answer correct to 3 significant figures.



- 14 Two hikers, Patricia and Quentin, ascend a hill.
Patricia sets off immediately, walking at a steady speed of 2.5 km per hour.
Quentin also sets off immediately. He walks at a speed of 4 km per hour, but he has to stop for a rest for 5 minutes after every 500 metres.
- If the hill is 2.9 km long, which hiker gets to the top of the hill first, and how much longer does the other hiker take?
 - If, instead, the hill is more than 6.5 km but no more than 7 km long, explain why:
 - Patricia will definitely beat Quentin;
 - Patricia cannot beat Quentin by more than 6.5 minutes.
 - If Patricia beats Quentin to the top of the hill by nine minutes and twelve seconds, what is the shortest possible length of the hill?

END OF QUESTIONS

Paper Notes: 11+ Maths Question Paper (11+ Maths Past Paper (2022))

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

Overview

This is **Westminster School's Mathematics II** paper from **The Challenge 2022**, set on Tuesday 26 April 2022. It is part of Westminster's **11+ entrance examination** for pupils applying for Year 7 entry, one of the most selective independent school entrance exams in London. The paper tests advanced mathematical problem-solving, multi-step reasoning, and fluency with algebraic manipulation well beyond the standard primary curriculum.

Candidates are given **90 minutes** to complete the paper and are permitted to use a calculator. The questions are all free-response, requiring full working to be shown, and they cover a wide-ranging syllabus including algebra, ratio, percentages, geometric problem-solving, sequences, and sophisticated word problems. The final questions in particular demand creativity and mathematical proof.

This paper is designed to identify pupils with exceptional mathematical aptitude and stamina. It assumes familiarity with topics typically encountered in Year 7 or 8, making it significantly more challenging than standard 11+ practice papers. Parents and tutors should use it to prepare candidates specifically for Westminster or similar highly selective independent schools.

How this paper is organised

The paper comprises **14 multi-part questions** with a total time allowance of **1 hour 30 minutes**. Early questions test algebraic manipulation, problem-solving with speed-distance-time, and forming and rearranging equations. Mid-range questions involve currency conversion, ratio problems with multiple steps, weighted averages, and geometric sequences. Later questions become substantially harder, covering exponential growth and decay, volume and surface area of solids, compound percentage change, and systems of equations.

Questions 12 to 14 are the most demanding. Question 12 introduces a recursive sequence called a 'Prodonacci list' and asks for a proof about divisibility. Question 13 requires setting up and solving a quadratic equation from a trapezium's dimensions. Question 14 is a complex speed-time problem with multiple parts requiring careful reasoning about inequalities and exact constraints.

No mark scheme is provided on the paper itself, but the instruction to show all working clearly indicates that method marks are awarded. The variety and depth of topics reflect Westminster's expectation that candidates are working comfortably at secondary-school level.

Topics covered

- Algebraic manipulation and evaluation of expressions involving powers and brackets
- Rearranging formulae to change the subject, including those with fractions and squared terms
- Solving linear equations with algebraic fractions and verifying solutions
- Multi-step word problems involving distance, speed, and time with mixed units
- Currency conversion and working backwards from partial information
- Ratio problems with redistribution and forming simultaneous equations from ratio constraints
- Weighted averages and using average values to deduce missing data points
- Exponential growth and decay with percentage multipliers applied over multiple periods
- Geometric sequences and finding the common ratio from non-consecutive terms
- Volume and surface area of spheres and cylinders, including conservation of volume problems
- Compound percentage change over multiple periods with unknown intermediate changes
- Pythagoras' theorem applied to composite rectangles and squares
- Recursive sequences with proofs about parity and divisibility
- Forming and solving quadratic equations from geometric constraints (trapezium area)
- Complex speed-time problems with repeated rest intervals and inequality reasoning

How to use this paper for revision

- Practise rearranging formulae methodically: isolate terms step by step, square or square-root both sides carefully, and always check dimensional consistency.
- For ratio problems, assign algebraic variables to the parts and write equations for both the initial and final states before attempting to solve.
- When working with percentages over multiple periods, use multipliers (e.g. a 51% fall means multiplying by 0.49) and set up equations linking start, intermediate, and end values.
- In geometry problems involving composite shapes, label every length clearly on a sketch and use Pythagoras or area formulae to form equations before substituting.
- For recursive or iterative sequences, calculate the first several terms by hand to spot patterns in remainders, parity, or digit properties before attempting a proof.
- Time yourself strictly on past papers to build stamina: aim to spend no more than 6 minutes per question on average, leaving harder questions until the end.
- Read multi-part word problems twice, underlining key numerical data and relationships, and write a brief plan before launching into calculations.

Common mistakes to avoid

- Forgetting to convert units in speed-distance-time problems (e.g. mixing kilometres and metres, or minutes and hours) leads to incorrect final answers.
- Misinterpreting ratio redistribution: students often add the new amounts to the old rather than replacing them, or fail to account for what stays constant.
- Rearranging formulae incorrectly when the subject appears in a denominator or under a square: common errors include not squaring both sides or losing negative signs.
- In percentage change problems, applying changes in the wrong order or forgetting that a percentage increase followed by a decrease does not return to the original value.
- Confusing surface area formulae for cylinders: forgetting that total surface area includes two circular ends, or miscounting which portions are curved.
- In proof questions, assuming what you need to prove or giving examples rather than general reasoning (e.g. 'it works for $n = 3, 4, 5$ ' is not a proof).

Exam technique

Start by skimming the entire paper to identify the questions you find most approachable, then tackle those first to build confidence and secure easier marks. Questions 1 to 3 are designed to be quick wins if you are fluent with algebraic manipulation, so complete them efficiently and move on. Leave the longer, multi-part problems such as Questions 12, 13, and 14 until you have secured marks elsewhere, as these require sustained reasoning and can consume significant time.

Show every stage of your working clearly, even for calculator steps, as Westminster awards method marks generously. If you make an arithmetic error early in a multi-part question, clear working allows you to earn credit for correct method in later parts. Use brackets and equals signs properly in algebraic manipulation to avoid ambiguity.

For the final 15 minutes, return to any part-completed questions and check that you have answered what was asked. Many questions ask for a specific form (e.g. '3 significant figures') or request justification or proof, not just a numerical answer. If stuck on a proof, write down what you know and any patterns you observe: partial credit is often available for structured attempts.

What to revise alongside this paper

To prepare for this paper, pupils should be confident with all Key Stage 3 algebra, including expanding brackets, factorising quadratics, and solving simultaneous equations. Revision of circle theorems, properties of polygons, and 3D mensuration (prisms, pyramids, spheres, cones) is essential, as geometric problem-solving appears throughout. Familiarity with index laws, fractional and negative indices, and simplifying surds will help with the more abstract manipulation.

Students should also practise forming equations from complex word problems, particularly those involving ratios, mixtures, and proportional reasoning. Sequences and series (arithmetic, geometric, and non-standard recursive definitions) are important, as are proofs by exhaustion, contradiction, or algebraic reasoning. Reading advanced problem-solving resources such as UKMT Junior Mathematical Challenge past papers or the first rounds of the Mathematical Olympiad for Girls will provide similar challenge and build resilience.

For those aiming at Westminster or equivalent selective schools, working through specimen papers from Eton, St Paul's, King's College School Wimbledon, and Sevenoaks will expose candidates to the breadth and depth expected. Strengthening mental arithmetic and calculator efficiency is also vital, as time pressure is significant.

Key terms

Subject of a formula, Algebraic fractions, Ratio and proportion, Weighted average, Exponential growth and decay, Geometric sequence, Common ratio, Volume of a sphere, Surface area of a cylinder, Compound percentage change, Pythagoras' theorem, Trapezium area formula, Recursive sequence, Mathematical proof, Parity (even and odd), Divisibility

For more free 11+ practice papers, past papers and online practice tests, visit [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk).



WESTMINSTER SCHOOL
THE CHALLENGE 2022

MATHEMATICS III

Wednesday 27 April 2022

Time allowed: 1 hour 30 minutes

You may not use a calculator for this paper.

All your working should be clearly shown.

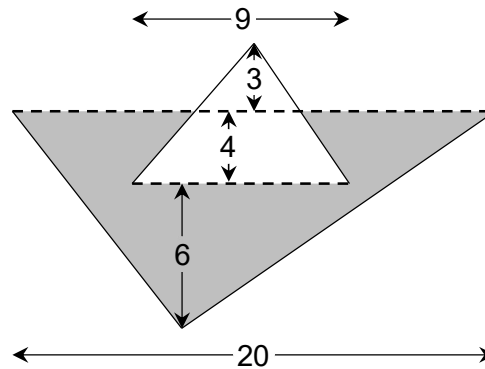
You should attempt all the questions.

Please write in black or blue ink.

- 1 Solve the following simultaneous equations.

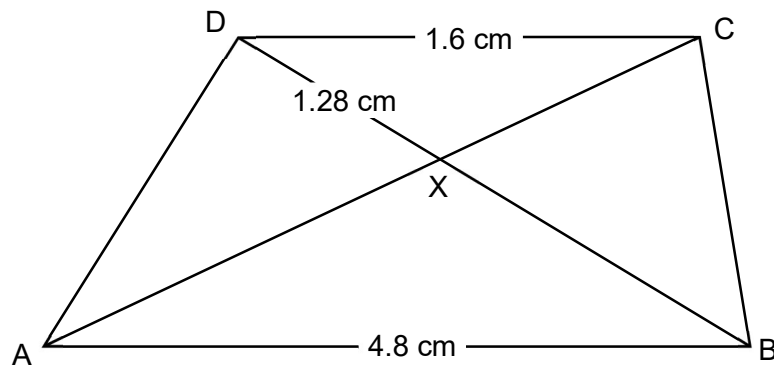
$$\begin{aligned}x + 2y + 3 &= 3(x + 5) \\ 3x - 2y + 1 &= -3(y + 1)\end{aligned}$$

- 2 It takes thirty sandsmiths to make 11,200 grains of sand in sixteen hours. How many sandsmiths does it take to make 14,700 grains of sand in eighteen hours?
- 3 The train from London Kings Cross station to Edinburgh Waverley station covers 420 miles and a ticket costs £189. The train from Leeds station to Plymouth station covers 350 miles and a ticket costs £154. Which train journey costs less per mile?
- 4 The diagram below shows two triangles. The dashed lines are parallel. All lengths shown are in cm. Find the shaded area.



- 5 At a clown college, some students can juggle and some can ride a unicycle. Some students are able to do both, and some can do both simultaneously.
- Of the students who can juggle, two-fifths can ride a unicycle, but only three-tenths can juggle while riding a unicycle. Of the students who can ride a unicycle, one-sixth can juggle while riding a unicycle.
- What proportion of the students who can ride a unicycle are able to juggle?
- 6 Four stoats and ten weasels will eat a sack of food in 44 minutes. Eleven stoats and fifteen weasels will eat a sack of food in 24 minutes. How long will it take twenty stoats to eat a sack of food?
- 7 a Expand and simplify the expression $(3x - 1)^2$.
b Use this to find 2999^2 .

- 8 The diagram below shows a trapezium ABCD with AB parallel to CD. Diagonals AC and BD meet at the point X. DC = 1.6 cm, AB = 4.8 cm and DX = 1.28 cm.



- a By finding a pair of similar triangles, calculate the length BX.
- b You are given that triangle AXD has area k cm². Find an expression for the area of triangle ADB in terms of k , fully justifying your answer.
- 9 A twenty pence coin weighs 5 g. A fifty pence coin weighs 8 g.
- a A set of such coins has a total value of £9.10 and a total weight of 187 g. How many of each type of coin is there in the set?
- b What is the greatest possible value for a set of such coins weighing 187 g?

- 10 At the ink factory, they mix cyan and magenta ink to make new inks.

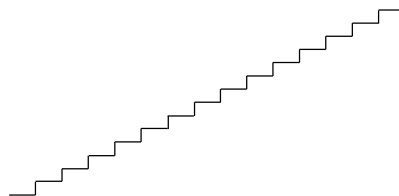
Blue Steel is made of cyan and magenta in the ratio 13 : 5.

Veronica Lake is made of cyan and magenta in the ratio 4 : 11.

Cerulean Sweater is made of cyan and magenta in the ratio 17 : 10.

The factory has a surplus of Blue Steel and Veronica Lake and a shortage of Cerulean Sweater. In what ratio could they mix Blue Steel and Veronica Lake in order to make Cerulean Sweater?

- 11 Rocky and Apollo are running continuously up and down a flight of stairs. They run at different speeds, but each athlete runs 25% faster down the stairs than he runs up the stairs.

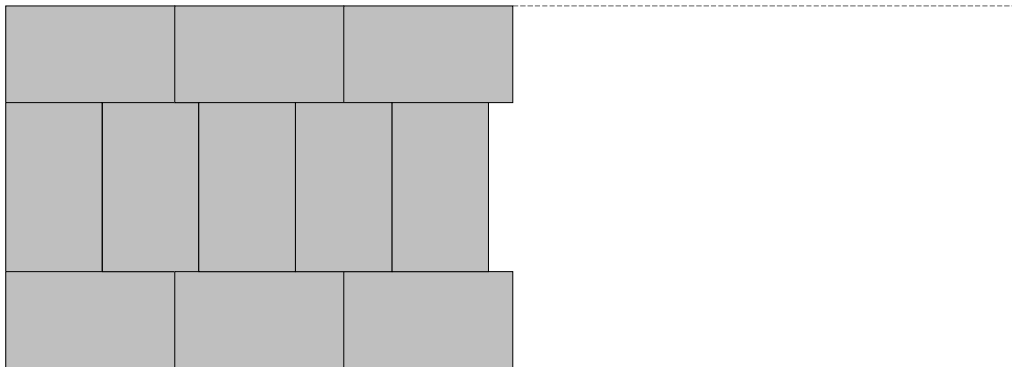


Rocky starts at the bottom of the stairs and Apollo starts at the top. The first time they pass each other, they are two-fifths of the way from the bottom of the stairs.

Where are they when they pass each other for the second time?

QUESTIONS CONTINUE OVERLEAF

- 12** I have a supply of 100 identical paving slabs of length 68 cm and width 41 cm, which I am using to create a path over a muddy field. The paved area will take the shape of a rectangle, and there must be no gaps. I use the following pattern:



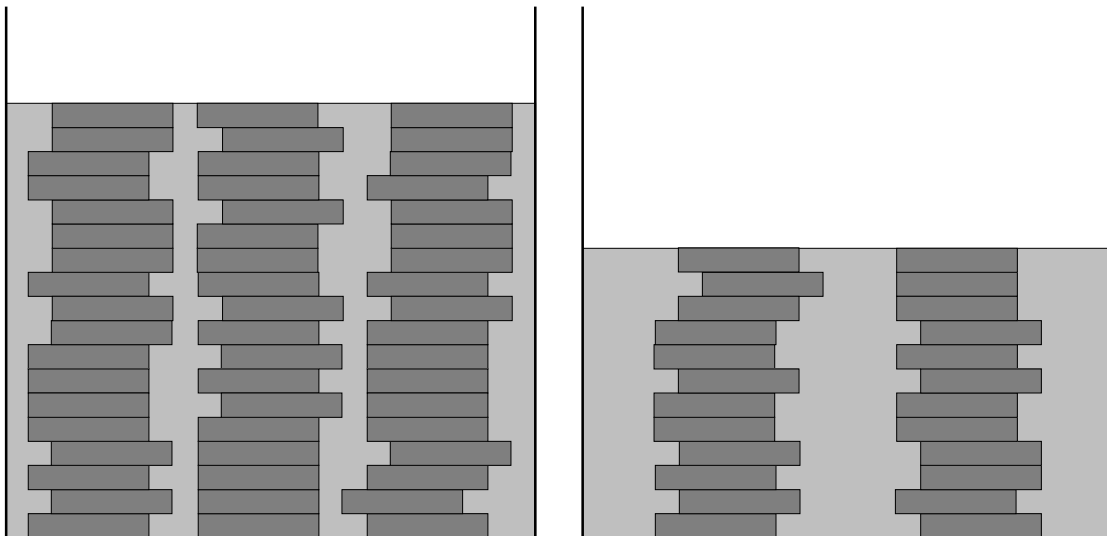
I lay the slabs lengthwise along the edges of the path and crosswise in the centre of the path, as shown in the diagram. When I have placed the final slabs in the pattern, I can, if necessary, make a single straight cut across the end of the path with my chainsaw, in order to leave an exactly rectangular paved area.

What is the longest paved area that I can make?

- 13** Pennies are thrown into a small well for good luck. The well is cylindrical, vertical and watertight, containing a fixed amount of water.

If the coins form three columns in the water, it takes 54 pennies in total for all columns to reach the surface of the water, as shown in the diagram on the left below.

If the coins form two columns in the water, it takes 24 pennies in total for both columns to reach the surface of the water, as shown in the diagram on the right below.



If the coins form a single column in the water, how many pennies would it take for this column to reach the surface of the water?

END OF QUESTIONS

Paper Notes: 11+ Maths Question Paper (11+ Maths Past Paper (2022))

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

Overview

This is **Westminster School's Mathematics III** paper from **The Challenge 2022**, sat on Wednesday 27 April 2022. It is an **11+ entrance examination** designed for students applying for Year 7 entry to one of London's most prestigious independent schools. The paper tests advanced mathematical reasoning and problem-solving across thirteen multi-step questions, all to be completed in **90 minutes without a calculator**.

The questions span algebra, geometry, ratio, proportion, and logical reasoning, with many problems presented through creative, narrative-driven scenarios (sandsmiths making grains of sand, stoats and weasels eating food, runners on staircases). This playful framing disguises the underlying mathematical sophistication required. Candidates must show all working clearly, as partial credit is likely awarded for method even when final answers are incorrect.

This paper is aimed at highly able 10- and 11-year-old students preparing for competitive grammar and independent school entrance exams. It goes well beyond the standard Year 6 curriculum, requiring fluency with GCSE-level algebraic manipulation, similarity in geometry, and multi-variable problem-solving. The paper rewards both technical skill and inventive thinking, making it an excellent benchmark for students targeting top-tier selective schools.

How this paper is organised

The paper contains **13 questions** of varying difficulty and length, with no formal sections or sub-divisions. Questions are numbered consecutively from 1 to 13, and candidates are instructed to attempt all of them. The **time allowance is 1 hour 30 minutes**, and **calculators are not permitted**.

Early questions (1 to 3) are relatively short and direct, covering simultaneous equations, proportional reasoning with workers and time, and unit cost comparison. Mid-range questions (4 to 10) introduce more complex geometry (similar triangles in a trapezium, area calculations with parallel lines), algebraic manipulation to compute large squares, and coin problems involving simultaneous equations and optimisation. The final three questions (11 to 13) are extended problem-solving challenges requiring sustained reasoning: relative motion on stairs, paving slab pattern optimisation, and a water displacement problem with stacked coins in a cylindrical well.

Each question asks for a numerical answer or algebraic expression, and all working must be shown. Diagrams accompany several questions (questions 4, 8, 11, 12, and 13), providing visual context for geometric and spatial reasoning tasks. The layout is clean and spacious, allowing room for candidates to annotate diagrams and work through multi-step solutions on the question paper itself.

Topics covered

- Simultaneous linear equations in two variables, requiring expansion of brackets and rearrangement
- Direct and inverse proportion problems involving multiple variables (workers, time, and output)
- Unit cost calculation and comparison across real-world scenarios
- Area of composite figures and similar triangles with parallel lines and proportional reasoning
- Set theory and Venn diagram logic applied to overlapping conditional probabilities
- Forming and solving simultaneous equations from word problems (stoats and weasels eating rates)
- Expanding and simplifying quadratic expressions, then applying algebra to mental arithmetic shortcuts
- Properties of similar triangles in trapezia, using scale factors to find unknown lengths and areas
- Optimisation problems with constraints: maximising value under a fixed weight limit
- Ratio mixing problems requiring solution of linear combinations to achieve a target ratio
- Relative motion and speed problems involving percentage increases and meeting points on a 循环 path
- Spatial reasoning and tessellation with rectangular slabs, finding maximum path length under constraints
- Volume and displacement reasoning in cylindrical containers with stacked objects

How to use this paper for revision

- Practise forming equations from wordy, narrative problems by identifying the key relationships and variables first, before attempting algebraic manipulation.
- Revise similarity and congruence in triangles thoroughly, focusing on scale factor ratios and how they apply to both lengths and areas.
- Strengthen mental arithmetic and algebraic substitution skills so you can compute large squares or cubes efficiently using factorisation identities.
- Work through proportion problems systematically: set up a clear ratio or rate equation, then scale both sides to match the new scenario.
- Draw clear diagrams for geometry questions even when one is provided, labelling all known lengths, angles, and relationships to avoid confusion.
- Familiarise yourself with Venn diagram logic and conditional probability, especially when fractions and overlapping sets are involved.
- Attempt past papers under timed conditions without a calculator to build fluency with written methods for multiplication, division, and fraction arithmetic.

Common mistakes to avoid

- Failing to expand brackets fully before collecting like terms in simultaneous equations, leading to sign errors and incorrect coefficients.
- Confusing direct and inverse proportion, particularly in multi-variable worker problems where time and output scale in opposite directions.
- Mixing up scale factors for length and area in similar shapes: area scales by the square of the linear scale factor, not the factor itself.
- Rushing through ratio mixing problems without setting up a clear system of equations, resulting in trial-and-error guesses rather than algebraic solutions.
- Misreading the geometry in trapezium problems and failing to identify which triangles are similar or which angles are equal due to parallel lines.
- Forgetting to justify algebraic or geometric reasoning when the question explicitly asks for full working or justification, losing method marks.

Exam technique

Begin by reading through the entire paper quickly to identify questions that play to your strengths. Question 1 (simultaneous equations) and question 3 (unit cost) are good warm-up tasks that build confidence early. Aim to spend no more than 5 to 7 minutes per question on average, but recognise that questions 11, 12, and 13 are extended

problems requiring 12 to 15 minutes each. If you become stuck, move on and return later rather than losing time on a single question.

Show all working clearly and logically, even for questions where the answer seems obvious. Marks are awarded for method, and examiners need to follow your reasoning. Use diagrams wherever possible: sketch a Venn diagram for question 5, annotate the trapezium in question 8, and draw a timeline or position graph for question 11. Label variables consistently and check units throughout (grams, pence, centimetres).

In the final 10 minutes, prioritise checking arithmetic and ensuring every answer has appropriate units or justification. Questions that ask you to "fully justify" your answer (such as question 8b) require more than a number: write a sentence explaining the geometric or algebraic relationship you have used. If you cannot complete a difficult question, write down any partial progress or equations you have formed to secure some credit.

What to revise alongside this paper

Students should consolidate their understanding of **forming and solving systems of linear equations**, including cases with three or more variables, which appear in GCSE algebra modules. Revisit **proportional reasoning** across a variety of contexts (recipes, maps, speed-distance-time) to build flexibility in recognising direct versus inverse relationships. Work on **quadratic expansion and factorisation**, including the difference of two squares and perfect square identities, as these underpin efficient mental calculation strategies.

Geometry revision should focus on **similarity and congruence**, particularly in composite figures involving parallel lines and transversals, as well as **area and volume calculations** for compound shapes and solids. Practise **ratio and proportion problems** that involve mixing or combining quantities to achieve a target, as these appear frequently in selective school papers. For students aiming higher, explore **optimisation problems with constraints** and **relative motion scenarios**, both of which require logical reasoning and systematic trial within defined limits.

Finally, develop confidence with **non-calculator arithmetic**: long multiplication, division, fraction operations, and percentage calculations by hand. These skills are tested implicitly throughout the paper and separate strong candidates from those who rely too heavily on calculators in everyday maths lessons.

Key terms

Simultaneous equations, Direct proportion, Inverse proportion, Similar triangles, Scale factor, Trapezium, Ratio, Venn diagram, Conditional probability, Optimisation, Linear combination, Relative speed, Volume displacement, Algebraic expansion, Justification

For more free 11+ practice papers, past papers and online practice tests, visit [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk).