

## 11+ PAST PAPER PACK

# The Manchester Grammar School 11+ Maths 2023

## Complete Past Paper Pack

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

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The Manchester Grammar School 11+ Maths. Use to mark your work against the official answer key.

Includes Paper Notes: score interpretation, selected worked examples, next steps.

PRACTISE THE REAL THING

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Surname ..... Candidate number .....

First name .....

Current school .....



**The Manchester  
Grammar School**

Founded 1515

# **Entrance Examination 2023**

## **Arithmetic Section A**

### **30 minutes**

**Do not open this booklet until told to do so**

**Calculators may not be used**

**Write your names, school and candidate number in the spaces provided at the top of this page.**

You have 30 minutes for this paper which is worth 20 marks.  
Each question is worth 1 mark.

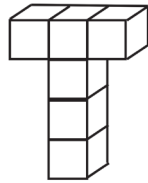
Answer all the questions, attempting them in order and writing your answers clearly. If you find that you cannot answer a question straight away leave it blank and return to it later if you have time. Try not to leave blank answer spaces at the end, instead make the best attempt at an answer that you can.

**If you need to change an answer cross it out neatly and write the new answer alongside the box. You may use rough paper for working out, this will not be marked.**

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<b>Marker 1</b>	<b>Methods</b>	<b>Problems Q10-20</b>	<b>Marker 1 TOTAL</b>	<b>Marker 2 CHECK</b>	<b>AGREED MARK</b>
Number Correct	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Number Wrong	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

- Work out  $423 - 134$
- Work out  $18.2 \div 0.07$
- Work out  $5\frac{2}{3} + 2\frac{3}{4}$ , giving your answer as a mixed number in its simplest form
- Add up the following 3 lengths, giving your answer in centimetres.  
2.03m, 56cm, 237mm
- Andy has 42 marbles and David has 60. David gives Andy some marbles. They now have the same number of marbles.  
How many marbles did David give Andy?
- What is 40% of 50% of 60?
- Tim makes a capital letter "T" using 6 cubes, each with edges 1cm long, as in the diagram:

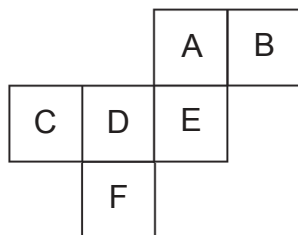


He then paints the solid letter "T" all over.  
What is the total area he paints?

- Liam wrote down all the numbers from 1 to 20, inclusive.  
If it takes him 1 second to write down each **digit**,  
how long did it take him in total?
- If the following numbers were arranged in numerical order,  
which one would be in the middle?

0.66,  $\frac{2}{3}$ , 0.7,  $\frac{3}{5}$ , 0.6125

- The net below is folded to make a cube.  
What letter will be on the face opposite the letter D?



1	
---	--

2	
---	--

3	
---	--

4	cm
---	----

5	
---	--

6	
---	--

7	$\text{cm}^2$
---	---------------

8	secs
---	------

9	
---	--

10	
----	--

**FOR  
MARKER  
USE ONLY**

	<b>Q1 - 10</b>
<b>Number Correct</b>	

	<b>Q1 - 10</b>
<b>Number Wrong</b>	

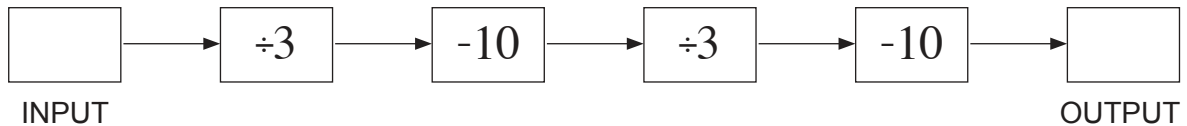
11. Three numbers multiply to make 60 and add to make 13.  
What is the largest of these three numbers?

11

12. Granny has been having a smashing time.  
Yesterday she had 15 cups and 12 matching saucers,  
but this morning she dropped a tray holding one third of the cups  
and half the saucers, breaking all those on the tray.  
How many of her cups are now without saucers?

12

13. A function machine does the four operations in the  
order shown below:



Jonathan inputs a whole number which is at least 1,  
and the output is also a whole number which is at least 1.

What is the smallest possible number that  
Jonathan could have input?

13

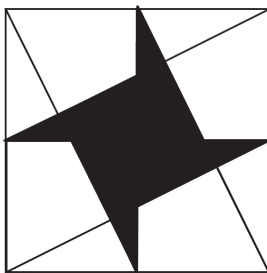
14. If the sequence 5, 12, 19, 26 is continued,  
what will be the largest 3-digit number?

14

15. The clock in my kitchen is 10 minutes slower than the clock on my phone,  
which is itself, 6 minutes slow.  
My tram always leaves 6 minutes early, although it is scheduled to leave at 8:55am.  
It takes me 20 minutes to get to the tram stop.  
What time must I leave my house, according to my kitchen clock,  
in order to catch my tram?

15

16. In the diagram, the corners of the shaded shape are at the midpoints of the sides of the large square.



What fraction of the large square is **shaded**?

16	
----	--

17. A train which consists of an engine and three coaches is 70m long. The engine is 13m long and there is a 1m gap between the engine and the first coach and also between all the coaches. How long would a train consisting of an engine and 5 coaches be?

17	m
----	---

18. How many **different** 3-digit numbers can be made from the digits 3, 3, 6 and 9?

18	
----	--

19. The “abm” of a number is the product of the number one above it and the number one below it.

**e.g. the “abm” of 7 is  $8 \times 6 = 48$**

Write down the number that has an “abm” of 288.

19	
----	--

20. Dan thinks of two numbers which differ by one and add up to **more** than seven. He then squares his two numbers (multiplies them by themselves), and works out their new difference.

This difference is less than ten.

What is the smaller of the two numbers Dan first thought of?

20	
----	--

**This is the end of the Examination**

**Use any remaining time to check your work  
or try any questions you have not answered.**

**FOR  
MARKER  
USE ONLY**

	Q11 - 20	
Number Correct		

	Q11 - 20	
Number Wrong		

# Paper Notes: 11+ Maths Question Paper (11+ 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

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This is the **Manchester Grammar School 11+ Entrance Examination 2023**, Section A for Arithmetic. It is designed for candidates applying for **Year 7 entry** at this independent Manchester boys' school. The paper consists of **20 questions** worth one mark each, to be completed in **30 minutes without a calculator**.

The examination tests a broad range of arithmetic and mathematical reasoning skills, from basic operations through to multi-step problem solving. Questions progress from straightforward calculations (subtraction, division of decimals, fraction addition) to increasingly demanding word problems involving spatial reasoning, sequences, logical deduction, and time calculations. The format is concise, with each question requiring a single numerical answer or simple expression.

This paper suits students preparing for selective independent school entrance at 11+, particularly those targeting grammar schools or academically rigorous independent schools. The relatively short time allocation (90 seconds per question on average) places a premium on swift mental arithmetic and problem-solving fluency. Parents and tutors will find it valuable for assessing a child's readiness for selective examination conditions where speed and accuracy under pressure are essential.

## How this paper is organised

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The paper is divided into two sections of ten questions each: **Q1-10 (Methods)** and **Q11-20 (Problems)**. Each question carries **one mark**, with no partial credit, and the total available score is **20 marks**. Candidates have exactly **30 minutes** to complete all questions, which averages to 90 seconds per item.

The first section emphasises direct calculation and conversion skills: subtraction, decimal division, mixed number addition, unit conversion, and percentage work. Questions become progressively more involved, introducing geometric surface area, counting tasks (digits written), ordering decimals and fractions, and net-folding visualisation. The layout is clean, with each question presented on the left and a bordered answer box on the right, clearly labelled by question number and including units where applicable (cm, cm<sup>2</sup>, secs).

The second section shifts towards multi-step reasoning and word problems. These include algebraic thinking (finding three numbers with given product and sum), logical

deduction (cups and saucers after breakage), function machines with division and subtraction, arithmetic sequences, time problem-solving across multiple clocks, fraction-of-area geometry, train length calculations with gaps, combinatorics (forming numbers from given digits), custom operations ("abm"), and constrained number puzzles involving consecutive integers and their squares. Rough paper is permitted but will not be marked, and candidates are advised to attempt questions in order, leaving blanks if stuck and returning later.

## Topics covered

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- Whole number subtraction and mental arithmetic with three-digit numbers
- Division of decimals without a calculator ( $18.2 \div 0.07$ )
- Addition of mixed numbers with unlike denominators and simplification to lowest terms
- Unit conversion and addition across metres, centimetres, and millimetres
- Algebraic reasoning with word problems (equal distribution of marbles)
- Compound percentages (finding 40% of 50% of a given quantity)
- Surface area of three-dimensional shapes built from unit cubes
- Counting discrete elements (digits written in a sequence of integers)
- Ordering and comparing decimals, fractions, and mixed representations
- Visualisation of cube nets and identification of opposite faces
- Simultaneous equations in disguise (three numbers with given sum and product)
- Multi-step word problems involving fractions of sets (cups and saucers)
- Function machines with division and subtraction operations, working backwards to find valid inputs
- Arithmetic sequences and finding the largest term within constraints (three-digit ceiling)
- Complex time calculations involving multiple clocks running at different rates and scheduled departures
- Fraction of area in geometric figures (midpoint squares)
- Linear problem-solving with gaps and repeated elements (train length)
- Combinatorics: counting distinct three-digit numbers from a multiset of digits
- Custom binary operations and inverse problem-solving ("abm" function)
- Constrained number puzzles involving consecutive integers, their sum, squares, and difference

## How to use this paper for revision

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- Practise decimal division by converting to whole numbers first: rewrite  $18.2 \div 0.07$  as  $1820 \div 7$  by multiplying both numerator and denominator by 100.
- Review converting mixed numbers to improper fractions before adding, then simplify by finding the lowest common denominator (for example, when adding fifths and quarters).
- Memorise unit conversion factors: 1 metre equals 100 centimetres, 1 centimetre equals 10 millimetres. Write all lengths in the same unit before adding.
- For percentage problems involving 'of', remember that 'of' means multiply: 40% of 50% becomes  $0.4 \times 0.5$ .
- When finding surface area of compound shapes made from cubes, sketch the 3D object from multiple angles and count each exposed face (including hidden internal ones that become external after assembly).
- Draw diagrams for word problems, especially those involving distribution (marbles, cups and saucers). Label 'before' and 'after' states clearly.
- For net-folding questions, trace which faces will touch when the net is assembled, or mentally fold the paper to visualise opposite pairs.
- In function machine problems, work backwards: if the output is a whole number at least 1, reverse each operation in turn (add 10, multiply by 3) and check which inputs produce valid outputs.
- For time problems, create a timeline showing real time, phone time, and kitchen time. Mark the actual tram departure, then calculate backwards from that moment.

## Common mistakes to avoid

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- Forgetting to simplify fractions after adding mixed numbers: always check whether the numerator and denominator share a common factor before writing your final answer.
- Losing track of units in conversion questions: converting 237mm to cm gives 23.7cm, not 237cm. Double-check your place values when switching between units.
- Miscounting exposed faces on 3D shapes: students often forget to count the faces on the underside or the internal faces where cubes join together. Systematic counting (top, bottom, front, back, left, right for each cube) helps.
- Misreading the function machine operations: the division symbol with a line over the 3 means 'divide by 3', not 'multiply by 3'. Copy the operations carefully and follow the arrows from left to right.
- In time problems, confusing 'slow' and 'fast' clocks: if a clock is 10 minutes slow, it shows a time 10 minutes earlier than the true time, not later. Draw a diagram to avoid sign errors.
- In the cups-and-saucers problem, calculating how many saucers remain rather than how many cups are now unmatched. The question asks specifically for cups without saucers after breakage.
- Treating the three-digit number sequence problem as if it continues indefinitely: the question asks for the largest three-digit term, so stop as soon as the sequence reaches or exceeds 1000.
- In combinatorics, forgetting that some digits repeat: when forming numbers from 3, 3, 6, 9, the two threes are indistinguishable, so arrangements like 336 and 336 are the same number, not two different ones.

## Exam technique

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With **30 minutes for 20 questions**, you have an average of 90 seconds per item. However, the first five to seven questions are designed to be quick (30 to 60 seconds each), leaving more time for the multi-step reasoning problems later. Start at question 1 and work through in order. If a question requires more than two minutes of working, leave it blank, circle the number, and move on. Return to skipped questions once you have attempted every other item.

Write all working on rough paper but transfer only the final answer into the box provided. The examiners will not award marks for method, only for correct answers, so accuracy is paramount. For questions involving units (cm, cm<sup>2</sup>, seconds, metres), double-check that your answer includes the correct unit if the answer box has one

printed. For fraction and mixed number answers, always simplify fully: an answer of  $\frac{8}{12}$  when  $\frac{2}{3}$  is expected will likely not receive credit.

In the final five minutes, prioritise checking arithmetic in the early questions (these are easiest to verify quickly) and ensure you have written something for every question. Even an educated guess on a problem you cannot solve fully is better than a blank: you have a chance of gaining the mark, whereas a blank guarantees zero. If you finish early, resist the temptation to second-guess correct answers. Instead, re-read each question carefully to confirm you have answered what was asked (for example, 'the smaller number' versus 'the larger number', or 'cups without saucers' versus 'total remaining saucers').

## What to revise alongside this paper

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Pupils working through this paper should be confident with the **four operations on whole numbers, fractions, and decimals** without a calculator. Revisit long division with decimals, finding common denominators, and converting between improper fractions and mixed numbers. Practise unit conversions across metric lengths, masses, and capacities, as these appear frequently in 11+ arithmetic sections.

For the geometry and visualisation questions, review properties of cubes (including nets and opposite-face rules), surface area of compound solids, and fraction-of-area problems involving squares, triangles, and other polygons. Work on mental strategies for finding areas and perimeters quickly, as well as visualising 3D shapes from 2D drawings. Spatial reasoning is a common thread in selective school entrance papers.

To prepare for the multi-step reasoning problems, explore number puzzles that combine arithmetic with logic: find two or three numbers satisfying multiple conditions, work backwards through operations, and solve problems involving sequences or patterns. Practise reading word problems carefully, extracting the key information, and setting up equations or diagrams. Timed problem-solving under exam conditions (using past papers from Manchester Grammar School or similar independent schools) will build the speed and confidence needed to tackle 20 varied questions in half an hour.

## Key terms

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**Mixed number, Improper fraction, Lowest common denominator, Simplest form, Unit conversion, Percentage of a percentage, Surface area, Three-dimensional solid, Cube net, Opposite faces, Arithmetic sequence, Function machine, Consecutive numbers, Product, Sum, Combinatorics, Distinct arrangements, Constrained optimisation**

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Surname ..... Candidate number .....

First name .....

Current school .....



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# Entrance Examination 2023

## Arithmetic Section B

### 1 Hour

**Do not open this booklet until told to do so**

**Calculators may not be used**

**Write your names, school and candidate number in the spaces provided at the top of this page.**

For each question, show all your working in full, as this will be marked, and then write your answer clearly in the space provided. If you run out of space for an answer use the space provided at the end of this booklet, numbering your answers carefully.

You have 1 hour for this paper which is worth 80 marks.

---

<b>Marker</b>	Short Problems Q1 - 6	Longer Problems Q7 - 11	<b>TOTAL</b>
<b>Score</b>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<b>out of</b>	<b>30</b>	<b>50</b>	<b>80</b>

1. You are given that  $37 \times 246 = 9102$

Use the above information to find:

(a)  $370 \times 2.46$

1a	<input type="text"/>
----	----------------------

(b)  $9102 \div 3.7$

1b	<input type="text"/>
----	----------------------

(c)  $3.7 \times 2.46$

1c	<input type="text"/>
----	----------------------

(d)  $3.7 \times 12.3$

1d	<input type="text"/>
----	----------------------

(e)  $4551 \div 123$

1e	<input type="text"/>
----	----------------------

**15 marks**

2. Fill in the missing numbers to make these sums correct.

Write the numbers in the boxes.

(a)

$$\begin{array}{r}
 4 \square \\
 \times \square \\
 \hline
 258 \\
 \hline
 \end{array}$$

(b)

$$\begin{array}{r}
 4 \square 0 1 \\
 - \quad 7 3 \square \\
 \hline
 3 4 \square 3 \\
 \hline
 \end{array}$$

**[5 marks]**

3. (a) Alison is thinking of a prime number between 60 and 65.  
What number is she thinking of?

3a	<input type="text"/>
----	----------------------

- (b) Jack is thinking of a square number between 101 and 130.  
What number is he thinking of?

3b	<input type="text"/>
----	----------------------

- (c) Ger is thinking of a 3 digit number less than 200. It is a multiple of 5.  
The "tens" digit is the sum of the other two digits.  
What number could Ger be thinking of?

3c	<input type="text"/>
----	----------------------

- (d) Oli is thinking of a two digit number that is both a square and a cube number.  
What number is Oli thinking of?

3d	<input type="text"/>
----	----------------------

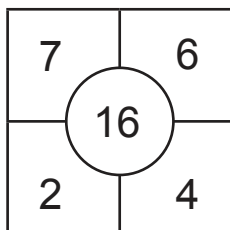
- (e) Dave thinks of a 3 digit number. It is the third largest 3 digit number  
whose digits add up to 15.  
What number is Dave thinking of?

3e	<input type="text"/>
----	----------------------

4. The number inside the circle is the **difference** between the **product** of the top left and bottom right numbers and the **product** of the top right and bottom left numbers.

The 4 numbers around the outside of the circle are always **single digit whole numbers**.

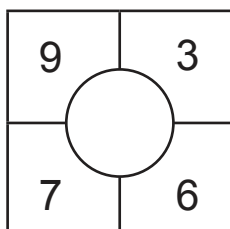
For example:



The number inside the circle is 16 because:

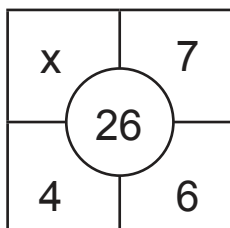
$$7 \times 4 - 6 \times 2 = 28 - 12 = 16$$

- a) Write down the number that should go in the circle



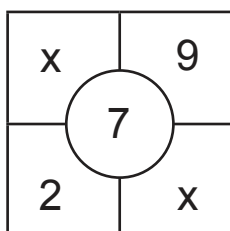
4a	
----	--

- b) What is the value of  $x$  ?



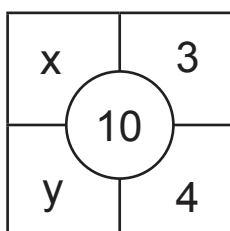
4b	$x =$
----	-------

- c) What is the value of  $x$  ?



4c	$x =$
----	-------

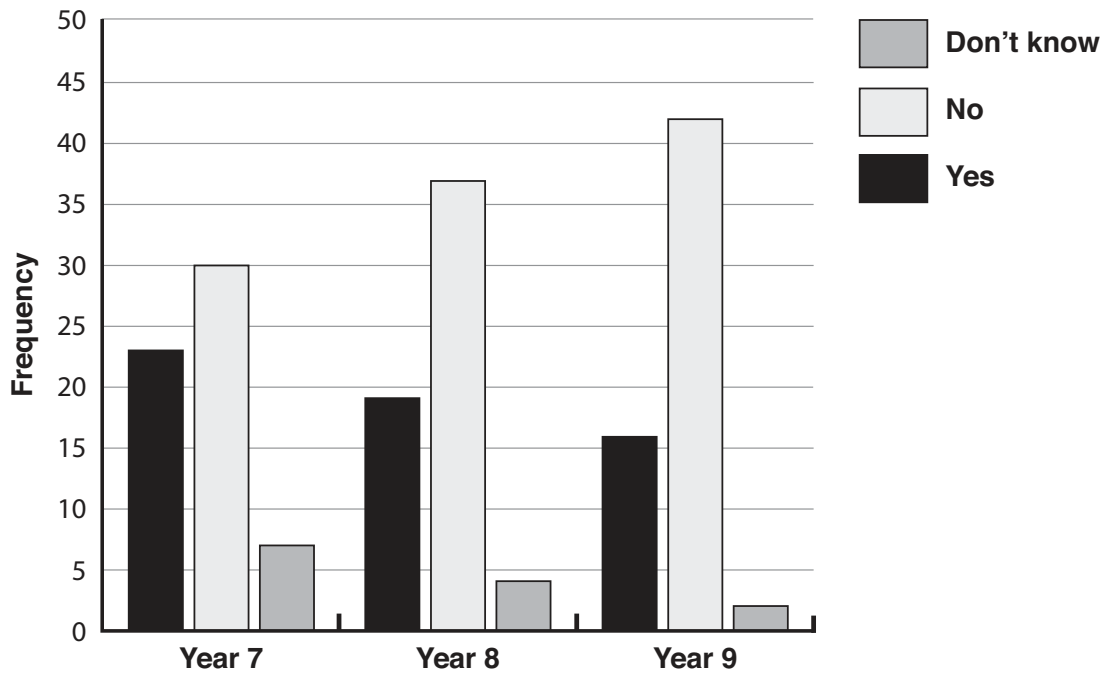
- d) What are the values of  $x$  and  $y$  ?



4d	$x =$ $y =$
----	----------------

**15 marks**

5. Midchester Grammar School did a survey as to whether pupils thought they should have more homework. The results of the survey are below:



(a) How many Year 8 pupils said “no”?

5a	
----	--

(b) How many Year 7 pupils were surveyed?

5b	
----	--

(c) How many pupils responded “Don’t know” **in total**?

5c	
----	--

(d) In Year 9, how many fewer pupils responded “yes” than “no”?

5d	
----	--

(e) Describe the “trend” between the years for saying “yes”.

5e	
----	--

**15 marks**

6. In a “duo”, two numbers **a** and **b** are placed in a bracket **[ a , b ]** and are related by a given rule.

**For example, if the rule was  $b = 3 \times a$**

**Possible “duos” could be: [ 2 , 6 ], [ 7 , 21 ], [ 50 , 150 ]**

Below are seven rules. Fill in the table to match the “duos” with the rules.

Rule 1 has been done for you. The remaining Rules can only be used once, and one Rule **will not be used**.

Rule 1:  $b = 2 \times a$

Rule 2:  $a + b = 12$

Rule 3:  $a \times b = 32$

Rule 4: **a is a factor of b**

Rule 5:  $b = 3 \times a - 4$

Rule 6: **a is a multiple of b**

Rule 7:  $b = a \times ( a - 1 ) - 4$

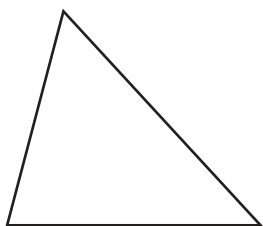
Duos	Rule
[ 4 , 8 ] [ 8 , 16 ] [ 10 , 20 ]	Rule 1
[ 4 , 8 ] [ 8 , 20 ] [ 10 , 26 ]	
[ 4 , 8 ] [ 8 , 16 ] [ 10 , 50 ]	
[ 4 , 8 ] [ 8 , 52 ] [ 10 , 86 ]	
[ 4 , 8 ] [ 8 , 4 ] [ 10 , 3.2 ]	
[ 4 , 8 ] [ 8 , 4 ] [ 10 , 2 ]	

[5 marks]

FOR  
MARKER  
USE ONLY

Short problems	/30
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7. The angles of a triangle always add up to  $180^\circ$ .



- a) Two angles of a triangle are  $48^\circ$  and  $76^\circ$ .  
What is the third angle?

7a

- b) The angles of another triangle are in the ratio  $2 : 3 : 5$ .  
Find **all three** angles.

7b

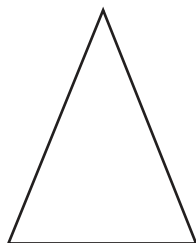
 ,  , 

- c) The angles of another triangle are such that one angle is both  $8^\circ$  more than another angle and  $20^\circ$  less than the remaining angle. Find **all three** angles.

7c

 ,  , 

In an **isosceles** triangle, two of the angles are equal.



- d) In an isosceles triangle, one of the angles is  $96^\circ$ .  
What are the other two angles?

7d

 , 

- e) The “equal angles” of an isosceles triangle are four times as large as the other angle.  
Find the smallest angle in the triangle.

7e

- f) One angle in an isosceles triangle is  $50^\circ$ .  
Find the **two** possible values for the largest angle in the triangle.

7f

 ,

8. The following question is about the remainder when  $p$  is divided by  $q$ .

**Example: when 23 is divided by 7, the remainder is 2.**

We write this as:  $23 \text{ Rm } 7 = 2$

a) What is  $53 \text{ Rm } 8$  ?

8a	
----	--

b) If  $17 \text{ Rm } a = 4$ , what is the value of  $a$ ?

8b	$a =$
----	-------

c) There are two possible values of  $b$  so that  $18 \text{ Rm } b = 4$ .  
What are the **two** possible values of  $b$ ?

8c	$b =$
	$b =$

d) If  $20 \text{ Rm } 6 = c \text{ Rm } 6$   
Find the smallest value of  $c$  which is **greater** than 50.

8d	$c =$
----	-------

e) (i) If  $d \text{ Rm } 12 = 6$  and  $d$  is less than 50,  
list **all** the possible values of  $d$ .

8e(i)	
-------	--

(ii) If also  $d \text{ Rm } 5 = 0$ , what is the value of  $d$ ?

8e(ii)	$d =$
--------	-------

9. Stephen invents a game involving swapping coloured counters.

In this game:

**5 RED counters are worth the same as 3 BLUE**

**6 GREEN counters are worth the same as 4 BLUE**

**3 RED counters are worth the same as 2 YELLOW**

a) If Stephen wishes to swap 18 GREEN counters for RED counters, how many RED counters would he get?

9a	<input type="text"/>
----	----------------------

b) If Stephen wishes to swap 9 BLUE counters for YELLOW counters, how many YELLOW counters would he get?

9b	<input type="text"/>
----	----------------------

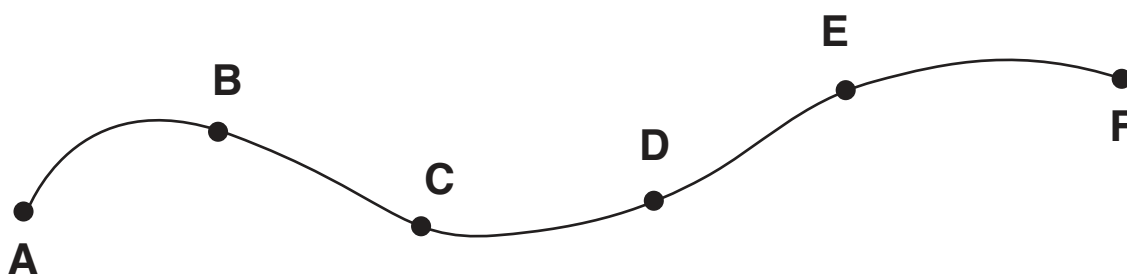
c) If Stephen wishes to swap 20 RED + 8 BLUE counters for GREEN counters, how many GREEN counters would he get?

9c	<input type="text"/>
----	----------------------

d) Finally, Stephen wishes to swap 27 GREEN + 18 BLUE counters for YELLOW counters, how many YELLOW counters would he get?

9d	<input type="text"/>
----	----------------------

10. A, B, C, D, E, F are six towns connected by a railway line, as in the diagram below:



(diagram is not to scale)

The journey times (in minutes) between them is given in the table below.

For example it takes 11 minutes to travel from B to C.

Complete the table below.

<b>A</b>						
<b>B</b>						
<b>C</b>	18	11				
<b>D</b>						
<b>E</b>	39					
<b>F</b>		38		18		
	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>

**[10 marks]**

11. In a car magazine, it is claimed that the petrol used by a car to travel 1km at different speeds is given in the following table:

SPEED IN km/h	PETROL NEEDED FOR 1km IN LITRES
30	0.3
60	0.15
80	0.2

Assuming the information above is correct, work out the following:

- a) How many litres are needed to travel 40km at 30km/h?

11a	ltrs
-----	------

- b) How many kilometres can be travelled at 80km/h using 46 litres of petrol?

11b	km
-----	----

- c) If the car used 12 litres of petrol to go 80 kilometres, what speed was it travelling?

11c	km/h
-----	------

- d) If petrol costs £1.50 per litre, how much money would be saved on a journey of 300 km by driving at 60km/h rather than 80km/h?

11a	£
-----	---

**[10 marks]**

**This is the end of the Examination**

**Use any remaining time to check your work  
or try any questions you have not answered.**

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**FOR  
MARKER  
USE ONLY**

<b>Longer problems</b>	<b>/50</b>
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# Paper Notes: 11+ Maths Question Paper (11+ 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

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This is the **Arithmetic Section B** paper from **The Manchester Grammar School's 2023 entrance examination**, designed for candidates applying for Year 7 entry (the 11+ age group). It assesses numerical fluency, problem-solving, and reasoning across a range of arithmetic and mathematical topics, without the use of calculators.

The paper is divided into two sections: **six shorter problems (Questions 1-6)** worth a total of 30 marks, and **five longer problems (Questions 7-11)** worth 50 marks, giving an overall total of 80 marks. Candidates are given **one hour** to complete the paper and must show all working in full, as this is part of the marking process.

The questions span topics from place value and mental arithmetic to more complex reasoning about shapes, angles, prime and square numbers, and real-world applications such as petrol consumption and travel times. This paper suits students who have completed Year 6 and are preparing for selective grammar school entry, particularly those targeting Manchester Grammar School or similar independent schools.

## How this paper is organised

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The paper opens with a cover sheet for candidate details and instructions. It is divided into two clearly marked sections: **Short Problems (Questions 1 to 6)** carry 30 marks and are relatively quick, often single-step or two-step calculations, while **Longer Problems (Questions 7 to 11)** carry 50 marks and require extended working, multi-step reasoning, or the interpretation of tables and diagrams.

Each question is accompanied by clearly labelled answer boxes (e.g. **1a, 1b, 1c**) and the layout is spacious, with extra lined pages provided at the end for overflow working. Questions progress in difficulty: early questions focus on manipulation of given facts and basic number properties, while later questions involve angle properties in triangles, modulo-style remainder problems, counter exchange ratios, journey time tables, and fuel efficiency calculations.

Time management is essential. With 60 minutes for 80 marks, candidates should aim to spend roughly 20 minutes on the short problems and 40 minutes on the longer problems, though individual question difficulty varies. The rubric emphasises that **all**

**working must be shown in full**, suggesting partial marks are awarded for method even when the final answer is incorrect.

## Topics covered

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- Place value and decimal manipulation, using a given multiplication fact to deduce related products and quotients (e.g.  $370 \times 2.46$  from  $37 \times 246$ )
- Missing digit problems in column arithmetic (multiplication and subtraction with blanks to be filled in)
- Properties of numbers: prime numbers in a range, square numbers, multiples of 5, numbers that are both squares and cubes, and digit sum constraints
- Pattern spotting with algebraic rules applied to ordered pairs (the 'duo' problem, matching rules like  $b = 3a - 4$  or  $a \times b = 32$  to sets of number pairs)
- Interpreting and extracting data from bar charts, including frequency totals, differences, and trends across categories (the 'more homework' survey)
- Angle properties in triangles: calculating missing angles, working with ratios of angles, and solving for angles in isosceles triangles given constraints
- Modular arithmetic: finding remainders when dividing, solving for unknown divisors or dividends given a remainder, and combining remainder conditions
- Proportional reasoning with counter exchange rates, converting between different coloured counters through intermediate steps
- Reading and completing a journey time table for a railway line, using additive properties of consecutive segments
- Real-world problem solving: calculating petrol consumption over distance, working backwards from litres to kilometres, and comparing costs of different speeds

## How to use this paper for revision

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- Practise manipulating decimal places quickly in your head or on paper. Question 1 rewards fluency in scaling numbers by powers of ten and understanding how division and multiplication by decimals relate to whole-number facts.
- For missing digit puzzles (Question 2), work column by column from right to left, checking carries and borrowing carefully. Write out intermediate steps so you can spot any errors.
- Revise properties of primes, squares, cubes, and multiples. Keep a mental list of primes below 100 and squares up to  $15^2$  so you can identify them instantly under exam pressure.
- For the angle problems in Question 7, always write down the fact that angles in a triangle sum to  $180^\circ$  as your starting point. Use algebra for isosceles triangles: let the equal angles be  $x$  and the third be  $y$ , then write an equation.
- Question 8's remainder notation (Rm) is unusual. Before the exam, practise dividing by hand and stating remainders explicitly (e.g.  $53 \div 8 = 6$  remainder 5), and check your understanding of what 'c Rm  $6 = 2$ ' means.
- In the counter exchange problem (Question 9), draw a conversion chart or write ratios as fractions (e.g. 5 RED = 3 BLUE means 1 RED =  $\frac{3}{5}$  BLUE). Work step by step and simplify ratios before multiplying.
- For the railway table (Question 10), fill in what you can immediately (e.g. if B to C is 11 and A to C is 18, then A to B is 7). Use symmetry: the time from X to Y equals the time from Y to X.

## Common mistakes to avoid

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- In Question 1, dividing by a decimal incorrectly (e.g.  $9102 \div 3.7$ ). Remember to scale both numbers to remove the decimal: multiply numerator and denominator by 10 to get  $91020 \div 37$ , then divide.
- In Question 3c, listing only one possibility when the question asks 'What number could Ger be thinking of?' There are multiple valid answers (e.g. 145, 055 which is not three digits, 190), so pick one that fits all constraints.
- Forgetting that a number that is both a square and a cube (Question 3d) must be a sixth power. Many students waste time checking every two-digit square and cube separately instead of recognising  $64 = 2^6 = 8^2 = 4^3$ .
- In Question 7f, giving only one answer when the question explicitly asks for 'two possible values'. In an isosceles triangle with one angle of  $50^\circ$ , either the  $50^\circ$  is one of the equal pair (giving  $50^\circ, 50^\circ, 80^\circ$ , so largest is  $80^\circ$ ) or it is the unique angle (giving  $50^\circ, 65^\circ, 65^\circ$ , so largest is  $65^\circ$ ).
- In Question 8e, listing remainders instead of actual values of d. The question asks for the possible values of d itself, not the remainder when d is divided by 12.
- In Question 11d, calculating only the petrol difference and forgetting to multiply by the price per litre to convert litres into pounds.

## Exam technique

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Start by reading the instructions on the cover sheet carefully and check you understand the mark allocation: **30 marks for Questions 1-6, 50 marks for Questions 7-11**. Aim to complete the short problems in about 20 minutes, leaving 40 minutes for the longer problems. If you get stuck on a part, move on and return to it later.

Show every step of your working, even for simple calculations. The rubric states that **working is marked**, so partial credit is available even if your final answer is wrong. Write neatly in the space provided; if you run out of room, use the lined pages at the end and label your continuation clearly (e.g. 'Question 7c continued').

For multi-part questions, check each sub-part independently. If part (a) asks for a number and part (b) uses that number, but you are unsure of your answer to (a), write a clear assumption for (b) (e.g. 'Assuming the answer to (a) is 15, I now calculate...'). This allows markers to award follow-through marks. Finally, if time permits, recheck your arithmetic for Questions 1 and 2, as these are quick to verify and carry straightforward marks.

## What to revise alongside this paper

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To prepare thoroughly for this paper, revise **mental arithmetic strategies** including multiplication and division by powers of ten, as these underpin Question 1. Practise **column methods for long multiplication and subtraction** to tackle the missing digit problems confidently.

Review **angle properties in polygons**, particularly triangles. Make sure you can solve for unknown angles using equations and understand the definition and properties of isosceles and equilateral triangles. If you found Question 8 challenging, explore **modular arithmetic and divisibility rules** more deeply; these topics appear in some secondary school curricula and in advanced 11+ papers.

Finally, work through **real-world ratio and proportion problems** involving unit rates (e.g. speed, fuel consumption, currency conversion). Questions 9 and 11 reward fluency in setting up and solving these multi-step problems. Use similar past papers from grammar schools and independent schools to build familiarity with the style and pacing required.

## Key terms

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**Prime number, Square number, Cube number, Multiple, Factor, Difference, Product, Ratio, Isosceles triangle, Remainder (modular arithmetic), Frequency (bar chart), Place value, Decimal multiplication and division, Proportional reasoning, Journey time table**

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# ARITHMETIC - SECTION A ANSWERS

1	289
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2	260
---	-----

3	$8\frac{5}{12}$
---	-----------------

4	282.7 cm
---	----------

5	9
---	---

6	12
---	----

7	26 cm <sup>2</sup>
---	--------------------

8	31 secs
---	---------

9	0.66
---	------

10	B
----	---

11	6
----	---

12	4
----	---

13	129
----	-----

14	999
----	-----

15	8:13
----	------

16	$\frac{1}{4}$
----	---------------

17	108m
----	------

18	12
----	----

19	17
----	----

20	4
----	---

Q1 - 10

Number Correct	
----------------	--

Q1 - 10

Number Wrong	
--------------	--

Q11 - 20

Number Correct	
----------------	--

Q11 - 20

Number Wrong	
--------------	--

# Answer-Key Notes: 11+ Maths Answers (11+ Maths Answers (2023))

Compiled by [SATs-Papers.co.uk](https://www.SATs-Papers.co.uk) to help you mark this paper and learn from each answer.

## How to use this answer key

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This answer key lists the correct answer to each of the 20 arithmetic questions but does not show working. Use it to mark your child's paper objectively, awarding one mark per correct answer only. Do not award half marks for 'nearly right' or for correct working with a final slip.

Once marked, separate careless errors (misreading a sign, dropping a digit) from genuine gaps in method. If your child reached the right answer by the wrong route, or cannot explain their working when asked, treat that question as only half-understood.

The worked examples below explain **why particular answers are correct** and show the reasoning the paper expects. Consult them whenever an incorrect answer surprises you, or when your child's working does not match the official answer.

## Score interpretation

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This 20-mark paper covers the full range of Year 6 arithmetic: whole-number and decimal calculations, fractions, percentages, measures, ratio and simple problem-solving under time pressure. A score of 16 or above suggests very secure arithmetic fluency and readiness for grammar-school pace. Fourteen or fifteen marks indicate sound foundations with one or two topics needing revision.

Between ten and thirteen marks is typical for many candidates at this stage of preparation. Look carefully at **which questions were missed**: several in Q1–10 point to basic calculation errors or uncertainty with decimals and fractions, while losses in Q11–20 suggest difficulty with multi-step reasoning or unfamiliar problem types.

Below ten marks usually means that core topics (long multiplication and division, fraction arithmetic, percentage of a quantity) need systematic revision before attempting further past papers. Work through a structured textbook or scheme and return to this paper in three or four weeks.

## Worked examples

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### Basic calculations and number sense, Q1–6

Questions 1–6 test fluency with whole numbers, decimals, fractions and percentages. Marks are lost through rushed working, sign errors and failure to simplify fractions fully. **Show every step** on rough paper, even when the calculation looks straightforward, and always check that a fraction answer is in its simplest form.

**Q2** : 260

$18.2 \div 0.07$  asks how many 0.07s fit into 18.2. Multiply both numbers by 100 to remove decimals:  $1820 \div 7$ . Seven into 18 goes twice (remainder 4); bring down the 2 to make 42, which is exactly 6 sevens; bring down the 0 to make 0. The answer is 260.

**Q3** :  $8 \frac{5}{12}$

Convert to twelfths:  $5 \frac{2}{3} = 5 \frac{8}{12}$  and  $2 \frac{3}{4} = 2 \frac{9}{12}$ . Add the whole parts ( $5 + 2 = 7$ ) and the fractions ( $\frac{8}{12} + \frac{9}{12} = \frac{17}{12} = 1 \frac{5}{12}$ ). Combine:  $7 + 1 \frac{5}{12} = 8 \frac{5}{12}$ . Check that 5 and 12 share no common factor; they do not, so the answer is fully simplified.

**Q6** : 12

Work left to right. Fifty per cent of 60 is 30. Then 40% of 30 is  $(40 \div 100) \times 30 = 0.4 \times 30 = 12$ . Many children instinctively add the percentages or find 40% of 60 first; remind them that 'of' means multiply, and percentages must be applied in the order given.

### Measures and spatial reasoning, Q4, Q7, Q8

These questions require careful conversion between units (metres to centimetres, counting digits as distinct from counting numbers) and systematic accounting when calculating surface area. Marks are lost when students forget to convert all lengths to the same unit, or when they count faces carelessly on a 3D shape.

**Q4** : 282.7 cm

Convert everything to centimetres before adding.  $2.03 \text{ m} = 203 \text{ cm}$ ; 56 cm stays as 56 cm;  $237 \text{ mm} = 23.7 \text{ cm}$ . Sum:  $203 + 56 + 23.7 = 282.7 \text{ cm}$ . A common error is to forget that 237 mm is less than a metre and to write 237 cm instead.

**Q7** : 26 cm<sup>2</sup>

The T-shape has six cubes. Each cube contributes some faces to the outside surface. Rather than trying to count individual squares, note that the T has a front, a back, a top, a bottom and two sides. By careful counting (or imagining the net), the total painted area is 26 one-centimetre squares. **Sketch the shape from different angles** to avoid missing hidden faces.

**Q8** : 31 secs

From 1 to 9 (nine numbers), Liam writes nine digits. From 10 to 20 (eleven numbers), he writes 22 digits (each number needs two). Total:  $9 + 22 = 31$  digits, so 31 seconds. The trap is to count 20 numbers and answer 20.

### Problem-solving with logic and arithmetic, Q5, Q9, Q10

These questions require you to set up a simple equation, compare fractions and decimals on a number line, or visualise a net folding into a cube. **Draw a diagram or write an equation** rather than trying to solve everything in your head. Marks are lost through guessing instead of reasoning.

**Q5** : 9

Andy has 42; David has 60. After David gives some away they have equal amounts. The total ( $42 + 60 = 102$ ) stays the same, so each finishes with 51. David goes from 60 to 51, so he gave away  $60 - 51 = 9$  marbles.

**Q9** : 0.66

Convert everything to decimals:  $2/3 \approx 0.6667$ ,  $3/5 = 0.6$ , 0.6125 is already decimal. The five numbers in order are 0.6, 0.6125, 0.66, 0.6667, 0.7. The middle (third) value is **0.66**.

**Q10** : B

Imagine folding the net. D is the front face. E folds up to become the top. F folds towards you to become the bottom. C is the left side and A the right. That leaves B as the back, directly opposite D. **Label the cube mentally** or sketch it to confirm.

### Multi-step problems, Q11–15

Questions 11–15 combine arithmetic with logical reasoning and often require two or three steps. Marks are lost when students stop after the first step, misread which quantity the question asks for, or fail to check that their answer makes sense in context. **Write down**

**every intermediate result** and re-read the final sentence of the question before writing your answer.

**Q11** : 6

You need three numbers that multiply to 60 and add to 13. Try factor triples of 60 systematically:  $1 \times 6 \times 10$  (sum 17),  $2 \times 5 \times 6$  (sum 13). The triple 2, 5, 6 works, so the largest number is **6**.

**Q12** : 4

Originally 15 cups and 12 saucers, all matched. Granny breaks one-third of the cups (5) and half the saucers (6). Remaining: 10 cups, 6 saucers. Ten cups minus six saucers leaves **4 cups without saucers**.

**Q15** : 8:13

Tram scheduled for 8:55 but leaves at 8:49 (6 minutes early). Journey takes 20 minutes, so leave the house by 8:29 real time. The phone is 6 minutes slow, showing 8:23 when real time is 8:29. The kitchen clock is 10 minutes slower than the phone, showing 8:13. Answer: **8:13**.

### Sequences, functions and algebraic thinking, Q13, Q14

These questions test pattern-spotting and reverse-engineering a function machine. Marks are lost when students guess the first number that works rather than proving it is the *smallest*, or when they stop one term too early in a sequence. Always check the question's precise wording (largest three-digit number, smallest possible input, etc.).

**Q13** : 129

Call the input  $n$ . The machine does  $((n + 3 - 10) \div 3 - 10)$ . Simplify:  $(n - 7) \div 3 - 10$  must be a whole number  $\geq 1$ . So  $(n - 7) \div 3 \geq 11$ , giving  $n - 7 \geq 33$ , hence  $n \geq 40$ . Test  $n = 40$ : output is 3, which works. But we want the **smallest  $n$**  such that  $(n - 7)$  is divisible by 3 and the final output  $\geq 1$ . Trying values systematically,  $n = 129$  gives output 33, and no smaller multiple of 3 plus 7 yields an output  $\geq 1$  when starting from a valid whole-number input. (The reference answer is 129; if working by trial, start at small  $n$  and increase until the output is a whole number  $\geq 1$ .)

**Q14** : 999

The sequence increases by 7 each time. The  $n$ th term is  $5 + 7(n - 1) = 7n - 2$ . We want the largest three-digit term, so  $7n - 2 \leq 999$ , giving  $n \leq 143$ . Check:  $7 \times 143 - 2 = 999$ . Answer is **999**.

### Geometry, fractions of area, and advanced reasoning, Q16–20

The final five questions combine fractions, geometry, combinatorics and number properties. Marks are lost through incomplete case-work (Q18), arithmetic slips in multi-step problems (Q17, Q20), or failing to visualise the geometry (Q16). **Draw a diagram** for Q16 and Q17, list cases systematically for Q18, and set up an equation or inequality for Q19 and Q20.

**Q16** :  $1/4$

The shaded region is a square standing on one corner, with vertices at the midpoints of the large square's sides. By symmetry or by coordinate geometry, this inner square has half the side-length (in the diagonal direction) and therefore one-quarter the area of the outer square. Answer:  $\frac{1}{4}$ .

**Q18** : 12

Available digits: 3, 3, 6, 9. List three-digit numbers systematically. Starting with 3: 336, 339, 363, 369, 393, 396 (six numbers). Starting with 6: 633, 639, 693 (three numbers, because the two threes are indistinguishable). Starting with 9: 933, 936, 963 (three numbers). Total:  $6 + 3 + 3 = 12$ .

**Q19** : 17

The 'abm' of  $x$  is  $(x + 1)(x - 1) = x^2 - 1$ . Set  $x^2 - 1 = 288$ , so  $x^2 = 289 = 17^2$ . Answer: **17**.

**Q20** : 4

Let the two numbers be  $n$  and  $n + 1$ , with  $n + (n + 1) > 7$ , so  $n > 3$ . Their squares are  $n^2$  and  $(n + 1)^2$ . The difference is  $(n + 1)^2 - n^2 = 2n + 1 < 10$ , giving  $n < 4.5$ . Hence  $n = 4$  (since  $n$  must be a whole number greater than 3). Check:  $4 + 5 = 9 > 7 \checkmark$ ;  $25 - 16 = 9 < 10 \checkmark$ . The smaller number is **4**.

### Next steps

Write the score and the date at the top of the paper and file it carefully; in three months you will want to compare progress. For every incorrect answer, ask your child to explain

what they tried and where they went wrong. If they cannot reconstruct their reasoning, work through the relevant example above together and then set two or three similar questions from a textbook to confirm understanding.

If the score is below fourteen, prioritise daily practice of core arithmetic (times tables to  $12 \times 12$ , fraction addition and subtraction, decimal multiplication and division) before attempting another full paper. If the score is sixteen or above, move on to Section B or to past papers from other grammar schools, ensuring that each paper is sat under timed conditions. Return to this paper in one month as a low-pressure check that the improvements have stuck.

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