

Surname Candidate number

First name

Current school



**The Manchester
Grammar School**

Founded 1515

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.

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

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

Use the above information to find:

(a) 370×2.46

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

(b) $9102 \div 3.7$

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

(c) 3.7×2.46

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

(d) 3.7×12.3

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

(e) $4551 \div 123$

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

[5 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]

Please turn over

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"/> |
|----|----------------------|

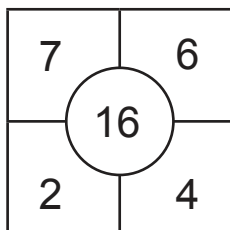
- (e) Dave thinks of a 3 digit number. It is the third largest 3 digit number
whose digits add up to 15.
What number is Dave thinking of?

| | |
|----|----------------------|
| 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**.

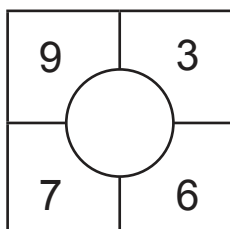
For example:



The number inside the circle is 16 because:

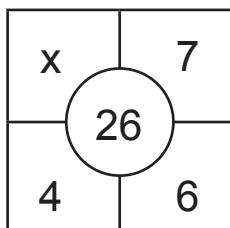
$$7 \times 4 - 6 \times 2 = 28 - 12 = 16$$

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



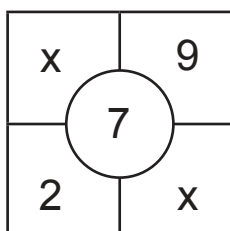
| | |
|----|--|
| 4a | |
|----|--|

- b) What is the value of x ?



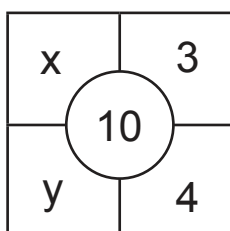
| | |
|----|-----|
| 4b | x = |
|----|-----|

- c) What is the value of x ?



| | |
|----|-----|
| 4c | x = |
|----|-----|

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

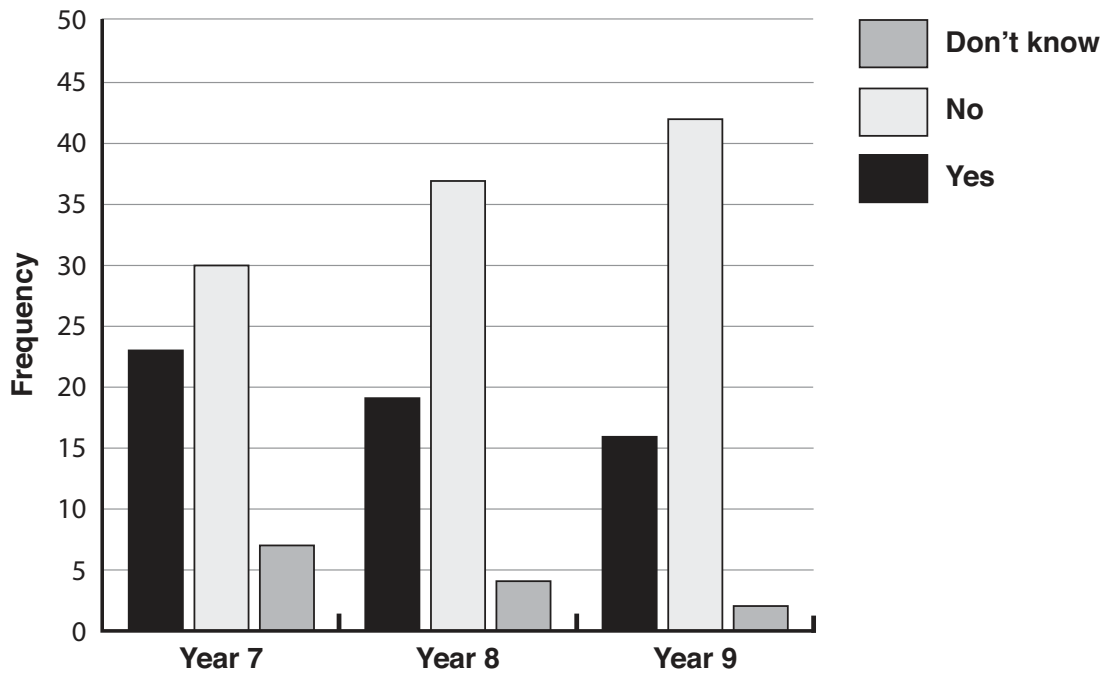


| | |
|----|------------|
| 4d | x = y = |
|----|------------|

[5 marks]

Please turn over

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 | |
|----|--|

[5 marks]

Please turn over

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] | |

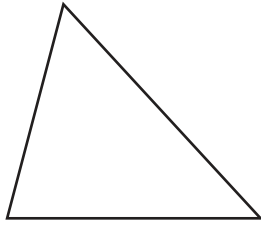
[5 marks]

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| | |
|-------------------|-----|
| Short problems | /30 |
|-------------------|-----|

Please turn over

7. The angles of a triangle always add up to 180° .



- a) Two angles of a triangle are 48° and 76° .
What is the third angle?

| | |
|----|--|
| 7a | |
|----|--|

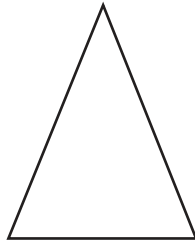
- b) The angles of another triangle are in the ratio $2 : 3 : 5$.
Find **all three** angles.

| | |
|----|-----|
| 7b | , , |
|----|-----|

- c) The angles of another triangle are such that one angle is both 8° more than another angle and 20° 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° .
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° .
Find the **two** possible values for the largest angle in the triangle.

| | |
|----|-----|
| 7f | , , |
|----|-----|

[10 marks]

Please turn over

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) | $d =$ |
|--------|-------|

[10 marks]

Please turn over

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"/> |
|----|----------------------|

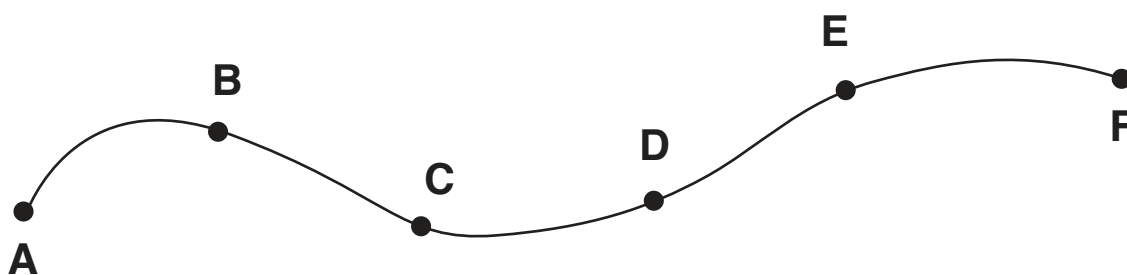
- d) Finally, Stephen wishes to swap 27 GREEN + 18 BLUE counters for YELLOW counters, how many YELLOW counters would he get?

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

[10 marks]

Please turn over

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.

| | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|
| A | | | | | | |
| B | | | | | | |
| C | 18 | 11 | | | | |
| D | | | | | | |
| E | 39 | | | | | |
| F | | 38 | | 18 | | |
| | A | B | C | D | E | F |

[10 marks]

Please turn over

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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| | |
|----------------------------|------------|
| Longer problems | /50 |
|----------------------------|------------|

