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

First name .....

Current school .....

mgs Founded 1515 | The Manchester Grammar School

Entrance Examination 2018
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			
out of	**30**	**50**	**80**

1. Alison buys 6 cups of coffee which cost £2.20 each, 4 glasses of juice which cost £1.15 each and some packets of crisps which cost 55p each. She pays by giving the member of staff £25 and receives £2.80 in change.

   Using this information, complete the bill below by filling in the five spaces

   6 cups of coffee costing £2.20 each £ .....

   4 glasses of juice costing £1.15 each £ .....

   ..... packets of crisps costing 55p each £ .....

   TOTAL £ .....

[5 marks]

2. Here is a list of numbers

   11 12 13 14 15 16 17 18 19

   On the list of numbers

   (a) Put a circle round **each** of the multiples of 3

   (b) Draw a line underneath **each** of the prime numbers

   (c) Put a **square** round the square number

   (d) Write down **all** the factors of the remaining number.

[5 marks]

3. In a scrabble tournament, players score 5 points for a win, 3 points for a draw and get 0 points if they lose. Part way through the tournament four of the players taking part, players, A, B, C and D, **have played different numbers of games and have all lost at least one game**. Note that there are other players playing in the tournament whose results are not listed here.

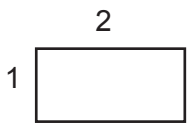
Complete the table below by filling in all the missing entries.

	Played	Won	Drawn	Lost	Points
A	12	7	.....	2	.....
B	10	3	.....	.....	27
C	.....	.....	2	6	41
D	8	.....	.....	.....	30

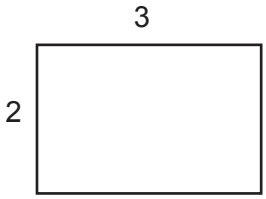
[5 marks]

4. A sequence of rectangles is drawn and the first three rectangles are as follows, with their length and width shown in each case.

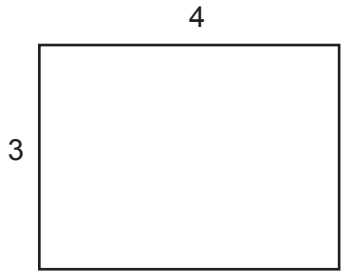
Rectangle 1



Rectangle 2



Rectangle 3



The perimeters and areas of each rectangle are noted in the table below

Rectangle number	**1**	**2**	**3**
Perimeter	6	10	14
Area	2	6	12

(a) Draw small sketches of the **<u>next two</u>** rectangles, marking the length and width on each sketch. Write the perimeter and area of each rectangle in the answer boxes. (Note: Your sketches do not need to be drawn to scale as they **will not** be marked for accuracy)

4a	Perimeter
	Area
	Perimeter
	Area

(b) What rectangle number has a perimeter of 162?

4b	

(c) What is the area of rectangle number 30?

4c	

[5 marks]

5. **If** $2^4 \times 3^1 = 2 \times 2 \times 2 \times 2 \times 3 = 48$

and $2^0 \times 3^2 = 3 \times 3 = 9$

Using this method to set out your work, or otherwise

(a) Work out $2^2 \times 3^3$

5a	

(b) Find the **largest** value of b for which $2^0 \times 3^b$ is **less** than 100

5b	b =

(c) Find the **smallest** value of c for which $2^c \times 3^1$ is **greater** than 100

5c	c =

(d) Find the values of d and e for which $2^d \times 3^e = 144$

5d	d =
	e =

[5 marks]

6. Ger puts a cube against the floor and the walls in the corner of his room, as in diagram 1, then paints the faces that he can see. **He therefore paints three faces.**

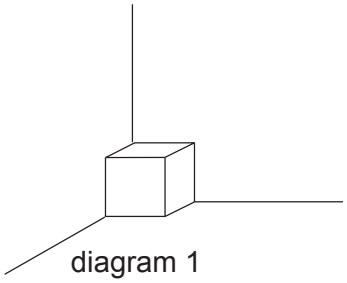


diagram 1

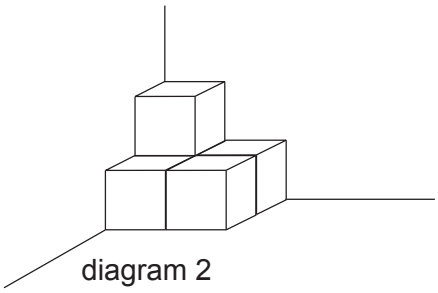


diagram 2

(a) In the second corner he puts four cubes in a square on the floor in the corner and then puts one cube on top in the corner too as shown in diagram 2. If he paints all the faces he can see now, how many faces does he paint on the cubes in this corner?

6a	

(b) In the third corner he puts nine cubes in a square on the floor in the corner and then puts four cubes on top of the nine and then finally puts one cube on top of the four cubes. If he paints all the faces he can see here, how many faces does he paint on the cubes in this corner?

6b	

(c) In the last corner he starts with 16 cubes in a square on the floor in the corner and then puts nine cubes on top and then four on top of those and finally one on top of the four in the corner. If he paints all the faces he can see now, how many faces does he paint on the cubes in this last corner?

6c	

[5 marks]

FOR MARKER USE ONLY

Short problems	**/30**

7. In a school athletics triathlon, children score points for their performances in three events, running 100 m, Long Jump and Shot Putt (throwing) according to the following table

100 m (seconds)	Long Jump (metres)	Shot Putt (metres)	Points
16.2	2.2	7.2	50
14.9	2.35	7.5	60
14.1	2.7	8.0	70
13.5	3.1	8.6	80
13.2	3.55	9.5	90
13.0	4.1	11.8	100

So if Richard ran the 100 m in 13.0 secs he would earn 100 points, he would earn a further 80 points for putting the shot 8.6 m and 70 points for a long jump of 2.7 m making a total of 250 points scored for his performance in the three events

(a) If Alan runs 100 m in 14.9 secs, Long Jumps 3.1 metres and Putts the Shot 7.5 metres what is his total points score?

7a

(b) Betty runs the 100 m in 13.2 seconds and scores 20 points less in the Long Jump. How far does she jump?

7b m

(c) Colin long jumped 4.1 metres, putt the shot 7.5 metres and scored 210 points. How fast did he run the 100 m?

7c secs

(d) Deepak **averages 60** points over the three events having run the 100 m in 16.2 secs and long jumped 2.2 metres. How far does he putt the shot?

7d m

(e) Emily scores the same number of points in her 100 m run as she does for putting the shot 9.5 metres. Francine scores the same number of points in her 100 m run as she does for her 2.35 metre long jump. What is the difference **in time** between their two runs?

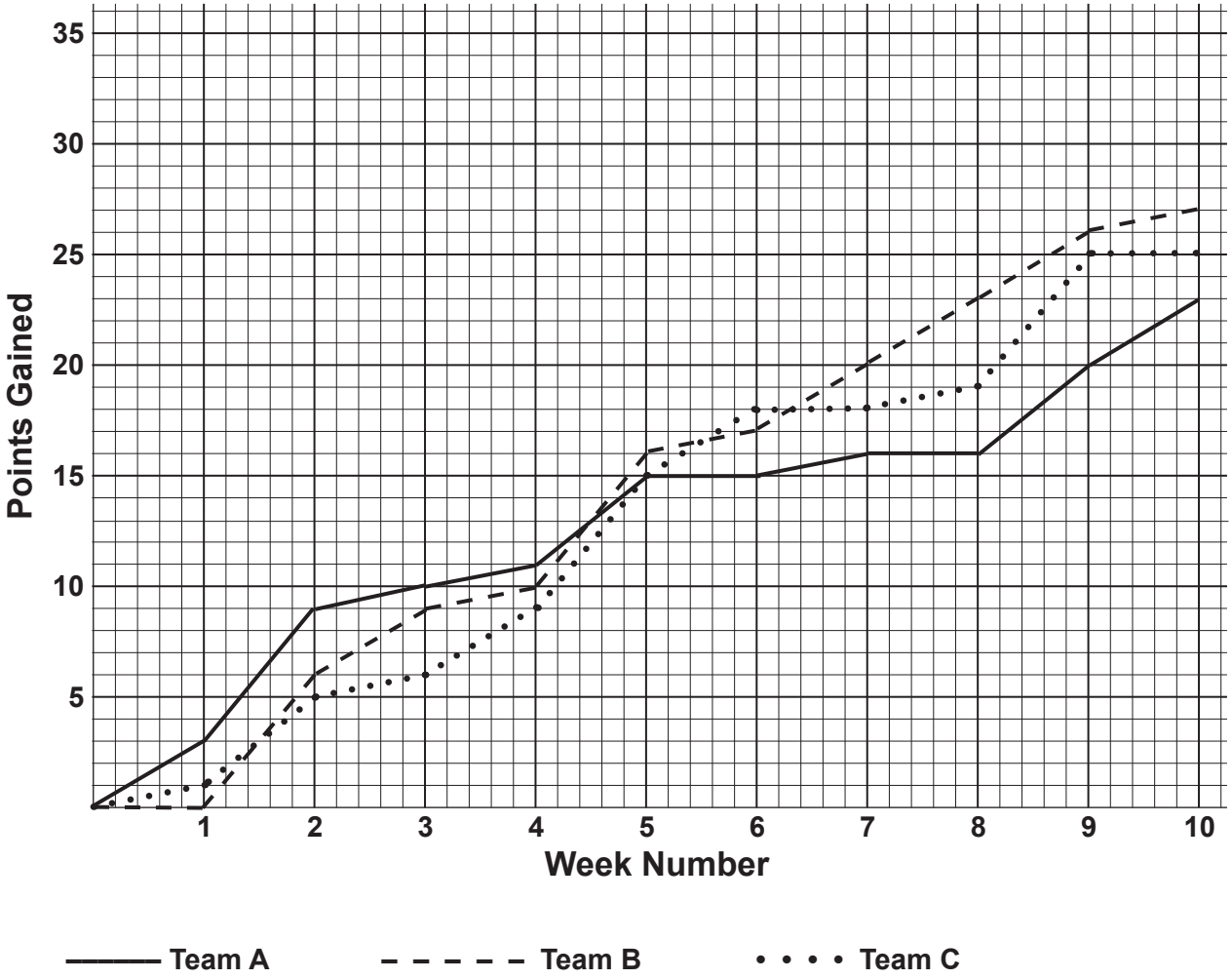
7e secs

(f) A Gold award is achieved by scoring a total of 270 points. What is the **slowest** run that could win a Gold award?

7f secs

[10 marks]

8. Three football teams, Aardvark Athletic, Buffalo Bears and Caribou Celtic, record of points gained during the first ten weeks of the 2016 - 17 season are shown on the graph below. Using the graph answer the questions which follow



(a) How many points did **team A - Aardvark Athletic** have after week six?

8a

(b) In which week did team A - Aardvark Athletic gain the most number of points?

8b

(c) When Aardvark Athletic has the same number of points as **team C - Caribou Celtic** how many more points do **team B - Buffalo Bears** have?

8c

(d) In how many weeks did Caribou Celtic gain exactly one point?

8d

(e) How many **more** points did Buffalo Bears gain than Aardvark Athletic in week 7?

8e

(f) What was the total number of points **gained** in week 6?

8f

(g) At the end of which week were Buffalo Bears seven points ahead of Aardvark Athletic?

8g

[10 marks]

9. The company Clearglass makes and fits window units and has the following scale of charges for its work.

It charges £500 for each square metre of glass in the window unit and there is a fixed charge of £150 for making <u>each</u> window unit.

For example:- the cost of making a unit 2m wide by 1.5m high will be calculated as

2 x 1.5 x 500 + 150 = 1500 + 150 = £1650

(a) What is the total cost of one window unit which measures 1.5 m by 1.8 m?

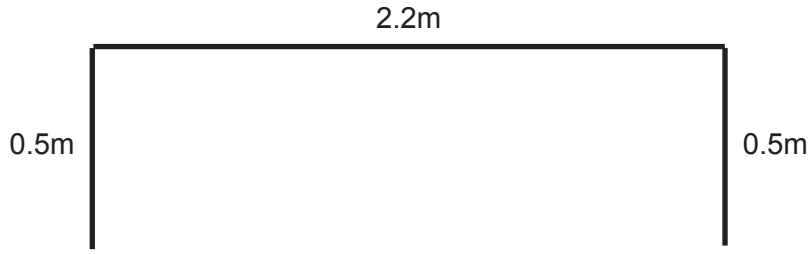
9a	£

(b) If the total cost of a different window unit is £1050, what is its area in m^2?

9b	m^2

(c) If the window unit in part b) is 1.5m high, how wide is it?

9c	m



(d) The diagram above shows a plan of the front window in a house which has to be made and fitted as **three separate** window units. The middle section of the window is 2.2m wide and the side sections are each 0.5m wide. The whole front window is 1.5m high. Calculate the total cost of making the three window units for this front window.

9d	£

[10 marks]

10. The **volume** of a sphere can be calculated approximately using the following formula

$V = 4r^3$ which means 4 x r x r x r, where r is the radius of the sphere.

The **mass** of the sphere is then calculated using the formula

$$M = \frac{V \times d}{1000}$$ where d is the density of the material that makes up the sphere.

For example if r = 20 and d = 3 then we can find the Volume (V) and the Mass (M) as follows

$$V = 4 \times (20)^3 = 4 \times 20 \times 20 \times 20 = 32000$$

$$\text{and } M = \frac{32000 \times 3}{1000} = 96$$

Using the **two** formulae

(a) Find the Volume (V) and the Mass (M) if the radius (r) is 10 and the density (d) is 5

10a	Volume
	Mass

(b) Find the Volume (V) and the Mass (M) if the radius (r) is 3 and the density (d) is 10

10b	Volume
	Mass

(c) Find the Volume (V) and the radius (r) if the Mass (M) is 4 and the density (d) is 8

10c	Volume
	Radius

(d) Find the Volume (V) and the density (d) if the radius (r) is 2 and the Mass (M) is 3.2

10d	Volume
	Density

[10 marks]

11. A train leaves Manchester with 200 passengers on board comprising of men, women, boys and girls. There are four times as many men as women, twice as many men as boys and three times as many girls as women in the 200 passengers.

(a) Using this information, **complete row one** of the table below.

At the first stop which is Macclesfield, $\frac{3}{8}$ of the men get off and 20% of the women get off the train. Twice as many girls as boys also get off at this first station.

(b) **Complete row two and row three** of the table if there are now 112 passengers left on the train after the first stop at Macclesfield **and if nobody new boarded the train.**

		Men	Women	Boys	Girls	TOTAL
Row 1	At Manchester	.....	.....	40	.....	.....
	1st stop at Macclesfield					
Row 2	Leaving the train	.....	.....	.....	.....	.....
Row 3	Still on the train	.....	.....	.....	.....	112

At the second stop which is Stoke on Trent, all the remaining women get off and an equal number of men also get off. The same number of boys as girls also get off.

(c) If there are now five times as many male passengers (men and boys) as female passengers (women and girls) left on the train, how many boys **got off** at this second stop?

11c	

[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.