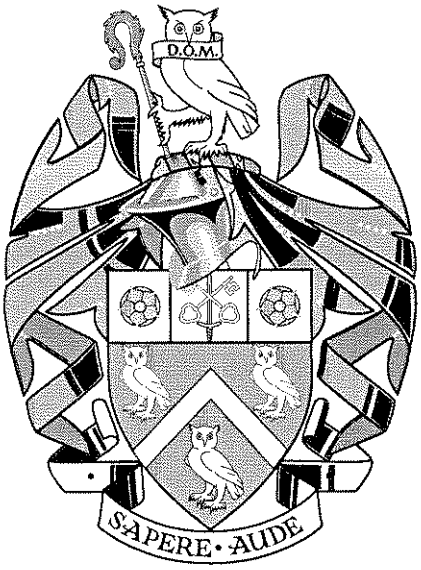
Name: _____ Candidate Number: _____



THE MANCHESTER GRAMMAR SCHOOL

ENTRANCE EXAMINATION 2005
PART 2 ARITHMETIC EXAMINATION

Time available: 75 minutes

Write your name and candidate number in the spaces provided at the top of the page.

Try to answer all the questions in the order that they appear.
Write your working and your answer in the space provided after each question. If you cannot answer a question, go on to the next.

If you run out of space for an answer, use the space provided after Question 13.

All your working must be shown because it may be worth some marks. Scrap paper must therefore not be used.

Take care to leave yourself enough time to answer all the questions. Use any time you have left to make the best attempt you can at any questions you have not done.

Calculators may not be used.

DO NOT WRITE IN THIS MARGIN

1. Each time a rubber ball bounces on the floor it rebounds to a height of three-quarters of the height that it fell.

   (a) I drop the ball from a height of 32 cm. How high does it rebound after it hits the floor?

   _____

   _____

   (b) If the ball rebounded up to a height of 36 cm after the **second** time it hit the floor, from what height was it originally dropped?

   _____

   _____

   (c) I drop the ball from a height of 160 cm. What is the total distance that has been travelled by the ball at the moment when it hits the floor for the third time?

   _____

   _____

   _____

5 Marks

2. The table below is an addition table.

   A, B, C, D and E stand for five different numbers.

   In each row and column the sum of the numbers is given. So, for example,
   A + B + C + D + E = 26 and A + A + C = 18

   Work out what number each of the letters stand for.

A	B	C	D	E	26
A	A	B	D	E	23
C	C	C	D	D	32
18	20	23	12	8	

Answers : A _____

B _____

C _____

D _____

E _____

5 Marks

DO NOT WRITE IN THIS MARGIN

3. Write down the next two values in the following sequences.

(a) 5, 6, 8, 11, 15, 20, ___ , ___

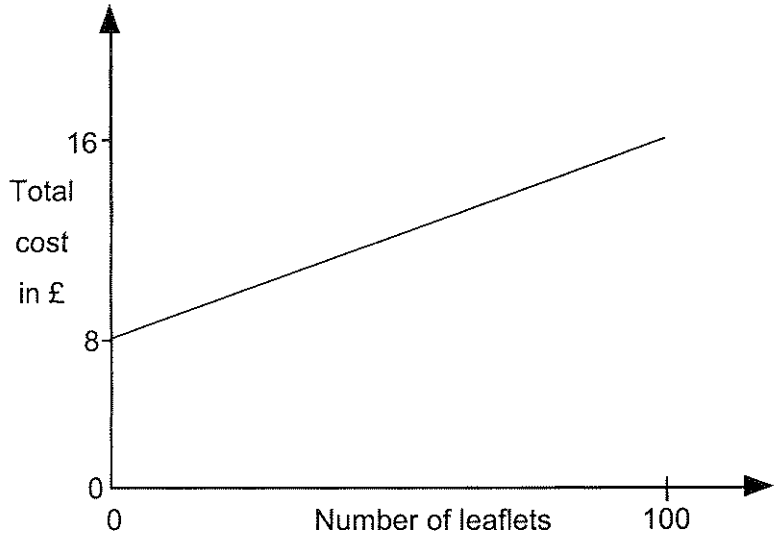
(b) 8, 9, 13, 22, 38, ___ , ___

(c) 2, 4, 6, 10, 16, 26, ___ , ___

5 Marks

4. The graph below shows the cost of having some leaflets printed.

There is a basic cost to set up the printer and then a price for each leaflet.



(a) What is the basic cost to set up the printer?

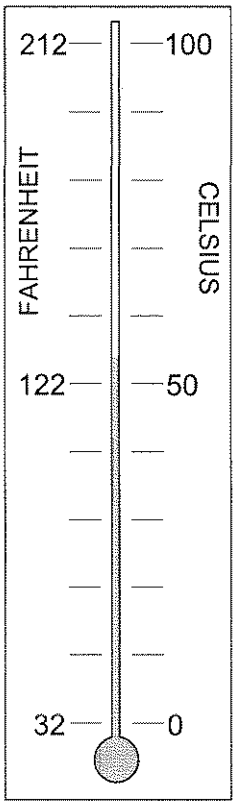
(b) After the printer has been set up, what is the cost for each leaflet?

(c) How many leaflets do I get for £10?

5 Marks

DO NOT WRITE IN THIS MARGIN

5. A thermometer measures the temperature on both Celsius and Fahrenheit scales. For example the boiling point of water is 100 degrees on the Celsius scale and 212 on the Fahrenheit scale. We write 100 °C = 212 °F.



(a) Convert 60 °C into °F.

(b) Convert 104 °F into °C.

(c) Which is hotter, 80 °C or 180 °F?

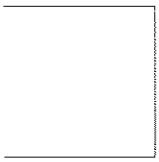
(d) If the temperature drops by 5 °C, what is the drop in °F?

(e) At how many degrees C is the number on the reading on the Fahrenheit scale five times the number on the reading on the Celsius scale?

5 Marks

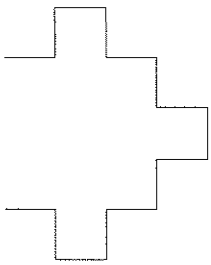
6. A **fractal** is a shape which is built up by a simple pattern.

Step 1



We start with three sides of a square. The length of each side is 1, and so the total length is 3.

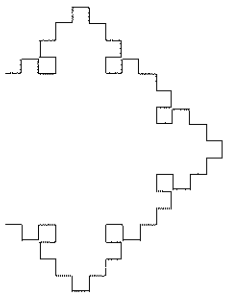
Step 2



Each of the three sides in step 1 has a smaller square added in the middle. The smaller square has edges of length $\frac{1}{3}$.

(a) What is the total length of all the edges?

Step 3



Each of the new edges has a smaller square (one-third of the previous size) added in the middle.

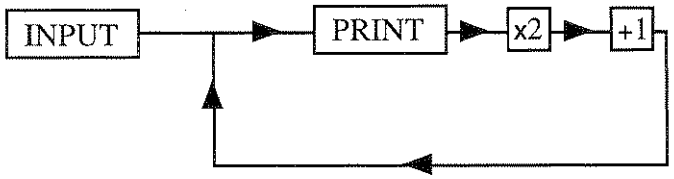
(b) What is the total length of all the edges?

(c) If the process were repeated, what would be the total length of all the edges after step 4? Do not attempt to draw this.

5 Marks

DO NOT WRITE IN THIS MARGIN

7. I have recently bought a 'Number Engine' into which I can put boxes which contain instructions. For example, if I put the instructions [x2] and [+1] into the machine, like this,



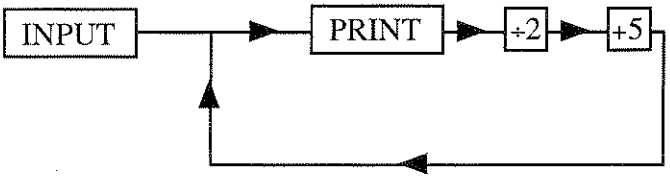
and input the number 1, the engine will print out the sequence 1, 3, 7, 15, ...

(a) What will be the first three numbers printed out if I input the number 10?

(b) If the third number printed out in a sequence was 23, what number did I input?

(c) I swapped over the two instructions [x2] and [+1] and input the number 1. What were the first three numbers printed out?

I replace [x2] by [÷2] and the [+1] by [+5] so the Number Engine now looks like this.



(d) I input 30. What are the first four numbers printed out?

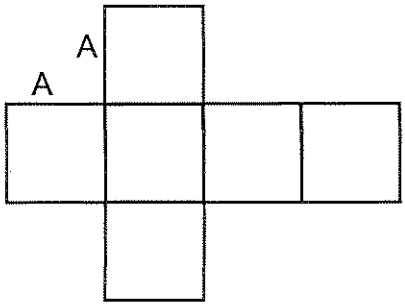
(e) The fourth number in a sequence was 9. What number was input into the engine?

(f) I input a number and notice that all the numbers in the sequence that is produced are the same. What number did I input?

10 Marks

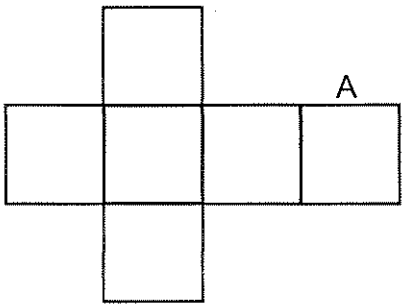
DO NOT WRITE IN THIS MARGIN

8. When the net below is folded to make a cube, the two edges marked with an A match up.

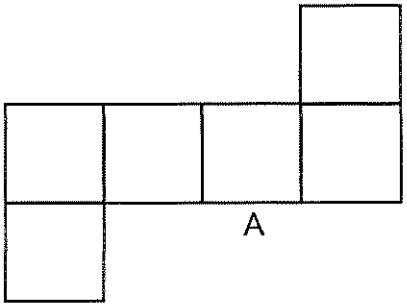


For each of the following nets add a second letter A to show which edges match up.

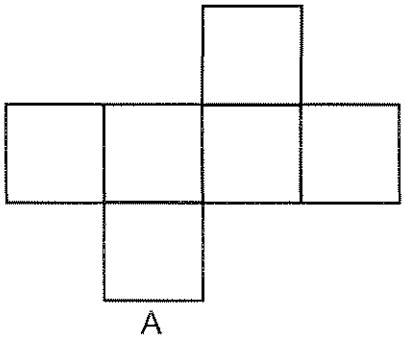
(a)



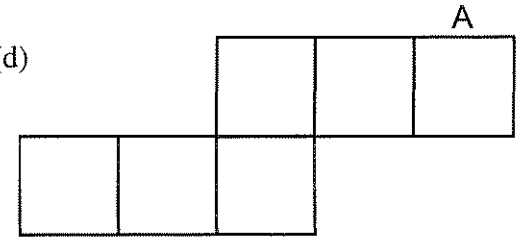
(b)



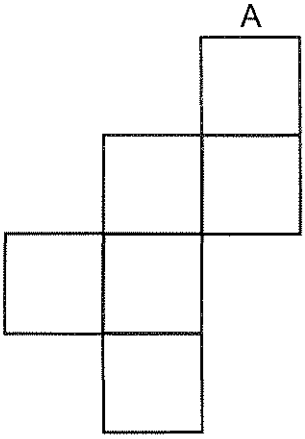
(c)



(d)



(e)



10 Marks

DO NOT WRITE IN THIS MARGIN

9. When a pan containing a volume of liquid is heated the temperature of the liquid in degrees Celsius (°C) is given by the formula;

$$\text{Temperature} = 20 + \left(\frac{120}{\text{volume}} \times \text{time}\right)$$

For example, if there are 10 litres of liquid being heated, then after 2 minutes the temperature of the liquid is given by;

$$\text{Temperature} = 20 + \left(\frac{120}{10} \times 2\right)$$

$$\text{Temperature} = 20 + (12 \times 2)$$

$$\text{Temperature} = 44$$

So the temperature is 44 °C.

(a) 20 litres of liquid are being heated. Find the temperature after 3 minutes.

(b) What is the temperature of the liquid before the heating starts?

(c) Some liquid is being heated. After 10 minutes the temperature is 50 °C. How many litres of liquid are in the pan?

(d) 24 litres of liquid are being heated. After how many minutes is the temperature 80 °C?

10 Marks

DO N
WRITE
IN THIS
MARGIN

10. By using the digits 1, 2, 3 and 4 we can make different numbers.

RULES : 1. You must use all the digits.

2. You can use each number only once.

3. You can use any of the operations +, −, x and ÷.

4. You can use brackets.

Examples

This is one way to make 10. $1 + 2 + 3 + 4 = 10$
This is one way to make 12. $(1 + 3) \times 2 + 4 = 12$
This is one way to make 7. $(3 + 4) \div (2 - 1) = 7$

(a) Make 5.

(b) Make 14.

(c) Make 23.

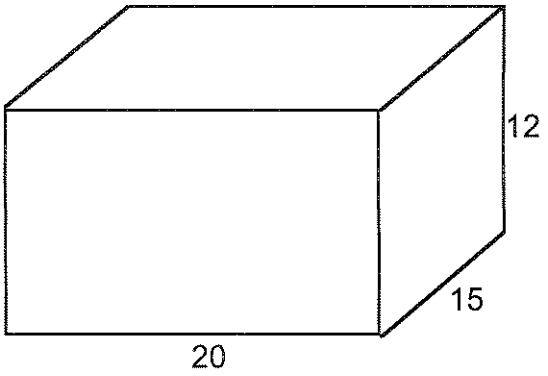
(d) Make 21.

(e) Make 19.

10 Marks

DO NOT WRITE IN THIS MARGIN

11.



I have a block like the one above. I call it a 20 x 15 x 12 block. I cut it up so that **all** of it is used.

(a) If I cut it up into identical blocks 6 x 5 x 2, how many of these will I have?

(b) How many 5 x 4 x 3 blocks could I make?

(c) If I cut it up into 4 x 5 x h blocks, there are 45 of these. What is the value of h?

(d) If I cut it up into 5 x 5 x y blocks, there are 72 of these. What is the value of y?

(e) If I cut it up so that **none** of the sides of my new blocks are 12, 15 or 20, what is the smallest number of blocks I could make so that the lengths of the edges are all whole numbers?

10 Marks

DO NOT WRITE IN THIS MARGIN

12. In a test, if an answer is correct, it earns 3 marks. For a wrong answer, 1 mark is subtracted. If a question is not attempted, 0 marks are given.

For example, in a test consisting of 10 questions, Nigel attempted 9 questions and got 2 of them wrong. His total mark is given by $7 \times 3 - 2 \times 1 = 21 - 2 = 19$

(a) In a test of 10 questions, Rodger got 6 correct and did not attempt 1 question. What was his total mark?

(b) In a test of 20 questions, Paul got 12 correct and his total mark was 30. How many questions did he not attempt?

(c) In a test of 20 questions, Neil got 5 more questions correct than he got wrong. His total mark was 23. How many questions did he get wrong?

(d) In a test of 30 questions, Jim got twice as many questions correct as he got wrong. His total mark was 45. How many questions did he not attempt?

(e) In a test of 5 questions, what is the smallest score that it is not possible to achieve?

(f) In a test of 20 questions, what is the smallest score that it is not possible to achieve?

10 Marks

DO NOT WRITE IN THIS MARGIN

13. Lemon, the mobile phone company, offers three different tariffs to its users:

TARIFF A	TARIFF B	TARIFF C
Pay £40 per month. All calls free. All texts free.	Pay £20 per month. 10 calls free. 20 texts free. After that, calls cost 15p each and texts cost 10p each.	No monthly payment. Each call costs 25p. Each text costs 5p.

Geraint pays for his phone on tariff A.

(a) He made 50 calls and sent 80 texts in January Work out how much Geraint would have saved himself by using:

(i) tariff B;

(ii) tariff C.

Tim uses tariff B.

(b) He sent 130 texts in January. He works out that he spent more using tariff B than he would have done using tariff A. What is the smallest number of calls he could have made?

(c) Stephen sent 100 texts in January. He works out that using tariff B would have cost him more than using tariff C. What is the largest number of calls that he could have made?

10 Marks

Information Sheet

In Russia the money is roubles.

Approximately 50 roubles = 1 pound (£)
and 30 roubles = 1 dollar ($).

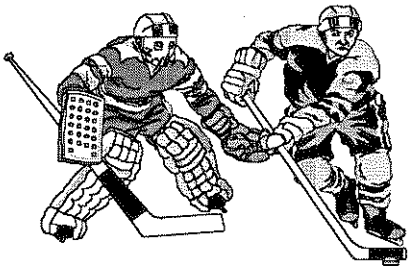
Here are some examples of prices.

a ticket on the met costs	8 roubles
an entry ticket to the museum costs	125 roubles
a ticket to watch ice hockey costs	80 roubles
a CD costs	100 roubles
a cup of coffee costs	55 roubles

Ice hockey is very popular in Russia.

The top 4 teams are:

SKA
Spartak
Akbars
Locomotiv



Time in St Petersburg is 3 hours ahead of time in Manchester. For example when it is 6am in Manchester it is 9am in Russia.

The population of St Petersburg is approximately five million, three thousand and one.

DO NOT WRITE IN THIS MARGIN

14. Richard and 9 of his friends each have a cup of coffee. What is the total cost in pounds?

_____

_____

_____

2 Marks

15. Richard and 2 of his friends from America go to watch a hockey match. What is the total cost in dollars?

_____

_____

3 Marks

16. A CD in England costs £14. If Richard spent this amount of money in St Petersburg how many CDs could he buy?

_____

_____

2 Marks

17. Richard catches a plane in England at 12 noon. The flight to St Petersburg takes 4 hours. What time will it be in St Petersburg when he lands there?

_____

_____

2 Marks

18. Richard's mother Isobel flies out to see Richard. He meets the plane, which was on time, at 12 noon, St Petersburg time. What time did the plane leave Manchester?

_____

_____

2 Marks

19. Richard is sent 40 dollars for his birthday and plans to go to watch the ice hockey match between SKA and Spartak and take some of his friends with him. If he pays for the met both ways, a cup of coffee each and the entry fee to the game how many friends can he treat with his 40 dollars? (Don't forget Richard's tickets).

_____

_____

2 Marks

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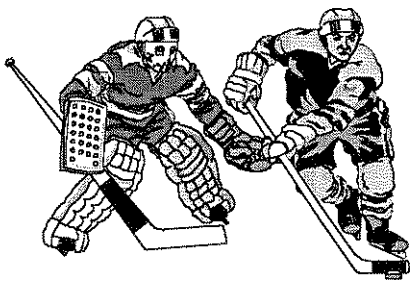

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DO NOT WRITE IN THIS MARGIN

20. In the ice hockey league each team plays each of the others twice, home and away. Teams score 5 points for a win, 2 for a draw and 0 if they lose.

Here are the statistics after some of the games have been played.

	Wins	Draws	Losses	Points
SKA	3	0	1	15
Spartak	1	1	2	
Akbars	1	2	2	
Locomotiv	2	1	2	

Fill in the last column.

3 Marks

21. Here are 6 of the matches.

SKA v Spartak

SKA v Akbars

SKA v Locomotiv

Spartak v Akbars

Spartak v Locomotiv

Akbars v Locomotiv

Ring the matches which you **know** resulted in a draw.

3 Marks

22. How many more games are to be played to complete the tournament?

3 Marks

23. Write the population of St Petersburg in figures.

3 Marks

24. Richard's parents and sister and sister travel to St Petersburg to see him. A special all-in ticket is available to tourists which covers 4 ice hockey tickets, 4 museum tickets and unlimited travel on the met. This is priced at 20 dollars. Should they buy the all-in ticket? Show all your working giving a reason for your answer.

3 Marks

END OF PAPER