



# MAGDALEN COLLEGE SCHOOL

## 16+ Entrance Exam 2023: **Mathematics**

Time allowed: 45 minutes

Name: .....

Current school: .....

### Instructions

- Use **black** ink or ball-point pen.
- Attempt **all** questions.
- Use the **answer sheet** to answer the questions.
- Write your name and school on both this booklet **and** the answer sheet.
- Remember to transfer your answers to the answer sheet before the end of the test.
- You may use the space between questions for rough working, but nothing written in this booklet will be marked.
- Calculators, formulae sheets, rulers, and compasses are not allowed.

### Information

- There is one mark per question. The total mark for this paper is 45. You will not lose marks for incorrect answers.
- The questions increase in difficulty towards the end of the paper. The latter questions are designed to be challenging, so do not worry if you find them hard or if you do not finish.

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly.
- Check your answers if you have time at the end.

**Total**      \_\_\_\_\_ /45      \_\_\_\_\_ %

1. The number exactly half way between  $-1.5$  and  $7$  is:

- A: 2                      B: 2.2                      C: 2.25                      D: 2.5  
E: 2.6                      F: 2.75                      G: 3                      H: 5.5

2.  $\frac{2}{5} - \frac{1}{3}$  is equal to:

- A:  $\frac{1}{20}$                       B:  $\frac{1}{16}$                       C:  $\frac{1}{15}$                       D:  $\frac{1}{10}$   
E:  $\frac{1}{8}$                       F:  $\frac{1}{5}$                       G:  $\frac{1}{3}$                       H:  $\frac{1}{2}$

3. How many integer solutions are there to the inequality  $2 \leq x < 7$ ?

- A: 0                      B: 1                      C: 2                      D: 3  
E: 4                      F: 5                      G: 6                      H: 7

4.  $\sqrt{27}$  is equal to:

- A:  $\sqrt{3}$                       B:  $3\sqrt{3}$                       C:  $\sqrt[3]{3}$                       D:  $9\sqrt{3}$   
E:  $\sqrt[3]{3}$                       F: 3                      G: 9                      H: None of these.

5. Which of the following is closest to 1?

- A:  $\frac{3}{4}$                       B:  $\frac{4}{3}$                       C:  $\frac{3}{5}$                       D:  $\frac{5}{3}$   
E:  $\frac{4}{5}$                       F:  $\frac{5}{4}$                       G:  $\frac{5}{6}$                       H:  $\frac{6}{5}$

6.  $y = -3x^2$ . When  $x = -2$ ,  $y$  is equal to:

- A:  $-36$                       B:  $-12$                       C:  $-9$                       D:  $-3$   
E: 3                      F: 9                      G: 12                      H: 36

*This page has been left blank for rough working*

7.  $\frac{1}{x} + \frac{3}{2x}$  is equivalent to:

A:  $\frac{5}{2x}$

B:  $\frac{2}{5x}$

C:  $\frac{4}{2x}$

D:  $\frac{4}{3x}$

E:  $\frac{2x}{5}$

F:  $\frac{5x}{2}$

G:  $\frac{2x}{4}$

H:  $\frac{3x}{4}$

8.  $2.1 \times 10^8 + 10^7$  is equal to:

A: 22,000,000

B: 21,200,000

C:  $2.12 \times 10^7$

D:  $2.12 \times 10^8$

E:  $2.12 \times 10^9$

F:  $2.2 \times 10^7$

G:  $2.2 \times 10^8$

H:  $2.2 \times 10^9$

9. 5 apples and 3 pears costs 8p more than 3 apples and 5 pears. How much more expensive is an apple than a pear?

A: 1p

B: 2p

C: 3p

D: 4p

E: 5p

F: 6p

G: 7p

H: 8p

10.  $(2x)^4$  is equivalent to:

A:  $2x^8$

B:  $4x^8$

C:  $8x^8$

D:  $16x^8$

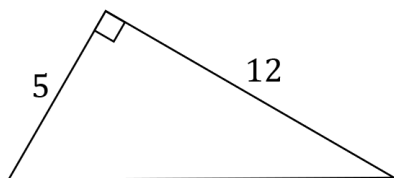
E:  $2x^4$

F:  $4x^4$

G:  $8x^4$

H:  $16x^4$

11.



In the triangle above, the length of the hypotenuse is:

A: 5

B: 12

C:  $\sqrt{60}$

D:  $\sqrt{17}$

E: 13

F: 25

G: 144

H: 169

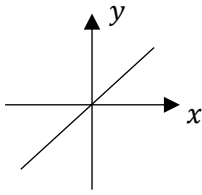
*This page has been left blank for rough working*



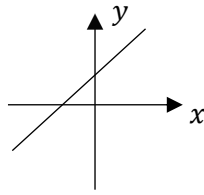
*This page has been left blank for rough working*

17. A sketch of the line  $x + y = 1$  is:

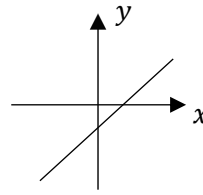
A:



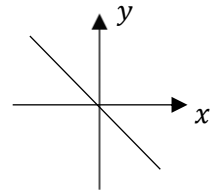
B:



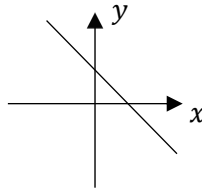
C:



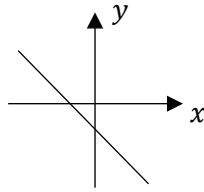
D:



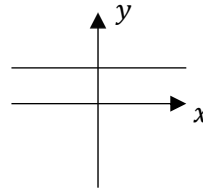
E:



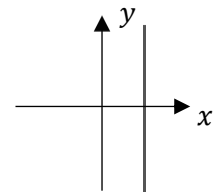
F:



G:



H:



18.  $a - (b - (a - b))$  simplifies to:

A: 0

B:  $a$

C:  $b$

D:  $a - b$

E:  $a + b$

F:  $2a$

G:  $2a - 2b$

H:  $2a + 2b$

19. The gradient of the straight line passing through the points  $(1, -2)$  and  $(-3, 2)$  is:

A:  $-2$

B:  $-1$

C: 1

D: 2

E:  $-\frac{1}{2}$

F:  $\frac{1}{2}$

G: 3

H:  $-\frac{1}{3}$

20. The solution of the equation  $x - 1 = 1 - x$  is:

A:  $x = 1$

B:  $x = 2$

C:  $x = 3$

D:  $x = 4$

E:  $x = 0$

F:  $x = -1$

G:  $x = -2$

H:  $x = -3$

21. The value of  $p$  is 20% more than the value of  $q$ . The ratio  $p : q$  is

A: 5:6

B: 6:5

C: 4:5

D: 5:4

E: 3:4

F: 4:3

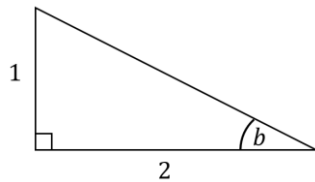
G: 20:1

H: None of these



*This page has been left blank for rough working*

22.



In the triangle above, the value of  $\sin b$  is:

A:  $\frac{1}{2}$

B:  $\frac{1}{\sqrt{3}}$

C:  $\frac{2}{\sqrt{5}}$

D:  $\frac{1}{\sqrt{5}}$

E: 2

F:  $\sqrt{3}$

G:  $\sqrt{5}$

H:  $\frac{\sqrt{5}}{2}$

23.  $2^2 \times 2^3 \times 2^p$  simplifies to:

A:  $2^{5p}$

B:  $2^{5+p}$

C:  $2^{6p}$

D:  $2^{6+p}$

E:  $4^{2+p}$

F:  $4^{3+p}$

G:  $4^{3p}$

H:  $4^{6p}$

24.  $\sqrt{12^2 - 4^2}$  simplifies to:

A: 16

B: 8

C: 11

D:  $12\sqrt{2}$

E:  $8\sqrt{2}$

F:  $4\sqrt{2}$

G:  $\sqrt{8}$

H: 2

25. Both  $x$  and  $y$  are positive, and  $x$  is proportional to the square of  $y$ .

When  $x = 12$ ,  $y = 2$ . When  $x = 9$ ,  $y$  is equal to:

A: 1

B:  $\sqrt{2}$

C:  $\sqrt{3}$

D: 3

E:  $\frac{1}{2}$

F:  $\frac{1}{\sqrt{2}}$

G:  $\frac{1}{\sqrt{3}}$

H:  $\frac{1}{3}$

26. The solution to  $1 - x > 2 + x$  is:

A:  $x < 1$

B:  $x < -2$

C:  $x > \frac{1}{2}$

D:  $x > 2$

E:  $x > 1$

F:  $x < -1$

G:  $x < \frac{1}{2}$

H:  $x < -\frac{1}{2}$

*This page has been left blank for rough working*

27. Which of these numbers is largest?

A:  $\frac{8}{25}$

B: 30%

C:  $\frac{1}{3}$

D: 0.31

E:  $\frac{7}{20}$

F:  $\frac{\pi}{10}$

G:  $3^{-2}$

H:  $4^{-0.5}$

28. The base length of a triangle is  $\sqrt{12}$  and the perpendicular height of the triangle is  $1 + \sqrt{3}$ . The area of the triangle is:

A:  $\sqrt{3} + \sqrt{6}$

B:  $3 + \sqrt{6}$

C: 4

D:  $12 + 2\sqrt{3}$

E:  $2 + \sqrt{3}$

F:  $3 + \sqrt{3}$

G:  $4 + \sqrt{3}$

H:  $2 + \sqrt{6}$

29.  $x^2 - 5x + 6$  factorises to give:

A:  $(x - 2)(x - 3)$

B:  $(x - 2)(x + 3)$

C:  $(x + 2)(x - 3)$

D:  $(x + 2)(x + 3)$

E:  $x = 2$  or  $x = 3$

F:  $x = 2$  or  $x = -3$

G:  $x = -2$  or  $x = 3$

H:  $x = -2$  or  $x = -3$

30.  $4p^2 - q^2$  is equivalent to:

A:  $4(p^2 - q^2)$

B:  $4p(p - q^2)$

C:  $2p(2p - q)$

D:  $2p(2p - q^2)$

E:  $(2p - q)^2$

F:  $(2p + q)^2$

G:  $(2p + q)(2p - q)$

H:  $(2p + q)(q - 2p)$

31.  $2^{16} \div 4^4$  is equal to:

A:  $2^2$

B:  $2^4$

C:  $2^6$

D:  $2^8$

E:  $2^{10}$

F:  $2^{12}$

G:  $2^{14}$

H:  $2^{16}$

32. The angles in a triangle are in the ratio 1:2:3. The largest angle in the triangle is:

A:  $15^\circ$

B:  $30^\circ$

C:  $45^\circ$

D:  $60^\circ$

E:  $75^\circ$

F:  $90^\circ$

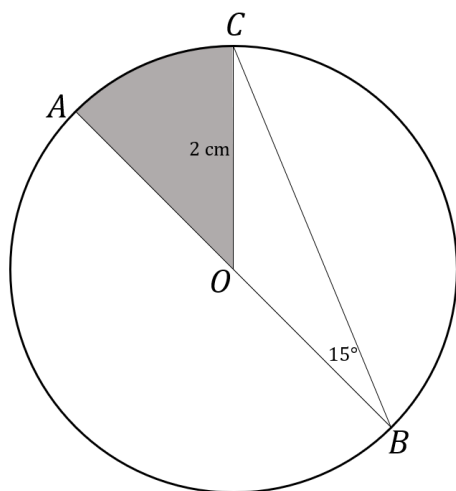
G:  $105^\circ$

H:  $120^\circ$

*This page has been left blank for rough working*



33.



$AOB$  is the diameter of a circle with centre  $O$ .

Angle  $O\hat{B}C$  is  $15^\circ$ , and  $OC$  is 2 cm.

Length  $OB$ , in cm, is:

- A:  $\sin 15^\circ$                       B:  $2 \sin 15^\circ$                       C:  $4 \sin 15^\circ$                       D: 2
- E: 4                                      F:  $\sin 30^\circ$                       G:  $2 \sin 30^\circ$                       H:  $4 \sin 30^\circ$

34. The area of the shaded sector  $AOC$  in question 33, in  $\text{cm}^2$ , is

- A:  $2\pi$                                       B:  $\frac{2\pi}{3}$                                       C:  $\pi$                                       D:  $\frac{\pi}{2}$
- E:  $\frac{\pi}{3}$                                       F:  $\frac{\pi}{4}$                                       G:  $\frac{\pi}{6}$                                       H:  $\frac{\pi}{8}$

35. The solutions of  $6x^2 + 5x - 6 = 0$  are:

- A:  $x = \frac{2}{3}$  or  $x = \frac{3}{2}$                       B:  $x = -\frac{2}{3}$  or  $x = \frac{3}{2}$                       C:  $x = \frac{2}{3}$  or  $x = -\frac{3}{2}$                       D:  $x = -\frac{2}{3}$  or  $x = -\frac{3}{2}$
- E:  $x = \frac{1}{6}$  or  $x = 1$                       F:  $x = -\frac{1}{6}$  or  $x = 1$                       G:  $x = \frac{1}{6}$  or  $x = -6$                       H:  $x = -\frac{1}{6}$  or  $x = 6$

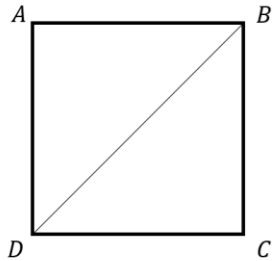
*This page has been left blank for rough working*

36. If  $(4^3)^k = \frac{1}{8}$  then  $k$  is equal to:

A:  $-1$                       B:  $-\frac{1}{2}$                       C:  $-\frac{1}{3}$                       D:  $-\frac{1}{4}$

E:  $1$                       F:  $\frac{1}{2}$                       G:  $\frac{1}{3}$                       H:  $\frac{1}{4}$

37. In the square below, the length of  $DB$  is  $4\sqrt{2}$  cm.



The perimeter of the square in cm is:

A:  $4$                       B:  $4\sqrt{2}$                       C:  $8$                       D:  $8\sqrt{2}$

E:  $12$                       F:  $12\sqrt{2}$                       G:  $16$                       H:  $16\sqrt{2}$

38. Which of these is not a cube number?

A:  $1$                       B:  $8$                       C:  $2^6$                       D:  $3^3$

E:  $64$                       F:  $4^3 \times 3^4$                       G:  $(2^3)^4$                       H:  $8 \times 10^3$

39. Given that  $x < 0$ , the solution to  $\frac{3}{x} = \frac{x}{27}$  is:

A:  $3$                       B:  $\frac{1}{3}$                       C:  $\frac{1}{9}$                       D:  $9$

E:  $-3$                       F:  $-\frac{1}{3}$                       G:  $-\frac{1}{9}$                       H:  $-9$

40. Two of the angles in an isosceles triangle are  $120^\circ$  and  $x^\circ$ . The value of  $x$  is:

A:  $15$                       B:  $30$                       C:  $45$                       D:  $60$

E:  $75$                       F:  $90$                       G:  $120$                       H:  $180$



*This page has been left blank for rough working*

41.  $\frac{x^2+x}{x^2-1}$  simplifies to:

A:  $\frac{x+1}{x-1}$

B:  $\frac{x+1}{x}$

C:  $\frac{x-1}{x+1}$

D: 1

E:  $x$

F:  $\frac{x}{x+1}$

G:  $\frac{x}{x-1}$

H:  $\frac{1}{x}$

42. The value of  $\frac{1}{1+\frac{1}{1+\frac{1}{1+1}}}$  is:

A:  $\frac{3}{5}$

B:  $\frac{5}{3}$

C:  $\frac{3}{2}$

D:  $\frac{2}{3}$

E: 2

F:  $\frac{1}{2}$

G: 0

H: 1

43. Which of the following correctly makes  $a$  the subject of  $\frac{x}{a} + \frac{y}{b} = 1$ ?

A:  $\frac{x}{a} = 1 - \frac{y}{b}$

B:  $\frac{x}{a} = 1 + \frac{y}{b}$

C:  $a = x - \frac{bx}{y}$

D:  $a = y - \frac{by}{x}$

E:  $a = \frac{by}{b+x}$

F:  $a = \frac{bx}{b+y}$

G:  $a = \frac{by}{b-x}$

H:  $a = \frac{bx}{b-y}$

44. The number  $\left(\sqrt{\sqrt{\sqrt{\sqrt{2}}}}\right)^{48}$  is equal to

A:  $\frac{1}{8}$

B:  $\frac{1}{2}$

C:  $\sqrt{2}$

D: 2

E: 4

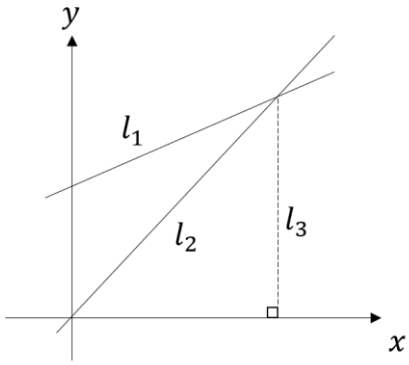
F: 8

G: 16

H: 64

*This page has been left blank for rough working*

45.



The line  $l_1$  has gradient  $\frac{m}{2}$  and passes through the point  $(0, 6)$ .

The line  $l_2$  has gradient  $2m$  and passes through the origin.

The line  $l_3$  is parallel to the  $y$  axis.

The area of the triangle enclosed by the lines  $l_1$ ,  $l_2$ , and the  $y$  axis is 24.

The area of the triangle enclosed by the lines  $l_2$ ,  $l_3$ , and the  $x$  axis is:

A: 24

B: 28

C: 32

D: 36

E: 40

F: 44

G: 48

H: 52

# 16+ Mathematics: ANSWER SHEET

Name: \_\_\_\_\_

Current School: \_\_\_\_\_

<i>For marker's use only:</i>	
<i>Mark</i>	<i>Check</i>

You will have **45 minutes** for the test, and the test consists of **45** multiple choice questions. Each correct answer scores 1 mark. You will not lose marks for incorrect answers.

For each question, select the correct answer from A to H and write the corresponding letter in the answer grid below. For example, if you think the correct answer to question 1 is G, you would fill in the grid as shown in **Example 1**. If you make a mistake, clearly cross out your wrong answer and write the correct one next to it, as shown in **Example 2**.

**Example 1:**

Question	Answer
1	G

**Example 2:**

Question	Answer
1	<del>X</del> H

## Answer grid - write your answers here before the end of the test.

Question	Answer
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

*For marker's use only:*

--

Question	Answer
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	

*For marker's use only:*

--

Question	Answer
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	

*For marker's use only:*

--