

Mathematics A
PAPER 2HR
Higher Tier
(Calculator)

| |
|-------------|
| Total Marks |
|-------------|

Monday 3 June 2024 – Morning

Time: 2 hours

In the boxes below, write your name, centre number and candidate number.

| | | | | | |
|------------------|--|--|--|--|--|
| Surname | | | | | |
| Other names | | | | | |
| Centre Number | | | | | |
| Candidate Number | | | | | |

YOU MUST HAVE

Ruler, protractor, pair of compasses, writing and drawing equipment, calculator. Tracing paper may be used.

YOU WILL BE GIVEN

A separate Formulae Booklet

A separate Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Without sufficient working, correct answers may be awarded no marks.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

Calculators may be used.

You must NOT write anything in the Formulae Booklet.

Anything you write on the formulae pages will gain NO credit.

INFORMATION

The total mark for this paper is 100.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

There may be spare copies of some diagrams.

You may be given a model for Question 24.

You may be given a cut out shape for Question 2.

ADVICE

Read each question carefully before you start to answer it.

Check your answers if you have time at the end.

Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1. Write **1400** as a product of powers of its prime factors.
Show your working clearly.

(Total for Question 1 is 3 marks)

2. Look at the diagram for Question 2 in the separate Diagram Booklet.

The diagram shows shape **A** and shape **B** on a coordinate grid.

- (a) Describe fully the single transformation that maps shape **A** onto shape **B**
(2 marks)

- (b) On the grid, rotate shape **A** 180° about $(-1, 0)$
Label your shape **C**
A cut out shape may be available for this question.
(2 marks)

(Total for Question 2 is 4 marks)

3. Here is a list of four numbers written in ascending order of size

x x y 15

where x and y are integers.

The numbers have

a median of 12.5

a range of 4

Find the value of x and the value of y
(2 marks)

Answer space continues on the next page.

3. continued.

x = _____

y = _____

(Total for Question 3 is 2 marks)

4. $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$A = \{\text{factors of } 6\}$

$B = \{\text{prime numbers}\}$

(a) List the members of the set

(i) $A \cup B$

(1 mark)

(ii) A'

(1 mark)

(continued on the next page)

4. continued.

(b) Harpreet states that $A \cap B = \emptyset$

Harpreet is incorrect.

Explain why.

(1 mark)

(continued on the next page)

4. continued.

(c) **C** is a set with **4** members such that

the set **A** \cap **C** has **2** members

the set **B** \cap **C** has **2** members

Set **A** \cap **C** and set **B** \cap **C** have no members
in common.

List the **4** members of set **C**

(2 marks)

(Total for Question 4 is 5 marks)

Turn over

5. Look at the diagram for Question 5 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

The diagram shows the design for a badge, which will be made using wire.

The design is a circle inside a square **ABCD**

The circle touches the square at the points **E, F, G** and **H**

The area of the square is 81 cm^2

Calculate the total length of wire that will be needed to make the square and the circle.

Give your answer correct to **3** significant figures.

(4 marks)

Answer space continues on the next page.

5. continued.

_____ cm

(Total for Question 5 is 4 marks)

6. (a) Solve $\frac{2f}{3} = 4f - 17$

Show clear algebraic working.

(3 marks)

$f =$ _____

(continued on the next page)

6. continued.

(b) Simplify $(e + 12)^0$ where $e > 0$
(1 mark)

(c) Simplify fully $\frac{12d^4h^6}{4dh^2}$
(2 marks)

(continued on the next page)

6. continued.

(d) Factorise fully $20x^5y + 12x^3y^4$

(2 marks)

(Total for Question 6 is 8 marks)

7. $\frac{3^{-2} \times 3^5}{3^{10}} = 3^n$

Find the value of n

n = _____

(Total for Question 7 is 2 marks)

8. In a sale, all normal prices are reduced by 17%

The sale price of a fridge is 6225 rupees.

Work out the normal price of the fridge.

_____ rupees

(Total for Question 8 is 3 marks)

9. (a) Write 6.04×10^5 as an ordinary number.
(1 mark)

- (b) Write 0.000 07 in standard form.
(1 mark)

(continued on the next page)

9. continued.

(c) Work out $\frac{7.6 \times 10^{10}}{4 \times 10^5 - 2 \times 10^4}$

Give your answer in standard form.

(2 marks)

(Total for Question 9 is 4 marks)

Turn over

10. Look at the diagram for Question 10 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

The diagram shows a hexagon **ABCDEF**

In the diagram:

$$AB = 11 \text{ cm}$$

$$BC = 5 \text{ cm}$$

$$DE = 23 \text{ cm}$$

$$EF = 4.7 \text{ cm}$$

$$\text{Angle } BCF = 30^\circ$$

AB, **FC** and **ED** are parallel.

Calculate the area of **ABCDEF**

Show your working clearly.

(5 marks)

Answer space continues on the next page.

10. continued.

_____ cm^2

(Total for Question 10 is 5 marks)

11. The cumulative frequency table gives information about the time, in hours, that each of 60 workers spent working from home in one week.

| Time (t hours) | Cumulative frequency |
|-----------------|----------------------|
| $0 < t \leq 5$ | 5 |
| $0 < t \leq 10$ | 10 |
| $0 < t \leq 15$ | 15 |
| $0 < t \leq 20$ | 15 |
| $0 < t \leq 25$ | 10 |
| $0 < t \leq 30$ | 5 |

- (a) Look at the diagram for Question 11 (a) in the separate Diagram Booklet.

The diagram shows a grid.

On the grid, draw a cumulative frequency graph for the information in the table.

(2 marks)

(continued on the next page)

Turn over

11. continued.

(b) Use your graph to find an estimate for the interquartile range of the times.

(2 marks)

_____ hours

(continued on the next page)

11. continued.

- (c) **25** workers spent more than **W** hours working from home.

Use your graph to find an estimate for the value of **W**
(2 marks)

W = _____

(continued on the next page)

11. continued.

(d) One of the 60 workers is chosen at random.

This worker spent H hours working from home.

Find the probability that $5 < H \leq 10$

(1 mark)

(Total for Question 11 is 7 marks)

12. Look at the diagram for Question 12 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

In the diagram, **ABC** and **AED** are straight lines.

BE is parallel to **CD**

$$AE = 10 \text{ cm}$$

$$CD = 1.5 \times BE$$

(a) Work out the length of **ED**

(2 marks)

_____ cm

(continued on the next page)

12. continued.

(b) $AB = (2x + 5) \text{ cm}$ and $BC = (3x - 5) \text{ cm}$

Work out the value of x

(2 marks)

$x =$ _____

(Total for Question 12 is 4 marks)

13. Look at the diagram for Question 13 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

OAB is a sector of a circle with centre **O** and radius **r cm**

In the diagram:

Angle **AOB** = 60°

The perimeter of the sector is **P cm**

Find a formula for **P** in terms of **r**

Give your answer in the form $P = r(c\pi + k)$ where **c** and **k** are values to be found.

(3 marks)

Answer space continues on the next page.

13. continued.

(Total for Question 13 is 3 marks)

14. Adriana is going to roll a biased dice and spin a biased coin.

The probability that the coin will land on Heads is 0.8

The probability that the dice will land on 6 and the coin will land on Heads is 0.24

Work out the probability that the dice will land on 6 and the coin will land on Tails.

(3 marks)

Answer space continues on the next page.

14. continued.

(Total for Question 14 is 3 marks)

15. Look at the diagram for Question 15 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

AB, **BC** and **CD** are three sides of a regular pentagon and **CDE** is a triangle.

BCE is a straight line.

$$CD = 6.5 \text{ cm}$$

$$CE = 3 \text{ cm}$$

Work out the area of triangle **CDE**

Give your answer correct to **3** significant figures.

(3 marks)

Answer space continues on the next page.

15. continued.

_____ cm^2

(Total for Question 15 is 3 marks)

16. Look at the diagram for Question 16 in the separate Diagram Booklet.

**The diagram shows six graphs, A, B, C, D, E and F
Write down the letter of the graph that could have
the equation**

(i) $y = -\frac{1}{x}$

(1 mark)

(continued on the next page)

16. continued.

Write down the letter of the graph that could have the equation

(ii) $y = \sin x^\circ$

(1 mark)

(Total for Question 16 is 2 marks)

17. $f(x) = \frac{x}{2x - 4}$

$$g(x) = 3x + 1$$

Given that $fg(k) = 2$

work out the value of k

(3 marks)

Answer space continues on the next page.

17. continued.

$k =$ _____

(Total for Question 17 is 3 marks)

Turn over

18. Use algebra to show that $0.\dot{3}0\dot{6} = \frac{34}{111}$

(Total for Question 18 is 2 marks)

19. Aviv goes on a cycle journey.

For the cycle journey

average speed = 19 km/h correct to the nearest whole number

time = 1.5 hours correct to one decimal place

Work out the upper bound for the distance

Aviv travels.

Give your answer correct to 3 significant figures.

(3 marks)

Answer space continues on the next page.

19. continued.

_____ km

(Total for Question 19 is 3 marks)

Turn over

20. Solve $6x^2 - 7x - 20 > 0$

Show clear algebraic working.

(4 marks)

Answer space continues on the next page.

20. continued.

(Total for Question 20 is 4 marks)

21. **ABCD** is a square.

The point **A** has coordinates **(−5, 2)**

The point **B** has coordinates **(3, 5)**

Find an equation of the line that passes through
B and **C**

Give your answer in the form **$ax + by + c = 0$**
where **a**, **b** and **c** are integers.

(4 marks)

Answer space continues on the next page.

21. continued.

(Total for Question 21 is 4 marks)

Turn over

22. Solve the simultaneous equations

$$x^2 + y^2 = y + 11$$

$$y = 3x - 1$$

Show clear algebraic working.

(5 marks)

Answer space continues on the next page.

22. continued.

(Total for Question 22 is 5 marks)

Turn over

23. A curve has equation $y = f(x)$

The coordinates of the minimum point on this curve are $(6, -3)$

Write down the coordinates of the minimum point on the curve with equation

(i) $y = f(x) + 10$

(1 mark)

(_____ , _____)

(continued on the next page)

23. continued.

Write down the coordinates of the minimum point on the curve with equation

(ii) $y = f(3x)$

(1 mark)

(_____ , _____)

(Total for Question 23 is 2 marks)

24. Look at the diagram for Question 24 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

The diagram shows a solid, S , made from a cone and a hemisphere.

You may also be given a model.

The centre of the circular face of the cone coincides with the centre of the flat surface of the hemisphere.

The radius of the circular face of the cone, x cm, is equal to the radius of the hemisphere.

The total height of S is $4x$ the radius of the hemisphere.

A separate sphere has radius kx cm

The volume of this sphere is $12.5x$ the volume of S

(a) Work out the value of k

(4 marks)

Answer space continues on the next 2 pages.

24. (a) continued.

24. (a) continued.

k = _____

(continued on the next page)

24. continued.

(b) A solid, T , is similar to solid S

The volume of T is $512 \times$ the volume of S

The total surface area of T is $d \times$ the total surface area of S

Find the value of d

(1 mark)

$d =$ _____

(Total for Question 24 is 5 marks)

25. Look at the diagram for Question 25 in the separate Diagram Booklet.

The diagram is NOT accurately drawn.

The diagram shows a parallelogram labelled **OPQR**

In the diagram:

$$\overrightarrow{OP} = 2a$$

$$\overrightarrow{OR} = 3b$$

The point **M** lies on **PQ** such that $PM = \frac{1}{4}PQ$

The point **N** lies on **RQ** such that $RN = \frac{4}{5}RQ$

(a) Find, in terms of **a** and **b**, giving your answers in simplest form

(i) \overrightarrow{ON}

(1 mark)

25. (a) continued.

Find, in terms of **a** and **b**, giving your answers in simplest form

(ii) \overrightarrow{MR}

(1 mark)

(continued on the next page)

25. continued.

(b) **MR** and **ON** intersect at the point **Y**

Given that

$$\mathbf{OY} = k \times \mathbf{ON}$$

use a vector method to find the value of **k**
(4 marks)

Answer space continues on the next page.

25. (b) continued.

$k =$ _____

(Total for Question 25 is 6 marks)

Turn over

26. Write $4 - \left[(3x - 5) \div \frac{3x^2 + x - 10}{4x - 1} \right]$

as a single fraction in its simplest form.

(4 marks)

Answer space continues on the next page.

26. continued.

(Total for Question 26 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

END OF PAPER
