

Mathematics A  
PAPER 2HR  
Higher Tier  
(Calculator)

Total Marks
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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.**

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**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.

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(Total for Question 1 is 3 marks)

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**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)**

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**(b) On the grid, rotate shape **A**  $180^\circ$  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)**

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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)**

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**Turn over**



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)

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(ii)  $A'$

(1 mark)

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(continued on the next page)

4. continued.

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

Harpreet is incorrect.

Explain why.

(1 mark)

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(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)

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(Total for Question 4 is 5 marks)

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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  $81 \text{ cm}^2$**

**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)**

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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)

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

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(continued on the next page)

Turn over

**6. continued.**

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

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**(Total for Question 6 is 8 marks)**

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

Find the value of n

n = \_\_\_\_\_

(Total for Question 7 is 2 marks)

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**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)**

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**Turn over**

9. (a) Write  $6.04 \times 10^5$  as an ordinary number.  
(1 mark)
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- (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)

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(Total for Question 9 is 4 marks)

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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.

\_\_\_\_\_  $\text{cm}^2$

(Total for Question 10 is 5 marks)

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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)**

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**(Total for Question 11 is 7 marks)**

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**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  $CD$**

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

$$\mathbf{CD = 1.5 \times BE}$$

**(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)

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**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 =  $60^\circ$**

**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.**

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**(Total for Question 13 is 3 marks)**

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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.

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(Total for Question 14 is 3 marks)

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**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.**

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

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

**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.**

\_\_\_\_\_  $\text{cm}^2$

**(Total for Question 15 is 3 marks)**

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**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)**

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**(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)

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(Total for Question 16 is 2 marks)

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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)

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Turn over

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

(Total for Question 18 is 2 marks)

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**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)

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Turn over

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

Show clear algebraic working.

(4 marks)

Answer space continues on the next page.

**20. continued.**

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**(Total for Question 20 is 4 marks)**

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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.**

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**(Total for Question 21 is 4 marks)**

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**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.**

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**(Total for Question 22 is 5 marks)**

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**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)**

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**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)**

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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)

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(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)

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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.

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(Total for Question 26 is 4 marks)

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**TOTAL FOR PAPER IS 100 MARKS**  
**END OF PAPER**

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