

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

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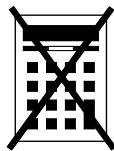
Higher Tier Paper 1 Non-Calculator

Wednesday 8 November 2023 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments
- the Formulae Sheet (enclosed).



You must **not** use a calculator.

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



Please note that these worked solutions have neither been provided nor approved by AQA and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer **all** questions in the spaces provided.

- 1 Work out the lowest common multiple (LCM) of 20 and 25

[1 mark]

25, 50, 75, 100

Counting in 25s until a multiple of 20 is reached. 100 is a multiple of 20 as $20 \times 5 = 100$

Answer _____ 100 _____

- 2 Work out the size of an **exterior** angle of a regular hexagon.

[1 mark]

$$\begin{array}{r} 060 \\ 6 \overline{)360} \end{array}$$

The exterior angles of any polygon add up to 360° . As there are 6 sides on a hexagon there will also be 6 exterior angles and the shape is regular so all the exterior angles are equal. So dividing 360° by the 6 equal exterior angles works out that one of them is 60°

Answer _____ 60 _____ °

- 3 A is (2, 0) and B is (0, -4)

Work out the midpoint of AB.

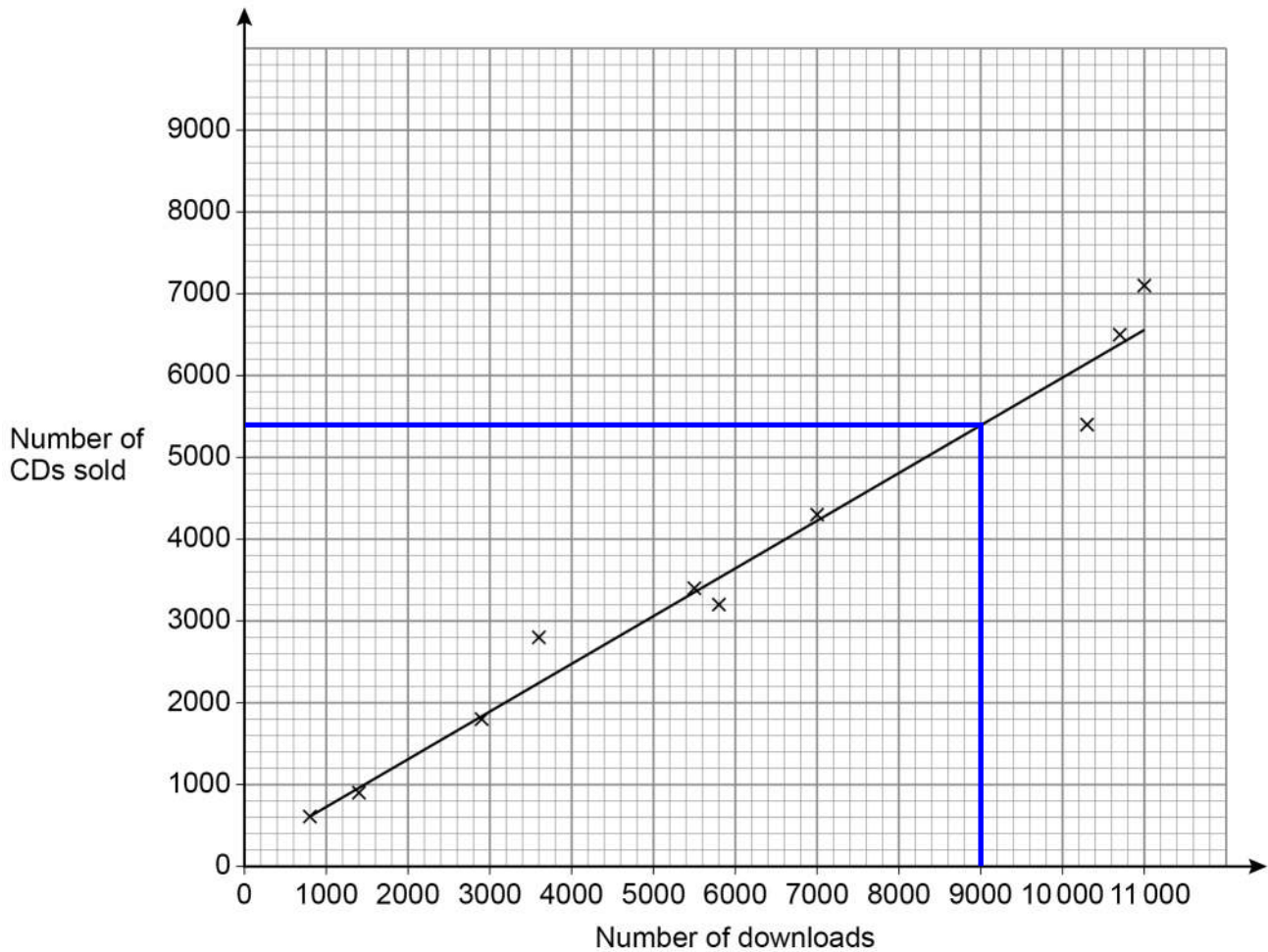
[1 mark]

Doing the mean of the x-coordinates and the mean of the y-coordinates works out the midpoint. For the x-coordinates: $2 + 0 = 2$, then $2 \div 2 = 1$. For the y-coordinates: $0 + -4 = -4$, then $-4 \div 2 = -2$

Answer (_____ 1 _____ , _____ -2 _____)



- 6 A music company releases 10 albums.
- The scatter graph shows, for each album,
- the number of downloads on the first day
 - and
 - the number of CDs sold on the first day.
- A line of best fit has been drawn on the scatter graph.



Reading up from 9000 downloads to the line of best fit then across estimates that there will be 5400 CDs sold. The scales go up 1000 over 5 small boxes. $1000 \div 5 = 200$ so each small box is worth 200



6 (a) The scatter graph shows positive correlation.

Describe the relationship between number of downloads and number of CDs sold.

[1 mark]

As the number of downloads increases, the number of CDs sold increases

6 (b) The company earns

£2.50 for each download

and

£3 for each CD sold.

The company releases another album.

On the first day it has 9000 downloads.

Estimate the **total** amount the company earns from downloads and CDs of the album that day.

[3 marks]

$$\begin{array}{r} 2.5 \\ \times 9000 \\ \hline 22500.0 \end{array}$$

Multiplying the £2.50 by the 9000 downloads works out that the company earns £22500 from the downloads

$$\begin{array}{r} 5400 \\ \times 3 \\ \hline 16200 \\ +22500 \\ \hline 38700 \end{array}$$

Multiplying the 5400 CDs sold by the £3 works out that the company earns £16200 from the CD sales

Adding the money earned from the downloads and CD sales works out the total the company earns

Answer £ 38700



7 70% of a number is 350

Work out 120% of the number.

[3 marks]

$$\begin{array}{r} 050 \\ 7 \overline{)350} \end{array}$$

Dividing the 350 by 7 works out that 10% of the number is 50

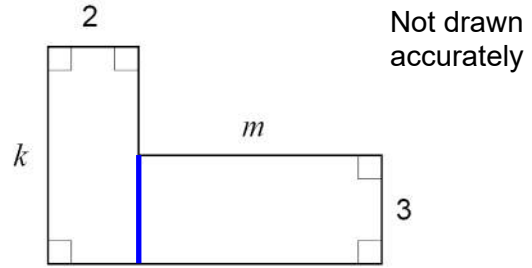
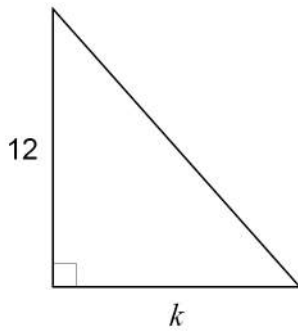
$$\begin{array}{r} 12 \\ \times 50 \\ \hline 600 \end{array}$$

Multiplying 10% of the number by 12 works out that 120% of the number is 600

Answer _____ 600 _____



8 In the diagrams, all lengths are in centimetres.



The two shapes have equal areas.

Work out $k : m$

[3 marks]

$$\frac{1}{2} \times k \times 12 = k \times 2 + m \times 3$$

Setting the areas of the two shapes equal to each other. Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base is k and the height is 12. Area of rectangle = length \times width. Adding the area of the two rectangles gives the area of the L-shape

$$6k = 2k + 3m$$

Simplifying both sides of the equation

$$4k = 3m$$

Subtracting $2k$ from both sides to get all the k on the same side and all the m on the other

Answer 3 : 4

k could be 3 and m could be 4, as $4 \times 3 = 3 \times 4$

Turn over for the next question

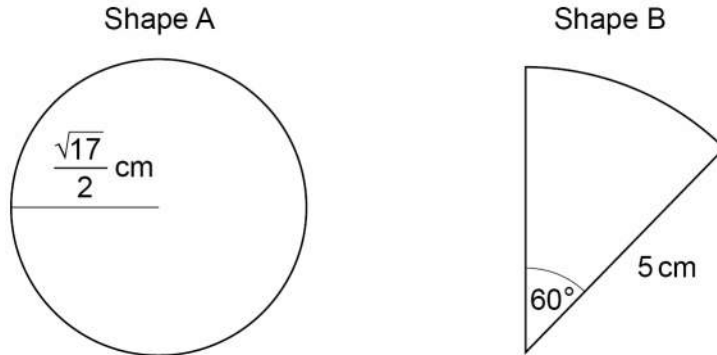


10

Shape A is a circle with radius $\frac{\sqrt{17}}{2}$ cm

Shape B is a sector of a circle with radius 5 cm

Not drawn
accurately



Which shape has the greater area, A or B?

You **must** show your working.

[5 marks]

$$\pi \times \left(\frac{\sqrt{17}}{2}\right)^2$$

This is an expression of the area of Shape A. Area of circle = $\pi \times \text{radius}^2$.

$$\frac{17}{4}\pi$$

To square a fraction: square the numerator and square the denominator. $(\sqrt{17})^2 = 17$ as squaring cancels out the square root. $2^2 = 2 \times 2 = 4$

$$4 \overline{)04.25} \begin{array}{r} 04.25 \\ \underline{4} \\ 0 \end{array}$$

Converting the fraction to decimal by dividing the numerator by the denominator so that it is easier to compare. So the area of Shape A is 4.25π

$$\frac{60}{360} \times \pi \times 5^2$$

This is an expression of the area of Shape B. Area of circle = $\pi \times \text{radius}^2$. Doing $60/360$ of the area of the whole circle as the sector is 60° out of the total 360° of the circle

$$\frac{25}{6}\pi$$

$60/360$ simplifies to $1/6$, $5^2 = 5 \times 5 = 25$ and $1/6 \times 25 = 25/6$

$$6 \overline{)04.1} \begin{array}{r} 04.1 \\ \underline{6} \\ 0 \end{array}$$

Converting the fraction to decimal by dividing the numerator by the denominator so that it is easier to compare. There is no need to complete the division as $4.1\dots$ must be less than 4.25

Answer _____ A

4.25π is greater than 4.1π

7

Turn over ►



- 13 Here is an identity in x .

$$5(2x + d) \equiv cx + 30$$

Work out the values of c and d .

$10x + 5d$

Expanding the bracket on the left to put it into the same form as the right

[3 marks]

$$c = \underline{\quad 10 \quad} \quad d = \underline{\quad 6 \quad}$$

There is $10x$ on the left so there must also be $10x$ on the right. So c must be 10. There is 30 on the right so there must also be 30 on the left. So d must be 6 as $5 \times 6 = 30$

- 14 Cora is revising for two subjects, History and French.
The time she spends revising is in the ratio

$$\text{History} : \text{French} = 7 : 2$$

The time she spends revising for History is 20 hours **more** than for French.

Work out the **total** time she spends revising.

$20 \div 5$

There are 5 more parts in the ratio for History than for French. So the 20 hours must be represented by 5 parts of the ratio. Dividing the 20 hours by the 5 parts works out that 1 part of the ratio is worth 4 hours

[3 marks]

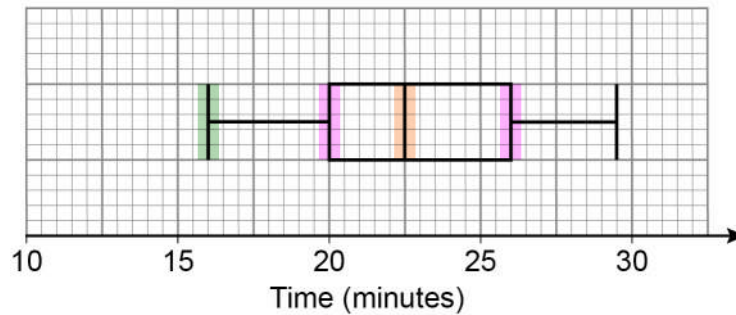
4×9

There are 9 parts in total in the ratio. Multiplying the value of 1 part of the ratio by 9 works out that the value of all 9 parts in the ratio is 36 hours. This is the total time she spends revising

Answer 36 hours



- 15** A race was run in 2019 and in 2020
The box plot shows information about the finishing times in 2019



- 15 (a)** In 2019, what was the fastest time?

[1 mark]

Answer _____ 16 _____ minutes

The fastest time is highlighted in green. The scale goes up by 5 over 10 small boxes. $5 \div 10 = 0.5$, so each small box is worth 0.5 and 2 small boxes are worth 1



15 (b) The table shows information about the finishing times in 2020

Lower quartile	21 minutes
Median	24 minutes
Upper quartile	27 minutes

Use the data to comment on each of the following statements.

[4 marks]

On average, times were faster in 2019 than in 2020

Correct as the median in 2019 was 22.5, which is lower than the median of 24 in 2020

The median for 2019 is highlighted in orange

Times were equally consistent in 2019 and 2020

Correct as the interquartile range for both years was 6

The interquartile range for 2019 is 6 as this is the distance between the lower and upper quartiles (highlighted in pink). The interquartile range for 2020 is 6 as subtracting the lower quartile from the upper quartile gives $27 - 21 = 6$



17 x and y are integers.

$$8 \leq 4x \leq 20 \quad \text{and} \quad y - 3x < 12$$

Work out the **largest** possible value of y .

[3 marks]

$$y < 12 + 3x$$

Adding $3x$ to both sides of the second inequality to get y on its own

$$x \leq 5$$

Dividing all sides of the first inequality by 4 solves for x . As $3x$ is added to the 12, x needs to be as large as possible in order for y to be the largest possible. So x should be 5

$$3 \times 5$$

$$12 + 15$$

$$y < 12 + 3x$$

$$y < 12 + 3 \times 5$$

$$y < 12 + 15$$

$$y < 27$$

Answer _____ 26 _____

26 is the largest possible integer which is less than 27

Turn over for the next question

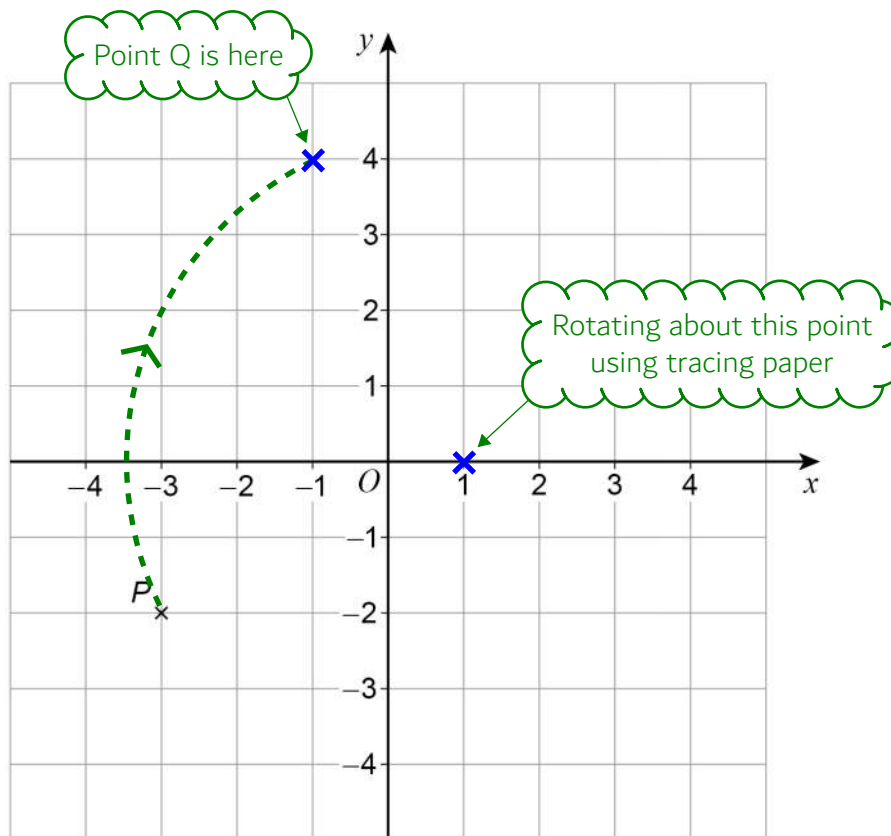
Turn over ►



18 (a) P and Q are points.

$P(-3, -2)$ is mapped to Q by a rotation about $(1, 0)$ through 90° clockwise.

Q is mapped back to P by a **single** transformation.



Complete these two **single** transformations that each map Q back to P .

[2 marks]

Rotation about $(1, 0)$ 90° anticlockwise

Rotating back in the opposite direction takes Q back to P

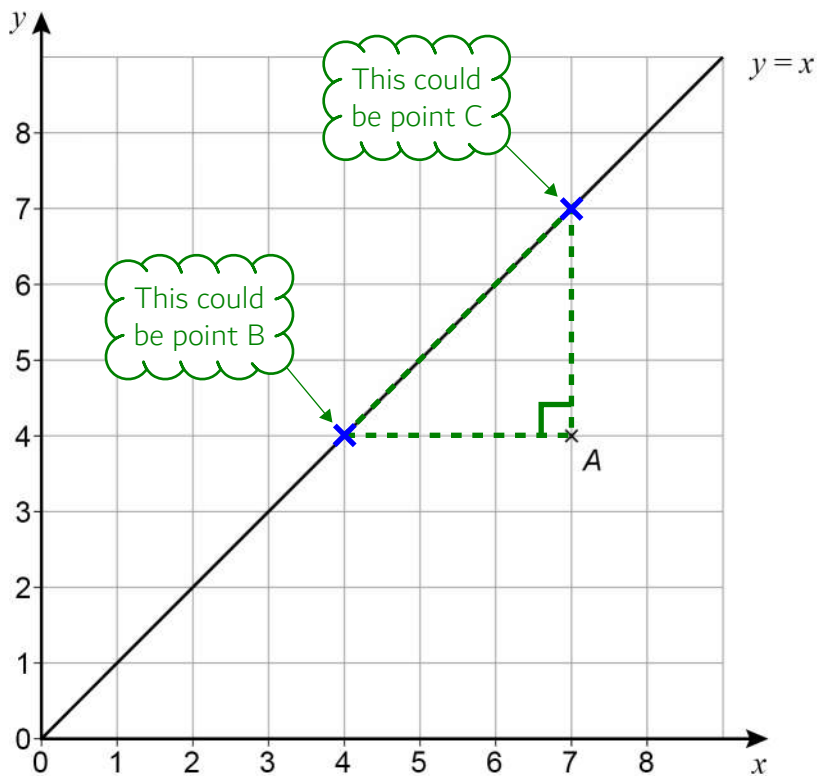
Translation

$$\begin{pmatrix} -2 \\ -6 \end{pmatrix}$$

Moving Q 2 to the left and 6 down takes Q back to P . This is -2 in the x -direction and -6 in the y -direction and can be written as a column vector



- 18 (b) Point A (7, 4) and the line $y = x$ are shown on the grid.



B and C are points on the grid, each having positive **integer** coordinates.

BAC is a right-angled triangle.

When BAC is reflected in the line $y = x$ side BC is invariant.

Work out **one** possible set of coordinates for B and C .

[1 mark]

B (4 , 4) C (7 , 7)

When reflected in the line $y = x$, side BC will be invariant as it does not change



19 When converted to a fraction $0.\dot{7} = \frac{7}{9}$

Work out $0.\dot{4} + 0.0\dot{7}$

Give your answer as a fraction.

[3 marks]

$$x = 0.\dot{4} \leftarrow \text{Let } x \text{ be } 0.\dot{4}$$

$$10x = 4.\dot{4} \leftarrow \text{There is one recurring digit so multiplying } x \text{ by ten once makes another decimal with the recurring digit in the same decimal place}$$

$$9x = 4 \leftarrow \text{Subtracting } x \text{ from } 10x \text{ cancels out the recurring digit}$$

$$x = \frac{4}{9} \leftarrow \text{Dividing both sides by 9 expresses } x \text{ as a fraction}$$

$$\frac{40}{90} + \frac{7}{90} \leftarrow 0.\dot{7} \div 10 = 0.0\dot{7}. \text{ So the } 7/9 \text{ needs to be divided by 10 to give } 7/90. \text{ Multiplying the numerator and denominator of } 4/9 \text{ by 10 so that the denominator is also 90 so the fractions can be added}$$

Answer $\frac{47}{90}$

The numerators can be added and the denominator stays the same



20 x and y are acute angles.

$$\sin x = \frac{\sqrt{3}}{2} \qquad \tan y = 1$$

$$w = 3x - 2y$$

Work out the value of $\cos w$

You **must** show your working.

[3 marks]

	0	30	45	60	90
sin	0	1	2	3	4
cos	4	3	2	1	0

Writing 0, 30, 54, 60, 90 for the angles we need to remember the trig values for. Writing 0, 1, 2, 3, 4 under these for sin and 4, 3, 2, 1, 0 under these for cos. Square rooting them all and putting them over 2 works out the sin and cos values. Square rooting the 3 for the sin values and putting it over 2 gives $\sqrt{3}/2$. So x must be 60 as $\sin 60 = \sqrt{3}/2$. Dividing the sin values by the cos values gives the tan values. Anything divided by itself gives 1 so y must be 45 as both $\sin 45$ and $\cos 45$ involve 2 and dividing these will give 1, meaning $\tan 45 = 1$

$$\begin{array}{r} 60 \\ \times 3 \\ \hline 180 \end{array}$$

Multiplying the value of x by 3 works out that $3x = 180$

$$\begin{array}{r} 45 \\ \times 2 \\ \hline 90 \end{array}$$

Multiplying the value of y by 2 works out that $2y = 90$

$$\begin{array}{r} 180 \\ - 90 \\ \hline 90 \end{array}$$

Subtracting the value of $2y$ from the value of $3x$ works out that $w = 90$

Answer _____ 0

From the table of trig values: square rooting the 0 for the cos values under the 90 and putting it over 2 gives 0. So $\cos 90 = 0$

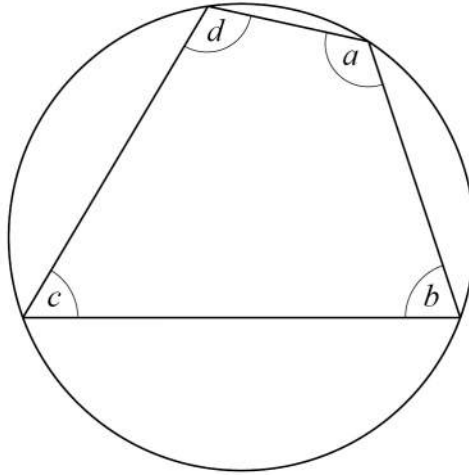
Turn over for the next question



22

Here is a cyclic quadrilateral.

$$a : b : c = 9 : 5 : 3$$

Not drawn
accuratelyWork out the size of angle d .**[3 marks]**

$$\begin{array}{r} 015 \\ 12 \overline{)180} \end{array}$$

Opposite angles in a cyclic quadrilateral add up to 180° . Angles a and c are opposite angles in the cyclic quadrilateral so add up to 180° . The ratio of a to c is $9 : 3$ and as $9 + 3 = 12$ the total of a and c is represented by 12 parts of the ratio. So dividing 180° by the 12 parts works out that 1 part of the ratio is worth 15°

$$\begin{array}{r} 15 \\ \times 5 \\ \hline 75 \\ 2 \end{array}$$

b is represented by 5 parts of the ratio. Multiplying the value of 1 part of the ratio by 5 works out that angle b must be 75°

$$\begin{array}{r} 180 \\ - 75 \\ \hline 105 \end{array}$$

Angles b and d are opposite angles in a cyclic quadrilateral so add up to 180° . Subtracting angle b from 180 leaves angle d

$$d = \underline{\hspace{2cm} 105 \hspace{2cm}}^\circ$$

Turn over ►



23 Work out $\frac{7}{\sqrt{2}} \times \frac{\sqrt{3}}{\sqrt{10}}$

Give your answer in the form $\frac{x\sqrt{15}}{y}$ where x and y are integers.

[3 marks]

$$\frac{7\sqrt{3}}{\sqrt{20}}$$

To multiply fractions: multiply the numerators and multiply the denominators. $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

$$\sqrt{4} \times \sqrt{5}$$

$\sqrt{20}$ can be simplified by splitting it into two square roots multiplied together, one of which is the square root of a square number

$$2\sqrt{5}$$

The square root of 4 is 2

Answer _____

$$\frac{7\sqrt{15}}{10}$$

Rationalising the denominator by multiplying both the numerator and the simplified denominator by $\sqrt{5}$. For the numerator: $7\sqrt{3} \times \sqrt{5} = 7\sqrt{15}$. For the denominator: $2\sqrt{5} \times \sqrt{5} = 2 \times 5 = 10$



- 24 Line A is perpendicular to line B.
The gradient of line A is -2
Work out the gradient of line B.

[1 mark]

Answer _____ $\frac{1}{2}$ _____

Perpendicular gradients are the negative reciprocal of each other. Reciprocal means to flip the fraction, so $-2/1$ becomes $-1/2$. Then the negative of a negative becomes positive

- 25 The n th term of a geometric progression is r^n where $r > 0$
The second term is $\frac{8}{9}$

Work out the third term.

Give your answer in the form $\frac{c\sqrt{2}}{d}$ where c and d are integers.

[2 marks]

$$r^2 = \frac{8}{9}$$

$n = 2$ on the second term

$$r = \frac{\sqrt{8}}{3}$$

Square rooting both sides finds what r is. To square root a fraction: square root the numerator and square root the denominator. The negative solution is ignored as $r > 0$

$$r^3 = \frac{8\sqrt{8}}{27}$$

$n = 3$ on the third term. So cubing r finds the third term. To cube a fraction: cube the numerator and cube the denominator. $(\sqrt{8})^3 = \sqrt{8} \times \sqrt{8} \times \sqrt{8} = 8\sqrt{8}$ and $3^3 = 3 \times 3 \times 3 = 27$

$$4 \times \sqrt{2}$$

Simplifying $\sqrt{8}$ by splitting it into two square roots multiplied together, one of which is the square root of a square number

$$2\sqrt{2}$$

The square root of 4 is 2

Answer _____ $\frac{16\sqrt{2}}{27}$ _____

Substituting $2\sqrt{2}$ back in for $\sqrt{8}$ in the expression for r^3



26 (a) Work out the value of $\left(5\frac{1}{16}\right)^{\frac{1}{4}}$

[2 marks]

$$\begin{array}{r} 16 \\ \times 5 \\ \hline 80 \end{array}$$

$$\frac{81}{16}$$

$$1, 16, 81$$

Converting the mixed number into an improper fraction by multiplying the whole number by the denominator then adding the result to the numerator. $1 + 80 = 81$

The power of $1/4$ means to do the fourth root. Finding the numbers which are 81 and 16 when raised to the power of 4. Listing out $1^4, 2^4, 3^4$. Squaring twice finds a number to the power of 4

Answer _____ $\frac{3}{2}$

$81 = 3^4$ and $16 = 2^4$. So the fourth root of $81/16$ must be $3/2$

26 (b) Write $(49^m)^{2.5}$ as a power of 7 in terms of m .

[2 marks]

$$(7^2)^m$$

$49 = 7^2$. Ignoring the power of 2.5 for now

$$(7^{2m})^{2.5}$$

$(a^x)^y = a^{xy}$, so the power of 2 and power of m are multiplied. Now raising to the power of the 2.5

$$\begin{array}{r} 2.5 \\ \times 2 \\ \hline 5.0 \end{array}$$

$(a^x)^y = a^{xy}$, so the power of $2m$ and power of 2.5 are multiplied

Answer _____ 7^{5m}

27 Write down the solution of $x^2 < 16$

[1 mark]

Answer _____ $-4 < x < 4$

Both 4 and -4 can be squared to give 16. The inequality symbol must flip for the negative side

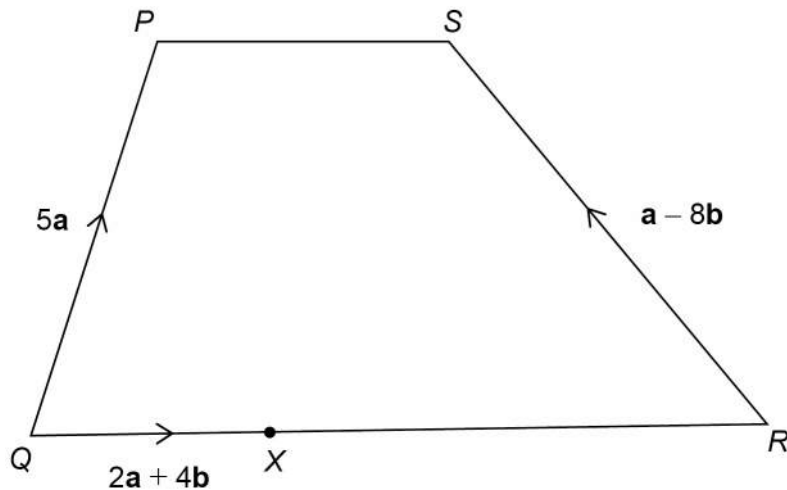


28

 $PQRS$ is a quadrilateral. PQ is not parallel to SR . X is a point on QR .

$$QX : XR = 2 : 3$$

$$\overrightarrow{QX} = 2\mathbf{a} + 4\mathbf{b}$$

Not drawn
accuratelyProve that $PQRS$ is a trapezium.**[3 marks]**

$$(2\mathbf{a} + 4\mathbf{b}) \div 2$$

2 parts of the ratio represent QX . So dividing \overrightarrow{QX} by 2 works out that 1 part of the ratio is $\mathbf{a} + 2\mathbf{b}$

$$(\mathbf{a} + 2\mathbf{b}) \times 5$$

$$\overrightarrow{QR} = 5\mathbf{a} + 10\mathbf{b}$$

2 + 3 = 5, so there are 5 parts in total in the ratio which represent QR . So multiplying 1 part of the ratio by 5 works out \overrightarrow{QR}

$$\overrightarrow{PS} = -5\mathbf{a} + 5\mathbf{a} + 10\mathbf{b} + \mathbf{a} - 8\mathbf{b}$$

$$\overrightarrow{PS} = \overrightarrow{PQ} + \overrightarrow{QR} + \overrightarrow{RS}, \overrightarrow{PQ} = -\overrightarrow{QP} = -5\mathbf{a}$$

$$= \mathbf{a} + 2\mathbf{b}$$

Simplifying by collecting like terms

 PS and QR are parallel as \overrightarrow{PS} can be multiplied to give \overrightarrow{QR} .Multiplying \overrightarrow{PS} by 5 gives \overrightarrow{QR} Therefore $PQRS$ is a trapeziumAs it is a quadrilateral with one pair of parallel sides. It is given that PQ is not parallel to SR so it cannot be a parallelogram

29 Here are the equations of three graphs.

$$y = \sin x$$

$$y = \cos x$$

$$y = \tan x$$

29 (a) Which statement is true?

Tick **one** box.

[1 mark]

$y = \sin x$ passes through $(180^\circ, -1)$

$y = \cos x$ passes through $(180^\circ, -1)$

$y = \tan x$ passes through $(180^\circ, -1)$

None of the graphs pass through $(180^\circ, -1)$

An explanation is on the next page

29 (b) Which statement is true?

Tick **one** box.

[1 mark]

$y = \sin x$ passes through $(270^\circ, 1)$

$y = \cos x$ passes through $(270^\circ, 1)$

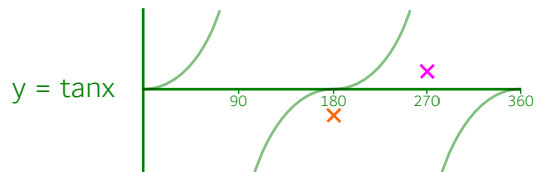
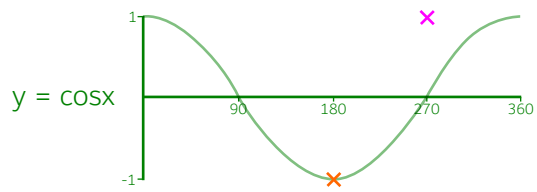
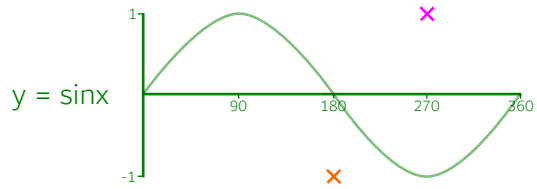
$y = \tan x$ passes through $(270^\circ, 1)$

None of the graphs pass through $(270^\circ, 1)$

An explanation is on the next page

END OF QUESTIONS





The graphs of each equation are sketched.
The point $(180, -1)$ is shown in orange and
the point $(270, 1)$ is shown in pink