Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

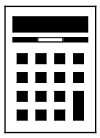
Higher Tier Paper 2 Calculator

Friday 8 November 2024 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



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.

Advice

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

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	
TOTAL	

N 0 V 2 4 8 3 0 0 2 H 0 1

IB/M/Nov24/G4008/E10

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 should be written in the exam.

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

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.

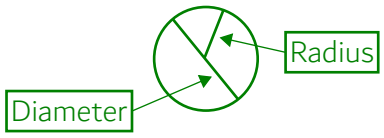
Do not write outside the box

1 Choose a word from the list below to complete each sentence.

arc	centre	circumference	diameter
radius	sector	segment	tangent

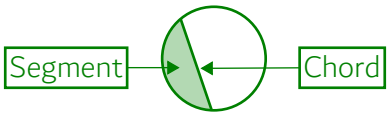
1 (a) The length of the diameter is double the length of the radius.

[1 mark]



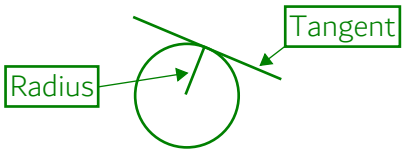
1 (b) A segment is a region created by drawing a chord through a circle.

[1 mark]



1 (c) A radius meets a tangent at a right angle.

[1 mark]



2 Here is a grouped frequency table.

Value, v	Frequency	Midpoint	
$0 \leqslant v < 10$	16	5	80
$10 \leqslant v < 20$	22	15	330
$20 \leqslant v < 30$	13	25	325
$30 \leqslant v < 40$	9	35	315
	Total = 60		1050 ÷ 60

Work out an estimate of the mean value.

[3 marks]

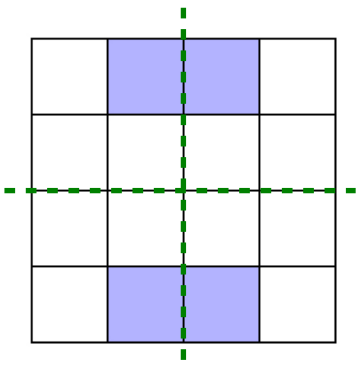
Multiplying the midpoints by the frequencies for each interval estimates the total value for each interval. Adding all these totals gives an estimated total value. Dividing this by the 60 values works out an estimate of the mean value

Answer 17.5

3 In the grid below, shade **one quarter** of the squares so that the grid has exactly **two** lines of symmetry.

Shade complete squares only.

[2 marks]



1/4 of 16 squares is 4 squares so this many squares need to be shaded.
The lines of symmetry are dashed in green and do not need to be drawn

8

Do not write outside the box

4 A map has a scale of 1 : 4000

On the map, the distance from a station to a museum is 7 cm

Is the **actual** distance from the station to the museum **more** than 300 m?

Tick a box.

Yes ☐ No ☑

Show working to support your answer.

[3 marks]

7×4000 ← The 4000 parts of the ratio is 4000 times the 1 part of the ratio. So multiplying the 7 cm on the map by 4000 works out that the actual distance is 28000 cm

$28000 \div 100 = 280$ ← There are 100 cm in 1 m so dividing the 28000 cm by 100 converts it to 280 m, which is not more than 300 m

5 X is inversely proportional to Y.

Circle the correct statement.

← These both mean that as Y increases, X decreases

[1 mark]

X is directly proportional to Y

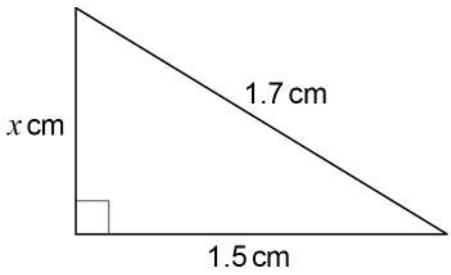
X is directly proportional to $\frac{1}{Y}$

X is directly proportional to $2Y$

X is directly proportional to $\sqrt{Y}$

Do not write outside the box

6 Here is a right-angled triangle.



Not drawn accurately

Use Pythagoras' theorem to show that $x = 0.8$

[2 marks]

$1.5^2 + x^2 = 1.7^2$ ← $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side

$x^2 = 0.64$ ← Subtracting 1.5^2 from both sides to get the x^2 on its own

$x = 0.8$ ← Square rooting both sides finds x

Turn over for the next question

6

Do not write outside the box

7 Beth and Lynn each spin the same biased coin a number of times.

The table shows information about the results.

	Beth	**Lynn**
Number of spins	125	80
Relative frequency of Heads	0.32	0.35

7 (a) How many **more** Heads did Beth spin than Lynn?

[2 marks]

$0.32 \times 125 = 40$

$0.35 \times 80 = 28$

Multiplying the relative frequencies by the numbers of spins works out that Beth had 40 Heads and Lynn had 28 Heads

$40 - 28$

Subtracting the 28 Heads Lynn had from the 40 Heads Beth had works out that Beth had 12 more Heads than Lynn

Answer 12

7 (b) Lynn says,

"My estimate of the probability of the coin landing on Heads must be the best, because 0.35 is greater than 0.32"

Is she correct?

Tick a box.

Yes ☐ No ☑

Give a reason for your answer.

[1 mark]

Beth did more spins ← The more spins, the better the estimate

Do not write outside the box

8 Some oil has

a mass of 537 g

a density of 895 000 g/m^3

1 m^3 = 1000 litres

Work out the volume of the oil.

Give your answer in litres.

[2 marks]

$d \frac{m}{v}$ ← Writing the formula triangle for density, mass, volume

$537 \div 895000$ ← Covering v in the formula triangle finds that volume = mass ÷ density. The unit of density involved m^3 so the unit of volume is m^3

0.0006×1000 ← Each m^3 is 1000 litres so multiplying the 0.0006 m^3 by 1000 converts it to 0.6 litres

Answer 0.6 litres

9 The length of a wall is 9 metres to the nearest metre.

Complete the error interval for the length of the wall.

[2 marks]

$9 \pm \frac{1}{2}$ ← Adding and subtracting half of the resolution to the measurement works out the upper and lower bound. The resolution is 1 m as it is to the nearest 1 m

Answer 8.5 m $\leqslant$ length $<$ 9.5 m

↑ It must be at least 8.5 m but less than 9.5 m to round to 9 m to the nearest metre

Turn over for the next question

7

Do not write outside the box

10 384 000 electric cars were sold this year.

This is 20% **more** than last year.

How many were sold **last year**?

[3 marks]

100 + 20 ← Adding 20% to 100% works out that it increased to 120% of last year

384000 ÷ 120 ← This works out that 1% of last year is 3200

3200 × 100 ← Multiplying 1% of last year by 100 works out that 100% of last year is 320000

Answer 320000

11 Here are three terms.

xy x^2 $5y^2$

Alec multiplies two of these terms.

Work out the **three** possible fully simplified answers.

[3 marks]

Answer x^3y ← $xy \times x^2$

Answer $5xy^3$ ← $xy \times 5y^2$

Answer $5x^2y^2$ ← $x^2 \times 5y^2$

Do not write outside the box

12 At a music festival, four types of instrument are played.

guitars keyboards drums trumpets

- The total number of instruments is 80
- Half of the instruments are guitars.
- keyboards : drums : trumpets = 3 : 4 : 1

So the other half of the instruments are keyboards, drums and trumpets

How many **keyboards** are there?

[4 marks]

80 ÷ 2 ← This works out that half of the instruments is 40. So there are 40 keyboards, drums and trumpets in total

40 ÷ 8 ← 3 + 4 + 1 = 8 parts in total in the ratio which represent the 40 keyboards, drums and trumpets. Dividing the 40 by the 8 parts works out that 1 part of the ratio is worth 5

5 × 3 ← Multiplying the value of 1 part of the ratio by the 3 parts which represent the keyboards works out that there are 15 keyboards

Answer 15

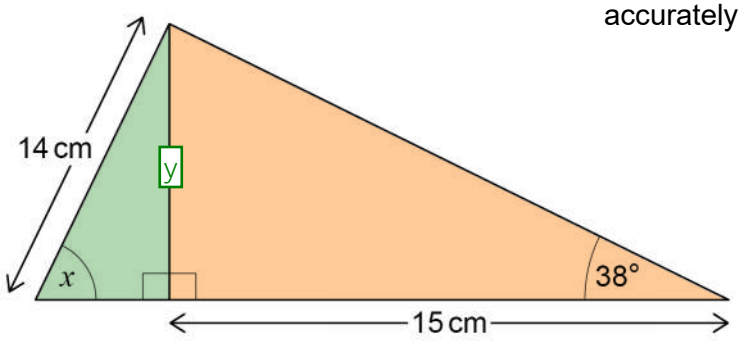
Turn over for the next question

10

Do not write outside the box

13 Two right-angled triangles are joined to make a larger triangle.

Not drawn accurately



Work out the size of angle x.

[4 marks]

S H C H T A — O A O

Using right-angled trigonometry in the orange right-angled triangle to find side y, which connects both triangles. Ticking A as the 15 cm is the adjacent and ticking O as y is the opposite. There are two ticks on the TOA formula triangle so this formula triangle can be used

$\tan 38 \times 15$

Covering O in the TOA formula triangle finds that opposite = tan of the angle × adjacent. So side y is 11.7... cm

S H C H T A — O A O

Using right-angled trigonometry in the green right-angled triangle to find angle x. Ticking O as the 11.7... cm is the opposite and ticking H as the 14 cm is the hypotenuse. There are two ticks on the SOH formula triangle so this formula triangle can be used

$\sin x = \frac{11.7...}{14}$

Covering S in the SOH formula triangle finds that sin of the angle = opposite/hypotenuse

$x =$ 56.8 °

Doing the inverse sin of both sides gets x on its own

Do not write outside the box

14 Here is a sign in a shop.

SALE

20% OFF ALL ITEMS

TODAY ONLY 10% OFF THE REDUCED PRICE

THAT MEANS YOU SAVE 30%

Is the sign correct?

Tick a box.

Yes ☐ No ☑

Give a reason for your answer.

[1 mark]

$x \times 0.8 \times 0.9 = 0.72x$

This shows that reducing by 20% then by 10% of the reduced price actually reduces the original price to 72%, which is a 28% reduction. Let x be the original price. 100% - 20% = 80%, then 80/100 = 0.8, which is the decimal multiplier which reduces by 20%. 100% - 10% = 90%, then 90/100 = 0.9, which is the decimal multiplier which reduces by 10%

Turn over for the next question

5

Do not write outside the box

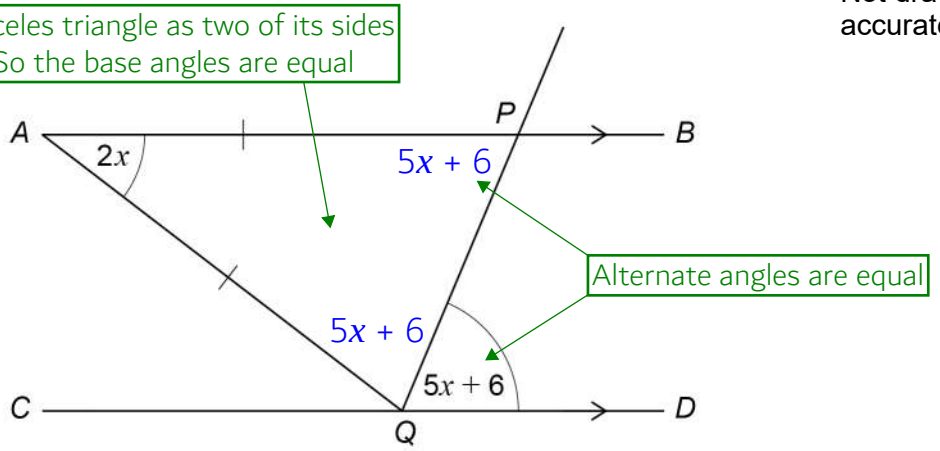
15 *AB* and *CD* are straight, parallel lines.

P is a point on *AB*.

Q is a point on *CD*.

$AP = AQ$

Not drawn accurately



This is an isosceles triangle as two of its sides are the same. So the base angles are equal

Alternate angles are equal

Work out the value of x.

[4 marks]

$2x + 5x + 6 + 5x + 6$ ← Adding all of the angles in the triangle

$12x + 12 = 180$ ← Simplifying by collecting like terms. This must be equal to 180 as there are 180° in a triangle

$12x = 168$ ← Subtracting 12 from both sides to get the x term on its own

$x =$ 14 °

↑ Dividing both sides by 12 gets x on its own

Do not write outside the box

16 Solve $(x + 2)(x - 5) = 6x$

[4 marks]

$x^2 - 5x + 2x - 10$ ← Expanding the brackets on the left of the equation

$x^2 - 3x - 10 = 6x$ ← Collecting like terms

$x^2 - 9x - 10 = 0$ ← Subtracting 6x from both sides to put into the quadratic form

$(x - 10)(x + 1) = 0$ ← Factorising. Two numbers which multiply to the -10 and add to the -9 are -10 and 1. Putting these in brackets with x

Answer 10, -1

One of the two brackets must equal to 0. Either x - 10 = 0 (so x = 10) or x + 1 = 0 (so x = -1)

17 Straight line *LM* has equation $y = 4x - 7$

Straight line *ST* has equation $y = \frac{9 - x}{4}$

Are the lines *LM* and *ST* perpendicular?

Tick a box.

Yes ✓ No ☐

Give a reason for your answer.

[2 marks]

$y = -\frac{1}{4}x + \frac{9}{4}$ ← Rewriting the equation for ST in the form y = mx + c by dividing both terms by 4 separately

$4 \times -\frac{1}{4} = -1$ ← The gradient of LM is 4 and the gradient of ST is -1/4. Multiplying these gradients gives -1, so the lines must be perpendicular

10

Do not write outside the box

18 Two types of battery, P and Q, were tested.

100 of each type were put into clocks.

The number of days each battery lasted was recorded.

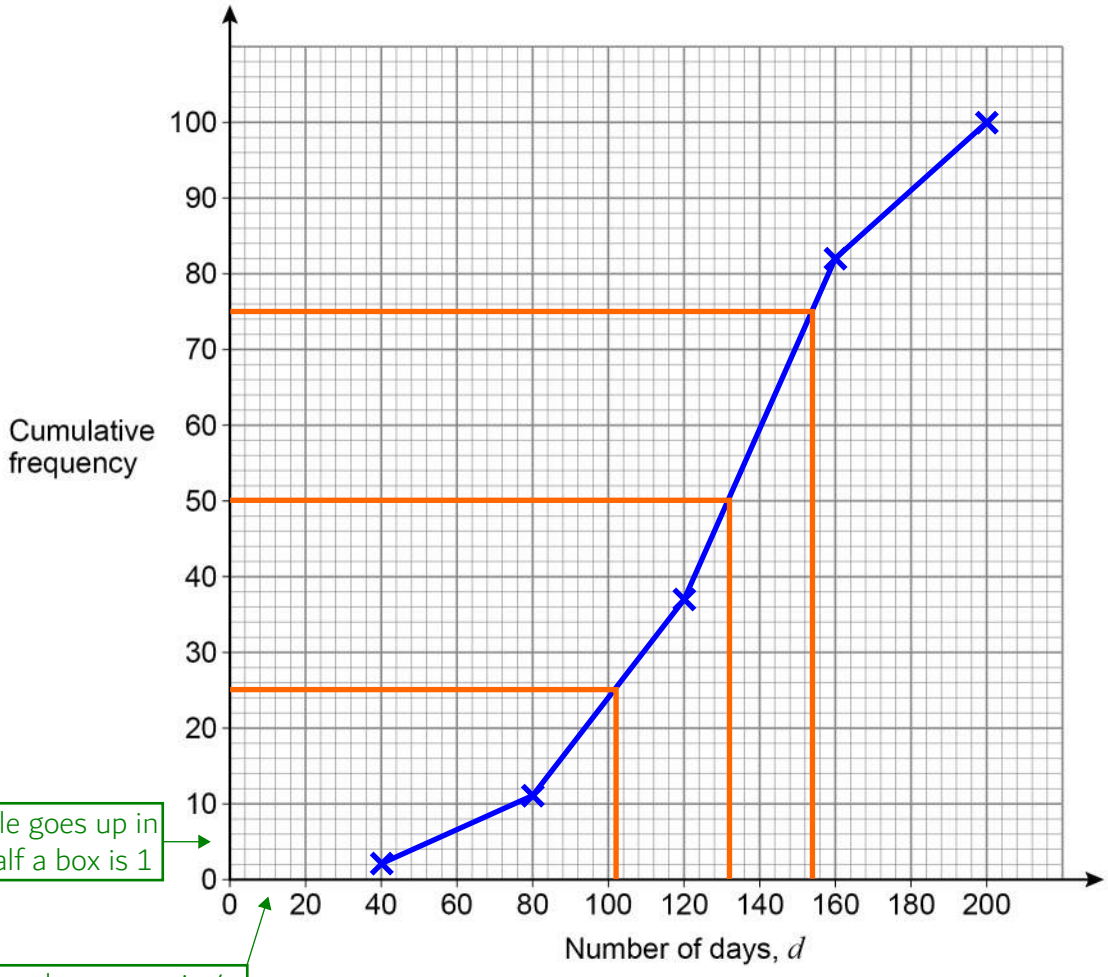
18 (a) The frequency table represents the results for **type P**.

Writing the cumulative frequencies by adding up the frequencies as they go. 2 + 9 = 11 then 11 + 26 = 37 then 37 + 45 = 82 then 82 + 18 = 100

Number of days, d	Frequency	
$0 \leqslant d < 40$	2	2
$40 \leqslant d < 80$	9	11
$80 \leqslant d < 120$	26	37
$120 \leqslant d < 160$	45	82
$160 \leqslant d < 200$	18	100

On the grid, draw a cumulative frequency diagram to represent the data.

[3 marks]



This scale goes up in 2s, so half a box is 1

This scale goes up in 4s

Plotting the cumulative frequencies at the end point of each interval then joining them up with a series of straight lines

Do not write outside the box

18 (b) For **type Q**,

the median was 126 days

the interquartile range was 57 days.

Compare the number of days that types P and Q lasted.

Make **one** statement about the average and **one** statement about the spread.

Use statistical measures to support your statements.

[4 marks]

Reading across from the cumulative frequency of 50 (which is 1/2 of 100) then reading down works out an estimate of the median. Reading across from the cumulative frequency of 25 (which is 1/4 of 100) then reading down works out an estimate of the lower quartile. Reading across from the cumulative frequency of 75 (which is 3/4 of 100) then reading down works out an estimate of the upper quartile

154 - 102 ← Interquartile range = upper quartile - lower quartile

Average The estimated median for type P is 134, which is greater than the median for type Q. So type P last longer on average

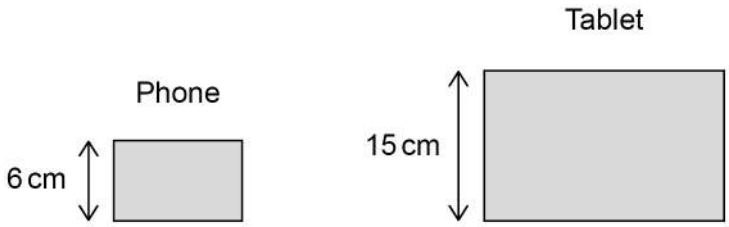
Spread The estimated interquartile range for type P is 52, which is less than the interquartile range for type Q. So type P is more consistent

Turn over for the next question

7

Do not write outside the box

19 A phone screen is **similar** to a tablet screen.



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The area of the **tablet** screen is 420 cm^2

A screen costs £7000 per **square metre**.

Work out the cost of a screen for the **phone**.

[5 marks]

$420 \times \left(\frac{6}{15}\right)^2$ ← Putting the 6 cm over the 15 cm expresses the length scale factor from the tablet to the phone. Squaring this expresses the area scale factor from the tablet to the phone. Multiplying this by the 420 cm^2 finds that the area of the phone screen is 67.2 cm^2

$67.2 \div 100^2$ ← There are 100 cm in 1 m so there are 100^2 cm^2 in 1 m^2. Dividing the area of the phone screen in cm^2 by 100^2 converts it to 0.00672 m^2

0.00672×7000 ← Multiplying the area of the phone screen in m^2 by the £7000 per square metre works out that the cost of a screen for the phone is £47.04

Answer £ 47.04

Do not write outside the box

20 Here is a formula for an iterative process.

$$u_{n+1} = \frac{24}{u_n} + 4$$

$u_2 = 8$

Work out the values of u_1 and u_3

[3 marks]

$8 = \frac{24}{u_1} + 4$ ← Substituting the value of u_2 for u_{n+1} and u_1 for u_n

$4 = \frac{24}{u_1}$ ← Subtracting 4 from both sides. Then 24 must be divided by 6 to get 4 so $u_1 = 6$

$u_3 = \frac{24}{8} + 4$ ← Substituting u_3 for u_{n+1} and the value of u_2 for u_n

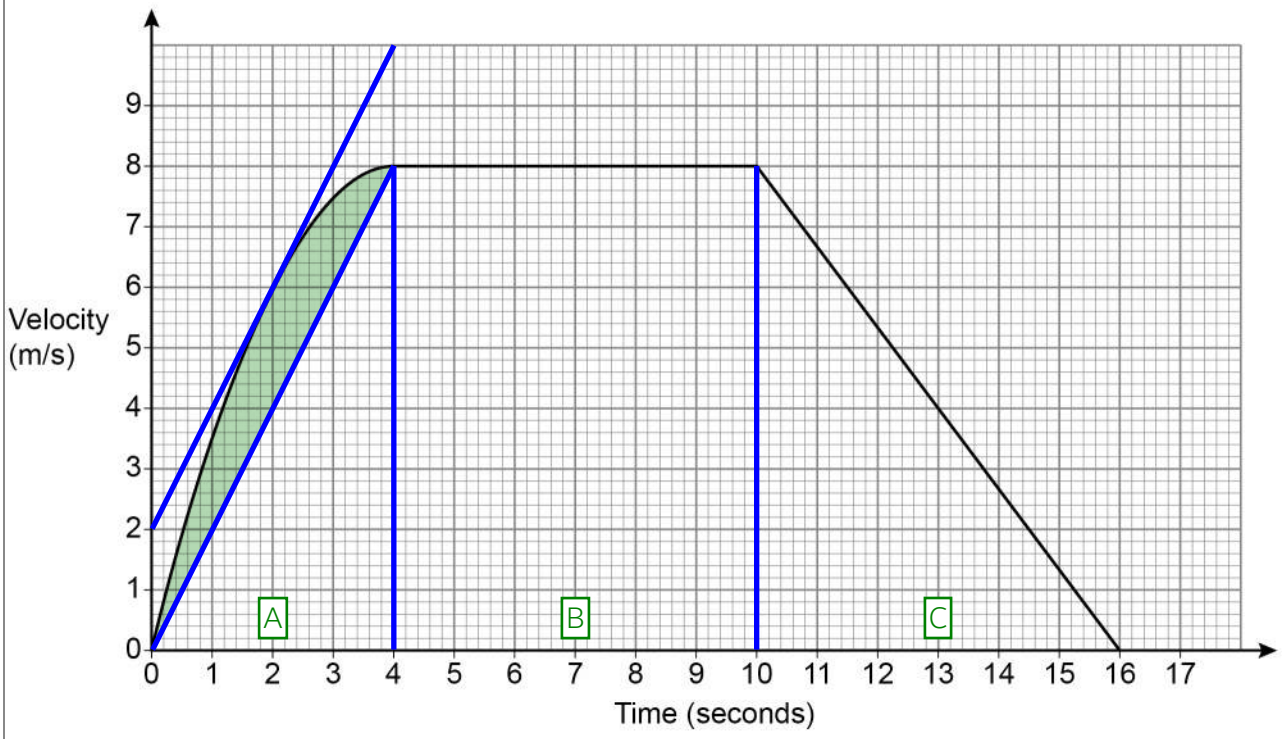
$u_1 =$ 6 $u_3 =$ 7

Turn over for the next question

8

Do not write outside the box

21 The graph represents the velocity of a ball as it rolls along the ground.



21 (a) Work out an estimate for the acceleration of the ball, in m/s^2, after 2 seconds.

You **must** show your working.

[2 marks]

$\frac{10 - 2}{4 - 0}$

Acceleration is the gradient of the line on a velocity-time graph. Drawing a tangent then working out its gradient. Gradient = (change in y)/(change in x). Using the two end points of the line as these are on grid lines. y changes from 2 to 10 and x changes from 0 to 4

Answer 2 m/s^2

Do not write outside the box

21 (b) Work out an estimate for the total distance covered by the ball.

[3 marks]

$\frac{1}{2} \times 4 \times 8 = 16$ ← Area of triangle = 1/2 × base × height. So the area of triangle A is 16

$6 \times 8 = 48$ ← Area of rectangle = base × height. So the area of rectangle B is 48

$\frac{1}{2} \times 6 \times 8 = 24$ ← Area of triangle = 1/2 × base × height. So the area of triangle C is 24

$16 + 48 + 24$ ← Adding all of the areas of the shapes estimates that the area under the line is 88. This is an estimate of the distance

Answer 88 m

21 (c) Is your estimate from part (b) an overestimate or underestimate?

Tick a box.

Overestimate ☐ Underestimate ☑

Give a reason for your answer.

[1 mark]

Some of the area was missed

The area in green was not included in the calculation so the estimate is less than the actual distance

Turn over for the next question

6

Do not write outside the box

22 The nth term of a sequence is $n^2 - 30n + 236$

By completing the square,

show that all the terms of the sequence have two or more digits.

[3 marks]

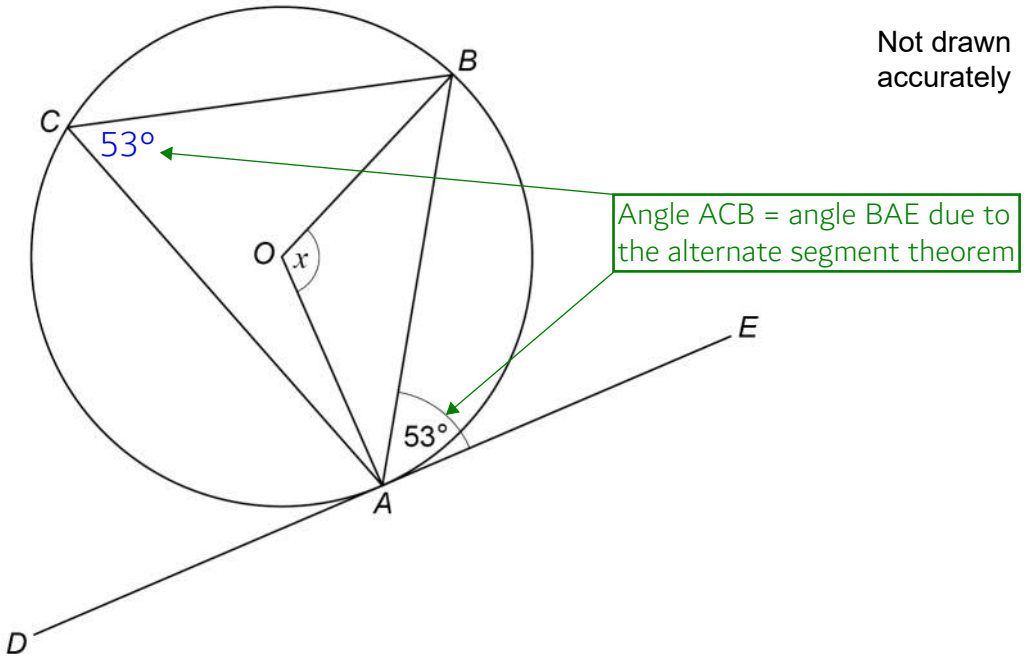
$(n - 15)^2 + 236 - 15^2$ ← Halving the -30 and putting this in a bracket with n and squaring. Subtracting $(-15)^2$, which is the same as subtracting 15^2

$(n - 15)^2 + 11$ ← This is completed the square form

11 is the minimum term ← The least value a squared bracket can have is 0. When the $(n - 15)^2 = 0$, the expression for the nth term is worth 11, so this is the minimum term and all other terms must be greater than this so have 2 or more digits

Do not write outside the box

23 (a)



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Angle ACB = angle BAE due to the alternate segment theorem

Line *DAE* is a tangent at *A* to the circle with centre *O*.

Work out the size of angle x.

[2 marks]

53 × 2

The angle at the centre of a circle is double the angle at the circumference. So doubling angle ACB works out the size of angle x

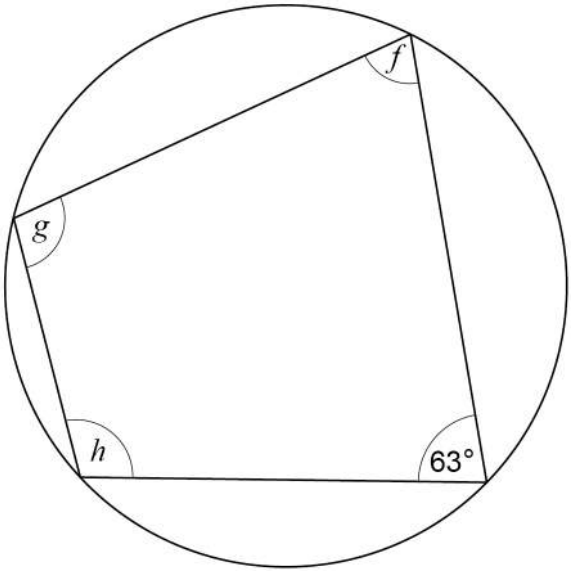
$x =$ 106 °

Turn over for the next question

5

Do not write outside the box

23 (b) Here is a cyclic quadrilateral.



Not drawn accurately

$f : g = 2 : 3$

Work out $f : h$

Give your answer in its simplest form.

[4 marks]

180 - 63 ← Opposite angles in a cyclic quadrilateral add up to 180°. So subtracting the 53° from 180° works out that g = 117°

117 ÷ 3 ← g is represented by 3 parts in the ratio. So dividing g by 3 works out that 1 part of the ratio is worth 39°

39 × 2 ← f is represented by 2 parts in the ratio. So multiplying the value of 1 part of the ratio by 2 works out that f = 78°

180 - 78 ← Opposite angles in a cyclic quadrilateral add up to 180°. So subtracting f from 180° works out that h = 102°

$\frac{78}{102} = \frac{13}{17}$ ← Fractions simplify in a similar way to ratios. So putting f over h and simplifying the fraction using the calculator can be used to find the ratio f : h in its simplest form

Answer 13 : 17

Do not write outside the box

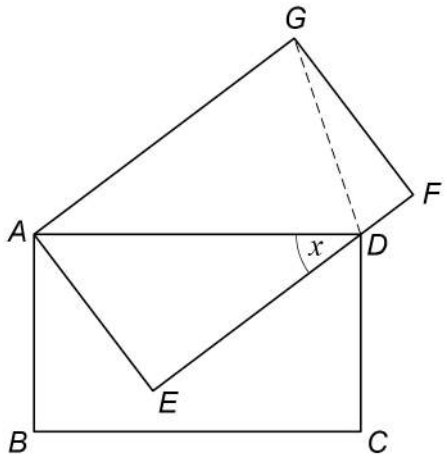
24 In the diagram,

ABCD and *AEFG* are congruent rectangles

D lies on *EF*

angle *ADE* = x

Not drawn accurately



Prove that *GD* bisects angle *ADF*.

[4 marks]

Angle DAG = x, as alternate angles are equal

EF must be parallel to AG as they are opposite sides in a rectangle. So angle ADE is alternate to angle DAG

Angles GDA and AGD = $\frac{180 - x}{2}$ as the base angles of an isosceles triangle are equal and angles in a triangle add up to 180°

Triangle ADG is isosceles as both AG and AD are the longer sides of congruent rectangles so are equal. The base angles are opposite the equal sides. As there are 180° in a triangle, subtracting angle DAG from 180° expresses the total of the two base angles, which can be divided by two to express each base angle

Angle GDF = $\frac{180 - x}{2}$, as alternate angles are equal

EF must be parallel to AG as they are opposite sides in a rectangle. So angle GDF is alternate to angle AGD

Angle GDA = angle GDF, so GD bisects angle ADF

Both angle GDA and angle GDF are equal to the same thing. Bisects means that it cuts the angle in two so that both halves are equal

END OF QUESTIONS

8