

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

**GCSE
MATHEMATICS****H**

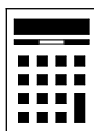
Higher Tier Paper 3 Calculator

Wednesday 11 June 2025 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	
24–25	
TOTAL	



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.**1** Convert 8.25 pounds into kilograms.

Use 2.2 pounds = 1 kilogram

$8.25 \div 2.2$

Dividing the 8.25 pounds by the 2.2 pounds finds that the 8.25 pounds is 3.75 lots of the 2.2 pounds. So it is 3.75 lots of the 1 kilogram

[2 marks]Answer 3.75 kg**2** Here are the temperatures in six cities in degrees Celsius.

0°C -3°C 0°C 1.5°C 23°C 4°C

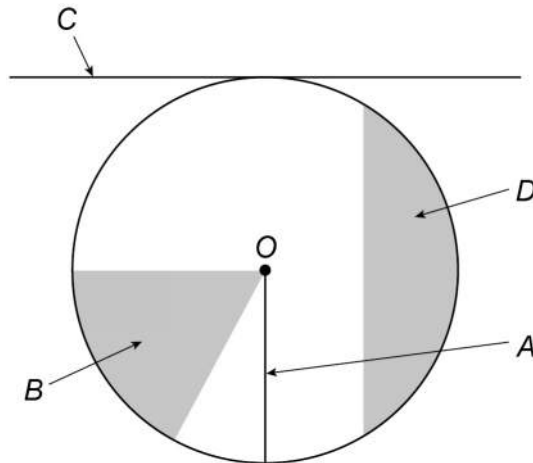
Write down the outlier.

[1 mark]Answer 23 °C

They are all quite close apart from 23°C, so this is the outlier



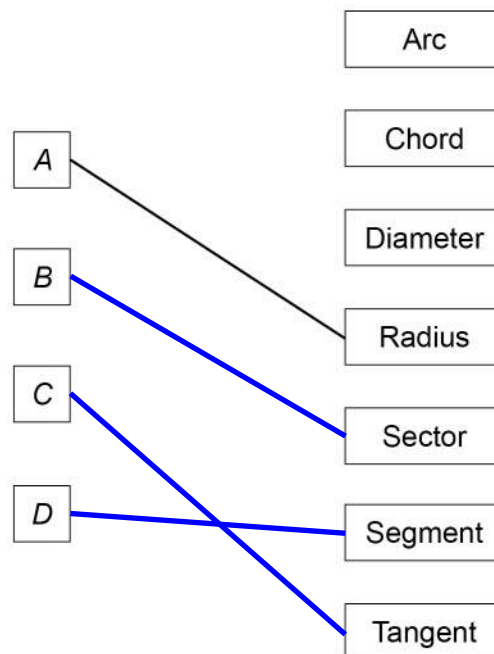
3

Here is a circle, centre O 

Match each letter to the correct word.

One has been done for you.

[3 marks]



The sector is the area between two radii and the circumference.

The tangent is a straight line which just touches the circle and does not cross it.

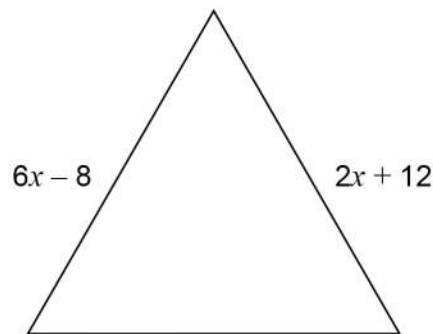
The segment is the area between a chord and the circumference



4

Here is an equilateral triangle.

All measurements are in centimetres.

Not drawn
accurately

Work out the value of the perimeter of the triangle.

[4 marks]

$$6x - 8 = 2x + 12$$

As it is equilateral, all the sides are equal. So the $6x - 8$ can be set equal to the $2x + 12$

$$4x - 8 = 12$$

Subtracting $2x$ from both sides to get all the x on the same side

$$4x = 20$$

Adding 8 to both sides to get the x term on its own

$$x = 5$$

Dividing both sides by 4 to get x on its own

$$2 \times 5 + 12$$

Substituting 5 for x in $2x + 12$ finds that each side is 22 cm

$$22 \times 3$$

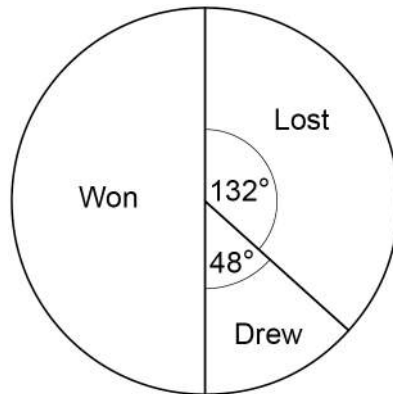
All three sides are equal so multiplying the side length by 3 finds the perimeter, which is the total of all of the outside sides

Answer 66 cm



5

The pie chart represents the results of matches played by a team.



30 matches were **won**.

How many matches were lost?

[3 marks]

$$360 - 132 - 48$$

Subtracting the angle for lost and the angle for drew from the total 360° finds that the angle for won is 180°

$$30 \div 180$$

Dividing the 30 matches won by the 180° representing them finds that 1° represents 0.16... matches

$$0.16... \times 132$$

Multiplying what 1° represents by the 132° for lost finds that 22 matches were lost

Answer 22

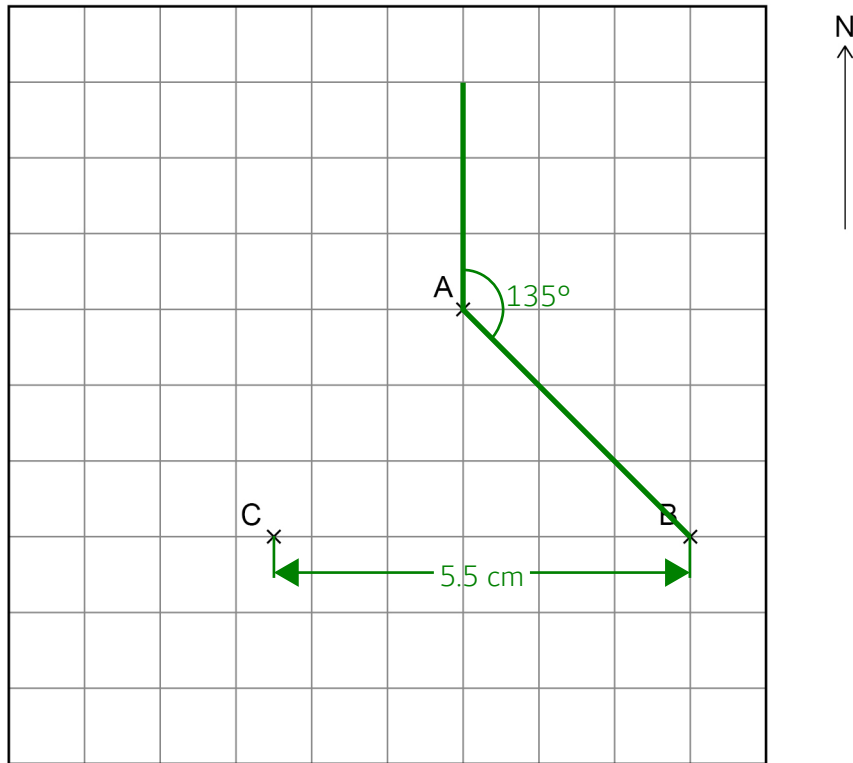
Turn over for the next question

Turn over ►



- 6 Here is a scale diagram showing towns A, B and C on a centimetre grid.

Scale 1 : 200 000



- 6 (a) Work out the **actual** distance from B to C.
Give your answer in kilometres.

[4 marks]

$$5.5 \times 200000$$

The 200000 is 200000 times greater than the 1. So multiplying the measured 5.5 cm by 200000 finds that the actual distance is 1100000 cm

$$1100000 \div 100$$

There are 100 cm in 1 m. So dividing the 1100000 cm by 100 converts it to 11000 m

$$11000 \div 1000$$

There are 1000 m in 1 km. So dividing the 11000 m by 1000 converts it to 11 km

Answer 11 km



- 6 (b) B is South East of A.

Write down the bearing of B from A.

[1 mark]

$90 + 45$

The bearing is the degrees turned clockwise from North at A to face B. It is 90° from North to East then half a right angle (45°) from East to South East. Adding these finds the bearing

Answer 135°

- 7 (a) Write 2 weeks as a fraction of 8 days.

Give your answer in its simplest form.

[1 mark]

2×7

1 week is 7 days. So multiplying the 2 weeks by 7 finds that it is 14 days

$\frac{14}{8}$

Putting the 14 days over the 8 days expresses the fraction

Answer $\frac{7}{4}$

The calculator simplifies the fraction

- 7 (b) Write 56 centimetres : 2.73 metres as a ratio in the form $1 : n$

[1 mark]

2.73×100

There are 100 cm in 1 m. So multiplying the 2.73 metres by 100 converts it to 273 centimetres

$273 \div 56$

So the ratio is 56 : 273. Dividing both sides by 56 gets 1 on the left

Answer 1 : 4.875

- 7 (c) $A : B = \frac{1}{5} : \frac{7}{10}$

Write A as a fraction of B.

[2 marks]

$\frac{1}{5} \div \frac{7}{10}$

Dividing A by B expresses A as a fraction of B

Answer $\frac{2}{7}$



8 A linear sequence has

- 2nd term = 6
- 5th term = 18

Work out the n th term of the sequence.

[3 marks]

$18 - 6$ ← Subtracting the 2nd term from the 5th term finds that the difference between them is 12

$12 \div 3$ ← Dividing the difference of 12 by the 3 jumps from the 2nd term to the 5th term finds that each jump is 4

$6 - 4 - 4$ ← Subtracting 4 from the 2nd term expresses the 1st term. Subtracting another 4 expresses the 0th term

Answer $4n - 2$

The sequence increases in 4s so must involve $4n$.
The 0th term is -2 so the n th term must be $4n - 2$

9 Ary, Bea and Cat each have an amount of money.

Cat has £280

- Cat's amount is $\frac{2}{3}$ of Bea's amount.
- Ary's amount : Bea's amount = 5 : 12

Work out how much money Ary has.

[3 marks]

$280 \div 2$ ← Dividing $\frac{2}{3}$ of Bea's amount by 2 finds that $\frac{1}{3}$ of Bea's amount is £140

140×3 ← Multiplying $\frac{1}{3}$ of Bea's amount by 3 finds that the whole of Bea's amount is £420

$420 \div 12$ ← Dividing Bea's amount by the 12 parts of the ratio which represent it finds that 1 part of the ratio is worth £35

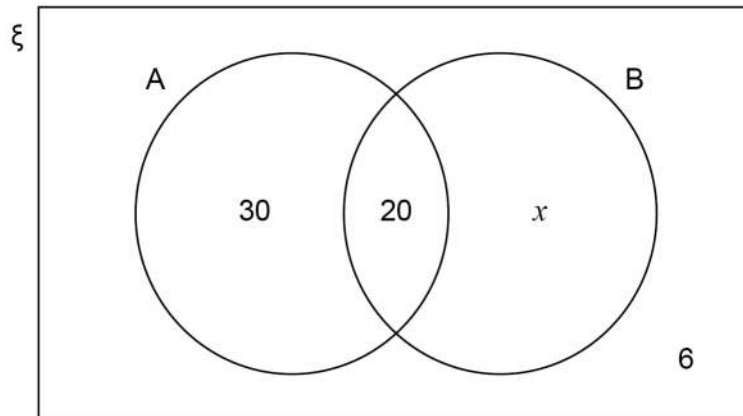
35×5 ← Multiplying the value of 1 part of the ratio by 5 finds that the 5 parts representing Ary's amount are worth £175

Answer £ 175



10

The Venn diagram shows some of the **numbers** of items in each set.



$$P(A) = \frac{1}{2}$$

Work out the value of x .

[2 marks]

$30 + 20$ ← Adding the 30 and 20 in A finds that there are 50 items in A

50×2 ← The probability of A is $\frac{1}{2}$ so multiplying the 50 items by 2 finds that there are 100 items in total

$100 - 30 - 20 - 6$ ← Subtracting all the known numbers from the total 100 finds that x is 44

$$x = \underline{\hspace{2cm} 44 \hspace{2cm}}$$

Turn over for the next question

Turn over ►



11 (a) Write down the equation of a straight line parallel to $y - 2x = 9$

[1 mark]

$$y = 2x + 9$$

Adding $2x$ to both sides to put in the form $y = mx + c$, where m is the gradient and c is the y -intercept. So the gradient is 2

Answer $y = 2x + 8$

Parallel lines have the same gradient but cannot be the same line. Giving it a gradient of 2 but a different y -intercept

11 (b) A straight line

- has gradient 5
- passes through the point (3, 7)

Circle the equation of the line.

[1 mark]

$$7 = 5(3) + c$$

$y = mx + c$, where m is the gradient and c is the y -intercept. Substituting the y coordinate of 7 for y , the x -coordinate of 3 for x and 5 for m

$$c = -8$$

Subtracting $5(3)$ from both sides finds that $c = -8$

$$y = 3x - 2$$

$$y = 3x + 7$$

$$y = 5x$$

$$y = 5x - 8$$

$y = mx + c$, where m is the gradient and c is the y -intercept. m is 5 and c is -8



12

Rob records the time he takes to drive to work every day for 80 days.

The table shows information about the results.

Time, t (minutes)	Frequency
$20 \leq t < 25$	16
$25 \leq t < 30$	32
$30 \leq t < 40$	24
$40 \leq t < 60$	8
	Total = 80

Midpoints of
each interval

22.5

27.5

35

50

Multiplying the frequencies by
the midpoints estimates the
total time for each interval

360

880

840

400

 2480

Adding the estimated totals for each interval finds
that the estimated total time is 2480 minutes

Last year, the **mean** time Rob took to drive to work was 25 minutes.

Estimate the percentage increase in the **mean** driving time for these 80 days.

[4 marks]

$$2480 \div 80$$

Mean = total $\div$ number, where total is the estimated total time and number is the total frequency. So the estimated mean for the 80 days is 31 minutes

$$31 - 25$$

Subtracting the mean last year from the estimated mean for the 80 days finds that the mean has increased by an estimated 6 minutes

$$\frac{6}{25} \times 100$$

Putting the increase of 6 minutes over the original 25 minutes expresses the increase as a fraction. Multiplying this by 100 converts it to a percentage

Answer 24 %



- 13** The table shows information about the salary of 90 employees.

Salary, s (£)	Frequency
$0 < s \leq 20\,000$	44
$20\,000 < s \leq 40\,000$	22
$40\,000 < s \leq 60\,000$	14
$60\,000 < s \leq 80\,000$	5
$80\,000 < s \leq 100\,000$	2
$100\,000 < s \leq 120\,000$	3

- 13 (a)** Complete the cumulative frequency table.

[1 mark]

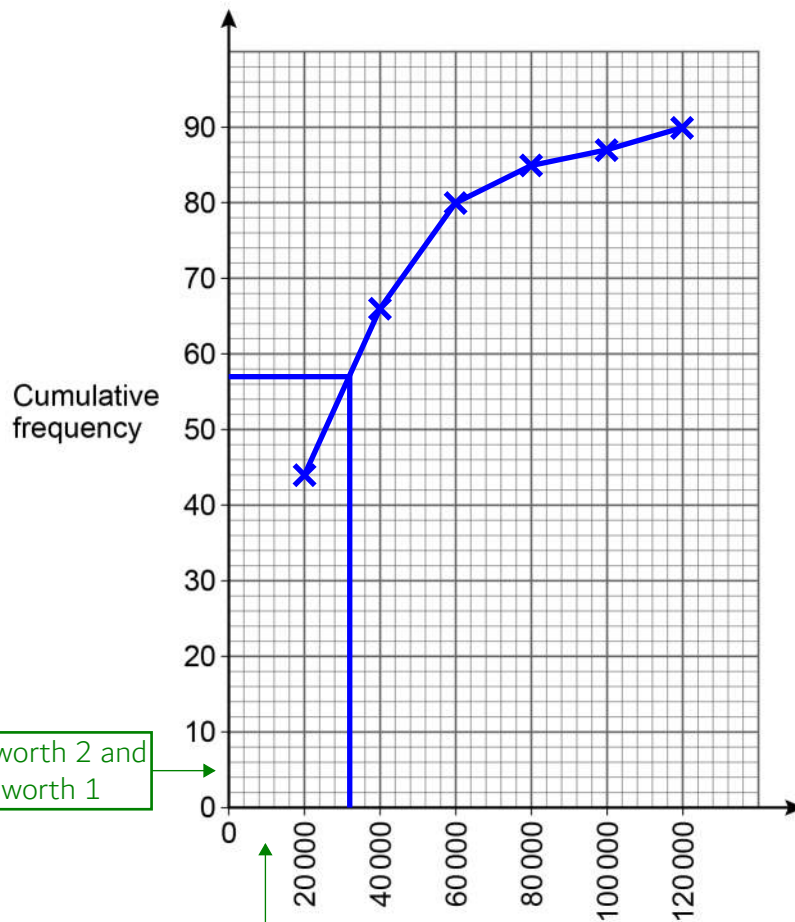
Salary, s (£)	Cumulative Frequency
$s \leq 20\,000$	44 ← 44
$s \leq 40\,000$	66 ← $44 + 22 = 66$
$s \leq 60\,000$	80 ← $66 + 14 = 80$
$s \leq 80\,000$	85 ← $80 + 5 = 85$
$s \leq 100\,000$	87 ← $85 + 2 = 87$
$s \leq 120\,000$	90 ← $87 + 3 = 90$

Adding the frequencies as they go finds the cumulative frequencies



13 (b) Draw a cumulative frequency diagram to represent the data.

[2 marks]



Each small box is worth 2 and
half a small box is worth 1

This scale goes up 20000 over 5 small boxes. $20000 \div 5 = 4000$,
so each small box is worth 4000 and half a box is worth 2000

Plotting the cumulative frequencies at the end of each interval then joining up the points

13 (c) Estimate the number of employees with a salary **less** than £32 000

[2 marks]

Reading up from £32000 to the line then across to the cumulative frequency

Answer 57



14 (a) For a small plane,

- the mass of the empty plane is 800 kg, to the nearest 100 kg
- the mass of fuel is 190 kg, to the nearest 5 kg
- the mass of the passengers is 163 kg, to the nearest kg

The total mass of a plane is calculated by adding these three masses.

The **maximum** mass for the plane to take off safely is 1200 kg

Can this plane definitely take off safely?

Tick a box.

Yes

☐

No

☒

Show working to support your answer.

[4 marks]

$$800 + \frac{100}{2} = 850$$

$$190 + \frac{5}{2} = 192.5$$

$$163 + \frac{1}{2} = 163.5$$

$$850 + 192.5 + 163.5 = 1206$$

Adding half of the resolution (what it is to the nearest) to each value works out the upper bounds

Adding all the upper bounds for each value finds that the upper bound of the total mass is 1206 kg. So it may not be safe as this is more than 1200 kg



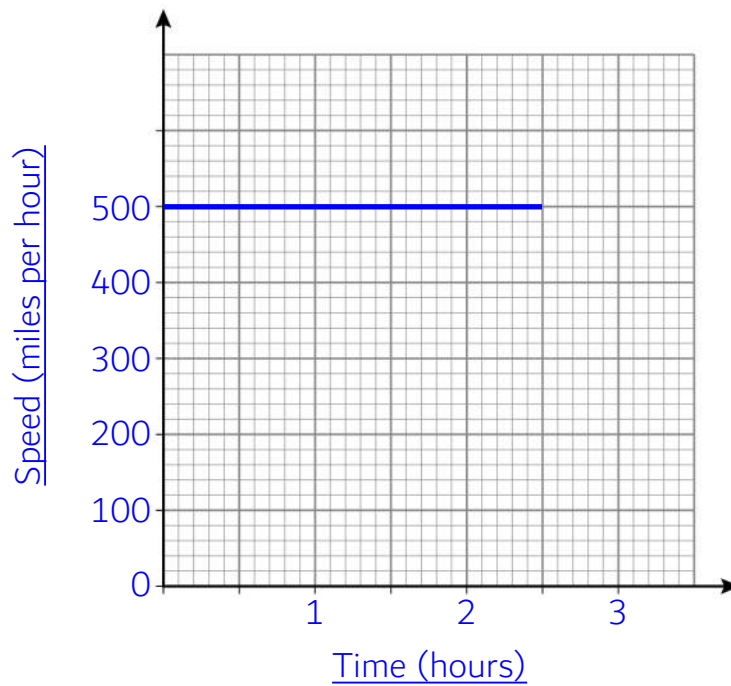
- 14 (b)** A different plane travels 1250 miles in 2 hours 30 minutes at a constant speed.

On the grid, draw a **speed/time** graph to represent this information.

[3 marks]

$$1250 \div 2.5 = 500$$

Speed in miles per hour means to divide the distance in miles by the time in hours. 2 hours 30 minutes is 2.5 hours. So the speed is 500 miles per hour



Turn over for the next question

Turn over ►



15 Amy and Becky each make integers using **three** single digits.

In any integer, digits may be repeated.

- Amy makes **even** integers with a first digit greater than 7
- Becky makes **odd** integers with a first digit that is non-zero.

They each make as many different integers as possible.

How many **more** integers than Amy does Becky make?

[3 marks]

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Listing the single digits to help count how many there are, how many are greater than 7, and how many are non-zero

$$2 \times 10 \times 5 = 100$$

Using the product rule for counting. Multiplying the number of possibilities for each digit finds how many possibilities there are for the integer. For Amy, there are 2 possibilities for the 1st digit (8 or 9), there are 10 possibilities for the 2nd digit (any of the digits) and there are 5 possibilities for the 3rd digit (0, 2, 4, 6, 8). So there are 100 possible integers Amy can make

Answer 350

$$9 \times 10 \times 5 = 450$$

Using the product rule for counting. Multiplying the number of possibilities for each digit finds how many possibilities there are for the integer. For Becky, there are 9 possibilities for the 1st digit (1 to 9), there are 10 possibilities for the 2nd digit (any of the digits) and there are 5 possibilities for the 3rd digit (1, 3, 5, 7, 9). So there are 450 possible integers Becky can make

$$450 - 100$$

Subtracting the 100 different integers Amy can make from the 450 different integers Becky can make finds that Becky can make 350 more integers than Amy



16 x is a **positive even number**.

$$y = (x - 3)(x - 5)(x + 6)$$

Without expanding brackets,

explain why there is only one value of x for which y is **negative**.

[3 marks]

Use table mode on the calculator. Define $f(x) = (x - 3)(x - 5)(x + 6)$. Start: 2. End: 30. Step: 2. This lists out the values of y for each positive even value of x up to 30 and helps to visualise what is going on

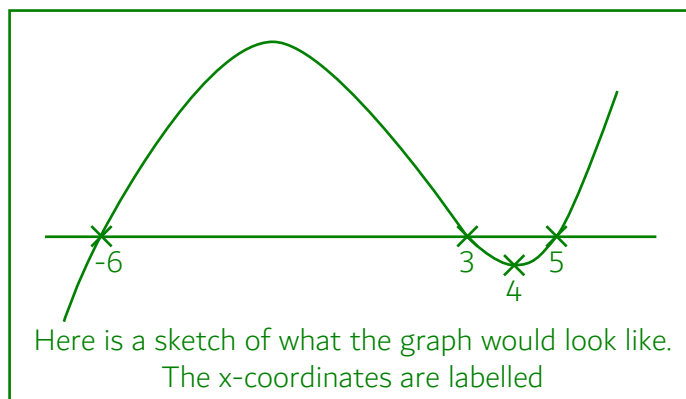
When $x = 2, y = 24$ ← 2 is the first positive even number. From the table of values, $y = 24$ when $x = 2$

When $x = 4, y = -10$ ← 4 is the next positive even number. From the table of values, $y = -10$ when $x = 4$

When $x = 6, y = 36$ ← 6 is the next positive even number. From the table of values, $y = 36$ when $x = 6$

When $x > 6, y > 36$ ← Increasing x beyond 6 will increase y as all three brackets will be positive and increasing positive numbers multiplied together gives a greater result

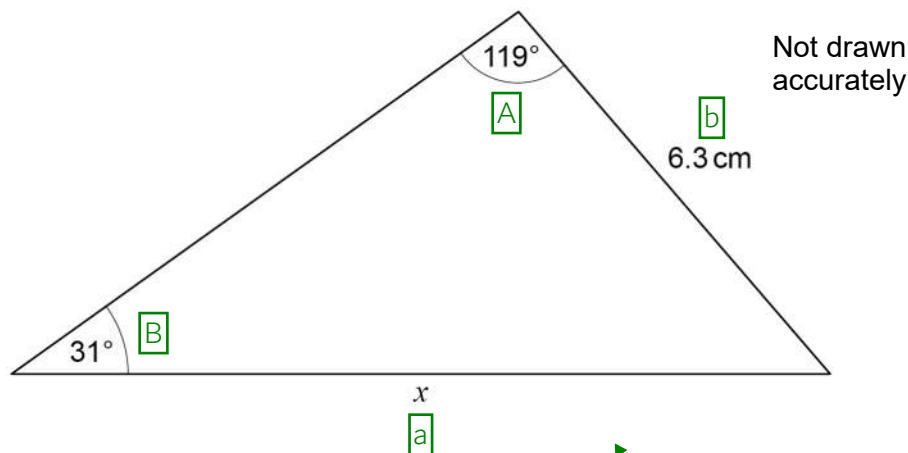
So the only value for which y is negative is when $x = 4$, given that x is a positive even number



Turn over for the next question



17

Use the sine rule to work out x .

Labelling the triangle. Side a is opposite angle A and side b is opposite angle B

[2 marks]

$$\frac{x}{\sin 119} = \frac{6.3}{\sin 31} \quad \leftarrow \quad \frac{a}{\sin A} = \frac{b}{\sin B}$$

$$x = \underline{\hspace{2cm}} 10.7 \hspace{2cm} \text{cm}$$

Multiplying both sides by $\sin 119$ gets x on its own



18 Here are the first four terms of a quadratic sequence.

6 15 28 45

So it will be in the form $an^2 + bn + c$

Work out an expression for the n th term.

[3 marks]

9, 13

The difference between the 1st and 2nd term is 9.
The difference between the 2nd and 3rd term is 13

$4 \div 2$

The second difference is 4 as this is the difference between the 9 and the 13. Dividing this by 2 finds that a must be 2 as the coefficient of the n^2 term is half of the second difference

$2n^2$: 2, 8

Listing the sequence of $2n^2$. $n = 1$ on the 1st term and $n = 2$ on the 2nd term. Substituting these values of n into the $2n^2$. $2(1)^2 = 2$ and $2(2)^2 = 8$

4, 7

Listing what needs to be added to the 1st and 2nd terms of $2n^2$ to get the original sequence. This forms the sequence $bn + c$. $b = 3$ as it increases by 3 between the 4 and the 7 and $c = 1$ as the 0th term (the term before the 1st term) would be 1

Answer

$$2n^2 + 3n + 1$$

Adding the sequences of $2n^2$ and $3n + 1$ gives the original sequence

Turn over for the next question



19

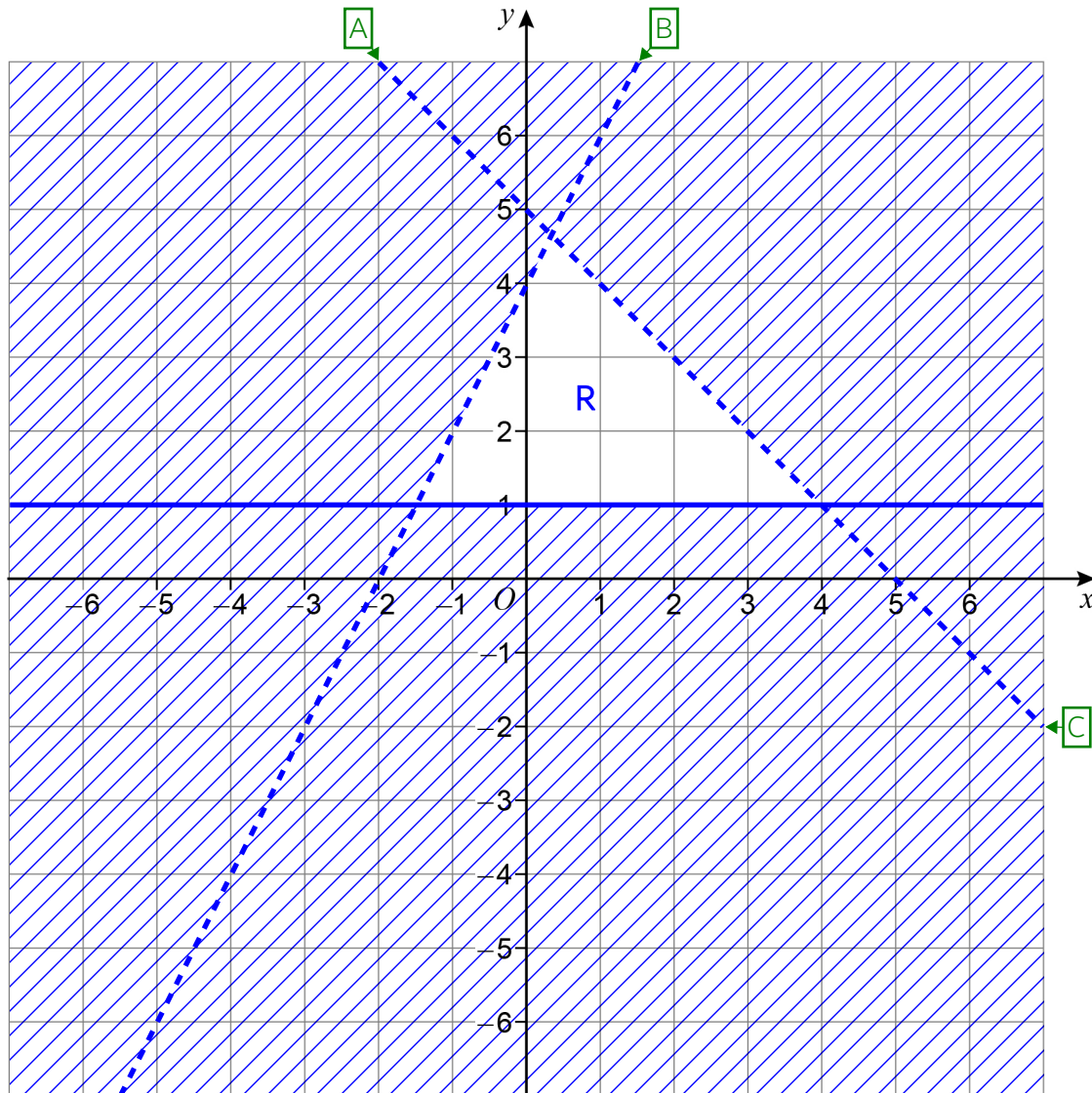
On the grid, identify the region represented by

$$x + y < 5 \quad \text{and} \quad y < 2x + 4 \quad \text{and} \quad y \geq 1$$

Label the region R.

[4 marks]

$$y < 5 - x \leftarrow \text{Subtracting } x \text{ from both sides of the 1st inequality to get } y \text{ on its own}$$



A: Drawing the line of $y = 5 - x$. When $x = 0$, $y = 5 - 0 = 5$, so the line goes through $(0, 5)$. When $x = 2$, $y = 5 - 2 = 3$, so the line goes through $(2, 3)$. Dashing the line as y is not equal. Crossing out everything above the line as y is less so the region must be below the line.

B: Drawing the line of $y = 2x + 4$. It is in the form $y = mx + c$, where m is the gradient and c is the y -intercept. So it crosses the y -axis at 4 and has a gradient of 2, meaning every 1 it goes to the right it goes up 2. Dashing the line as y is not equal. Crossing out everything above the line as y is less so the region must be below the line.

C: Drawing the line of $y = 1$. Using a solid line as y can be equal. Crossing out everything below the line as y is greater so the region must be above the line.

The region R is everything which is not crossed out and is labelled R



20 (a) Factorise fully $3n^2 + 5n + 2$ ← It is in the form $an^2 + bn + c$

[2 marks]

$3n^2 + 3n + 2n + 2$ ← Multiplying a by c gives 6. 3 and 2 multiply to this 6 and add to the 5. Splitting the middle n term into these numbers of n

$3n(n + 1) + 2(n + 1)$ ← Factorising the left two terms and factorising the right two terms

Answer $(3n + 2)(n + 1)$

Bringing together the 3n and +2 and writing the repeated bracket once

20 (b) A sequence has n th term $3n^2 + 5n + 2$

Are any of the terms in the sequence a prime number?

Tick a box.

Yes

☐

No

☒

Give a reason for your answer.

[1 mark]

$3n + 2$ and $n + 1$ are factors which cannot equal to 1

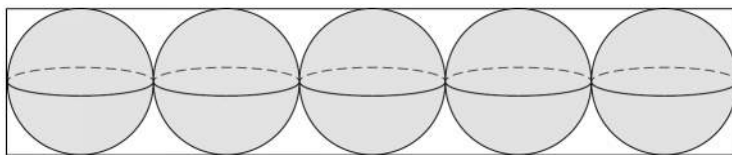
Prime numbers only have two factors: itself and 1. It can be factorised and neither factor can equal to 1 as the smallest n can be is 1 in a sequence so the smallest $n + 1$ can be is 2 and the smallest $3n + 2$ can be is 5. If neither factor is 1, the other factor cannot be itself. So the two factors must be numbers other than itself and 1, meaning no term is prime

Turn over for the next question

Turn over ►



21

Five identical spheres just fit inside a **cylinder**.Each sphere has radius r .

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

What fraction of the space inside the **cylinder** is filled by the spheres?You **must** show your working.**[4 marks]**

$$\frac{\frac{4}{3}\pi r^3 \times 5}{\pi r^2 \times 10r}$$

Multiplying the volume of a sphere by 5 expresses the volume of all 5 spheres

Volume of cylinder = area of circle $\times$ length. Area of circle = πr^2 . The length is 5 spheres, which each are 2 radii long so the total length is $10r$

Putting the volume of the 5 spheres over the volume of the cylinder expresses the fraction

Answer _____

$$\frac{2}{3}$$

Ignoring the r as these cancel out from the numerator and denominator. Putting the rest in the calculator to simplify the fraction



22 Solve $2x^2 > 12 - 5x$

[4 marks]

$$2x^2 + 5x - 12 > 0$$

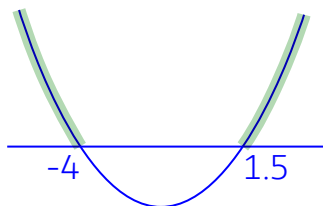
Adding $5x$ to both sides and subtracting 12 from both sides to get everything on one side so that it is in the quadratic form

$$x = \frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times -12}}{2 \times 2}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Solving when it is equal to 0 using the quadratic formula

$$x = 1.5 \quad \text{or} \quad x = -4$$



Sketching the graph to visualise where it is greater than 0 in the y-direction

Answer $x < -4$
 $x > 1.5$

The two lines highlighted in green are when it is above the x-axis and is greater than 0 in the y-direction. This is to the left of -4 and to the right of 1.5

Turn over for the next question

Turn over ►



23

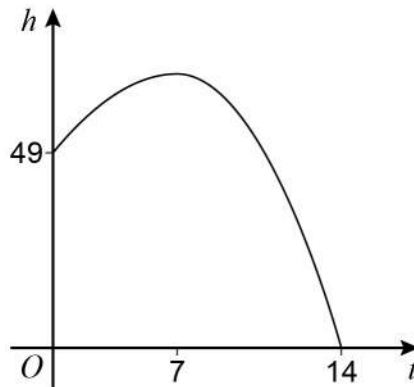
A roller coaster starts at ground level.

The height above ground level, h , in metres, of the roller coaster is given by

$$h = -(t - 7)^2 + 49$$

where t is the time in seconds after the roller coaster starts.

Sam draws a graph of h against t for $0 \leq t \leq 14$



Make **two** criticisms of Sam's graph.

[2 marks]

Criticism 1 Should start at (0, 0)

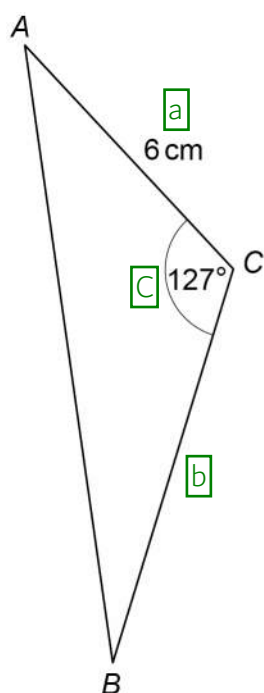
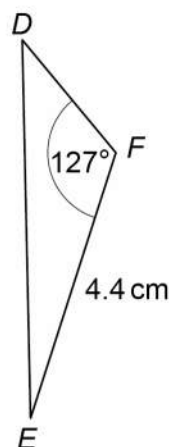
As it starts at ground level and h is the height above ground level

Criticism 2 Shouldn't go over 49 metres

The equation is in completed the square form. When $t = 7$ the bracket would equal 0 so there is a turning point. $h = 49$ when the bracket is equal to 0



24

Triangles ABC and DEF are similar.Not drawn
accuratelyThe area of ABC is 26.355 cm^2 Work out the area of DEF .**[4 marks]**

$$0.5 \times 6 \times BC \times \sin 127 = 26.355 \quad \leftarrow \text{Area of triangle} = \frac{1}{2} ab \sin C$$

$$BC = 11.0... \quad \leftarrow \text{Dividing both sides by } 0.5 \times 6 \times \sin 127 \text{ finds side } BC$$

$$11.0... \div 4.4 \quad \leftarrow \text{Dividing } BC \text{ by the smaller version } EF \text{ finds that the scale factor is } 2.50...$$

$$26.355 \div 2.50...^2 \quad \leftarrow \text{Dividing the area of } ABC \text{ by the scale factor squared (as the unit of area is } \text{cm}^2) \text{ finds the area of } DEF$$

Answer 4.2 cm^2 **END OF QUESTIONS**