AQA

.CG Maths.
Hints

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

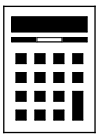
H

Higher Tier Paper 2 Calculator

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a calculator
- mathematical instruments.



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	
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 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

.CG Maths.

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

Do not write outside the box

1 Circle the factor of $x^2 - 5x$

[1 mark]

$x - 1$ $\quad -5x$ $\quad x - 5$ $\quad 5x$

When factorised it is x(x - 5)

2 A is half of B.

Work out the ratio $A : B$

Circle your answer.

[1 mark]

1 : 2 $\quad$ 2 : 1 $\quad$ 1 : 3 $\quad$ 3 : 1

The number of parts for A must be half of the number of parts for B

3 The first three terms of a geometric progression are $\frac{2}{3} \quad \frac{4}{9} \quad \frac{8}{27}$

Circle the fourth term.

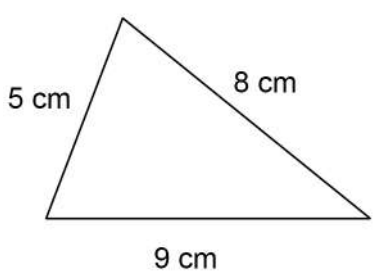
[1 mark]

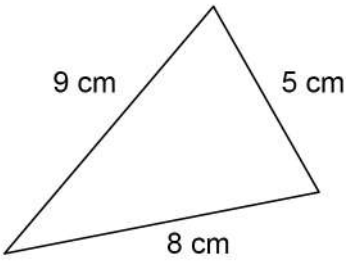
$\frac{10}{81} \quad \frac{14}{81} \quad \frac{16}{81} \quad \frac{32}{81}$

It multiplies by the same amount between each term

Do not write outside the box

4





Not drawn accurately

Circle the reason why these triangles are congruent.

[1 mark]

ASA RHS SAS SSS

A: angle. R: right angle. H: hypotenuse. S: side. ASA means that two angles and a side are the same in both triangles

5 Solve $10x = 62.4 - 3x$

[2 marks]

First eliminate the x term on one side to get all the x on one side. Simplify by collecting like terms if necessary to get one x term. Then eliminate the coefficient of x, the number x is multiplied by, to get x on its own. To eliminate do the opposite operation to both sides

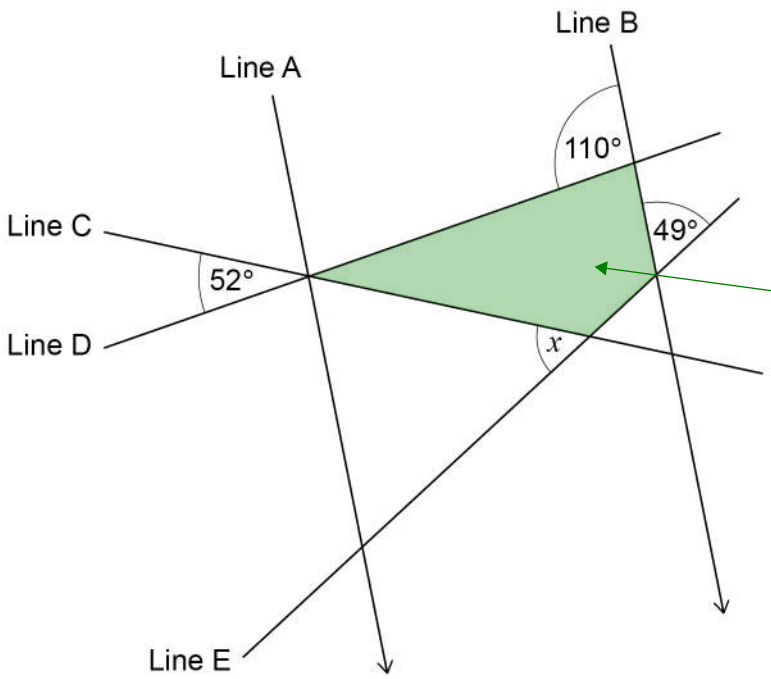
$x =$ _____

6

Do not write outside the box

6 Lines A, B, C, D and E intersect as shown.

Lines A and B are parallel.



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Angles in a quadrilateral add up to 360

Work out the size of angle x.

[3 marks]

Vertically opposite angles are equal. Angles around a point on a straight line add up to 180

Answer _____ degrees

Do not write outside the box

7 102 boys and 85 girls took a test.

The table shows information about the mean marks.

	Boys	Girls
Number of students	102	85
Mean mark	68.5	72.4

The pass mark for the test was 70

Was the mean mark for **all** of these students greater than the pass mark?

You **must** show your working.

[3 marks]

$m^t n$

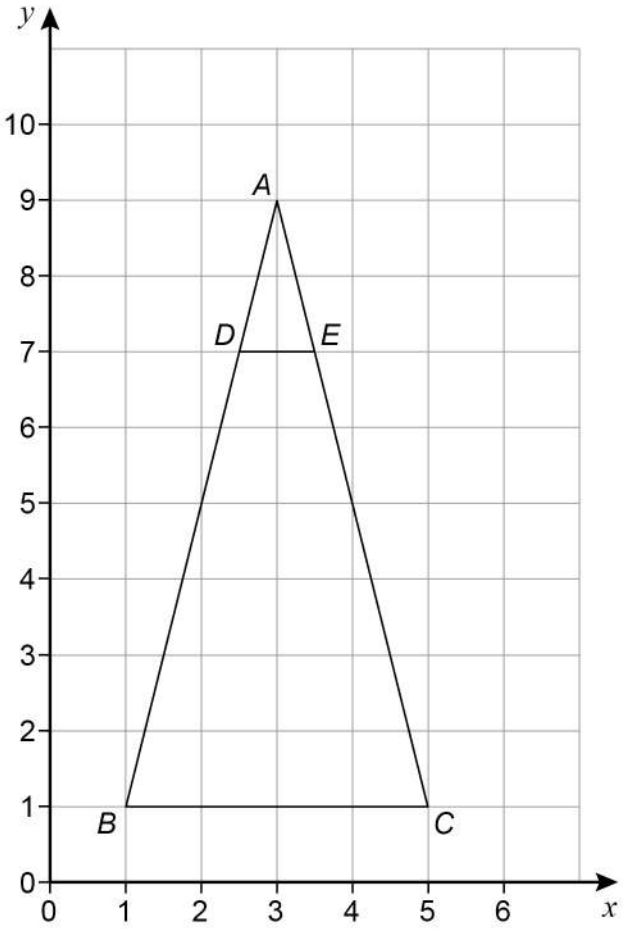
A formula triangle for mean. m: mean. t: total. n: number

Multiplying the number of boys by their mean mark works out the total for the boys. Multiplying the number of girls by their mean mark works out the total for the girls. Adding both of these totals gives the overall total for all of the students. Dividing this by the number of students gives the mean for all the students

6

Do not write outside the box

8



Describe fully the **single** transformation that maps triangle *ABC* to triangle *ADE*.

[3 marks]

Enlargement by scale factor ? from (? , ?)

Do not write outside the box

9 A ball contains 5000 cm^3 of air.

More air is pumped into the ball at a rate of 160 cm^3 per second.

The ball is full of air when it becomes a sphere with radius 15 cm

Volume of a sphere $= \frac{4}{3}\pi r^3$ where r is the radius

Does it take **less than** 1 minute to fill the ball?

You **must** show your working.

[4 marks]

s d t

Quoting the distance, speed, time formula triangle as the volume is basically distance, the rate it is pumped is basically speed and we are calculating time

Subtracting the 5000cm^3 already in the ball from the volume of the ball when full, which can be worked out using the volume of a sphere formula, leaves the volume needed to fill the ball, which can be thought of as the distance. The rate the air is pumped into the ball can be thought of as the speed. The time calculated will be in seconds and can be compared to a minute, which is 60 seconds

7

Do not write outside the box

10 p is a positive number.

n is a negative number.

For each statement, tick the correct box.

[4 marks]

	Always true	Sometimes true	Never true
$p + n$ is positive	☐	☐	☐
$p - n$ is positive	☐	☐	☐
$p^2 + n^2$ is positive	☐	☐	☐
$p^3 \div n^3$ is positive	☐	☐	☐

2 + -1 = 1. 1 + -2 = -1. Subtracting a negative is a double negative so it becomes a positive and a positive add a positive must be positive. Squaring means to multiply by itself and a positive multiplied by a positive is positive and a negative multiplied by a negative is double negative so becomes a positive and a positive add a positive must be positive. A positive cubed is positive and a negative cubed is negative and dividing a positive by a negative gives a negative

Do not write outside the box

11 250 trains arrived at a station.

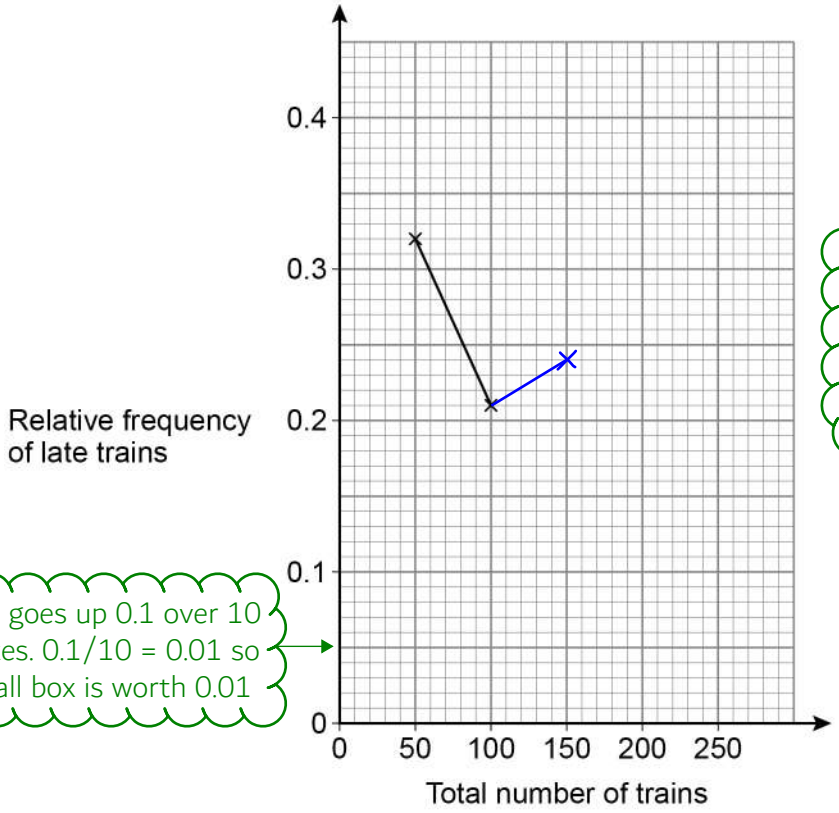
The number of trains that were late was recorded after every 50 trains.

The table shows some information about the results.

Total number of trains	50	100	150	200	250
Total number of late trains	16	21	36	38	55
Relative frequency of late trains	0.32	0.21			

11 (a) Complete the relative frequency graph.

[3 marks]



36/150 = 0.24

Expressing the number of late trains as a fraction of the total number of trains gives the relative frequency. Converting these to decimals so they can be plotted

The scale goes up 0.1 over 10 small boxes. 0.1/10 = 0.01 so each small box is worth 0.01

11 (b) Write down the best estimate of the probability that a train arriving at the station is late.

[1 mark]

Answer _____

Each relative frequency is an estimate of the probability but the best one is the one based on the most trains

8

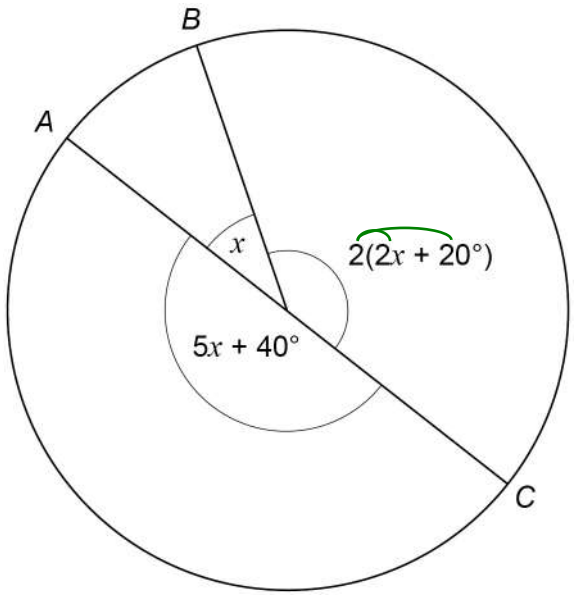
Turn over ►

Do not write outside the box

12 *A*, *B* and *C* are three points on a circle.

The radii from *A*, *B* and *C* are shown.

Not drawn accurately



Is *AC* a diameter of the circle?

You **must** show your working.

[3 marks]

A diameter is a straight line going through the centre of a circle. If the angles above AC are the same as the angle below AC, this must be the case

Do not write outside the box

13 A straight line

has gradient 6

and

passes through the point (3, 19)

Work out the equation of the line.

Give your answer in the form $y = mx + c$

[3 marks]

m is the gradient. Rearrange to make c the subject then substitute in the coordinates from the point and m to find c

Answer _____

Turn over for the next question

6

Do not write outside the box

14 The population of butterflies in a park is 4200

14 (a) Assume that the population increases by 12% each day.

Show that after 20 days the population would be greater than 40 000

[2 marks]

Use the compound interest formula: $P((100 + r)/100)^n$, where P is the amount we start with, r is the percentage change each time and n is the number of times the percentage change is done

14 (b) In fact, the population

increases by 13% each day for 19 days

then

decreases by 8% for 1 day.

After the 20 days, is the actual population greater than 40 000 ?

Tick a box.

☐ Yes ☐ No

Show working to support your answer.

[2 marks]

Use the compound interest formula: $P((100 + r)/100)^n$, where P is the amount we start with, r is the percentage change each time and n is the number of times the percentage change is done

Do not write outside the box

14 (c) The expected number of visitors to the park each day depends on the temperature.

Temperature	Expected number of visitors each day
Less than 21°C	700
21°C or more	900

On each of the 30 days in June

the park is open

the probability that the temperature is less than 21°C is 0.4

Work out the **total** number of expected visitors to the park in June.

[3 marks]

Adding the total number of people expected on the days less than 21°C and the total number of people expected on the days 21°C or more gives the total number of expected visitors. Multiplying the probability of the temperature being less than 21°C by the number of days in June works out an estimate of how many of the days will be less than 21°C. There are 700 visitors on each of these days. It is certain that it is either less than 21°C or 21°C or more so the probabilities have to add up to 1. Multiplying the probability of the temperature being 21°C or more by the number of days in June works out an estimate of how many of the days will be 21°C or more. There are 900 visitors on each of these days

Answer _____

7

Do not write outside the box

15 L is directly proportional to D^2

$L = 85$ when $D = 10$

15 (a) Work out an equation connecting L and D.

[3 marks]

$L = kD^2$

$L \propto D^2$ will be true whatever D^2 is multiplied by. So multiplying it by k, which represents the number it is multiplied by

Rearrange the equation to make k the subject. Then substitute L for 85 and D for 10 to work out k. Substitute the value of k back into the original equation

Answer _____

15 (b) Work out the value of L when $D = 5$

[2 marks]

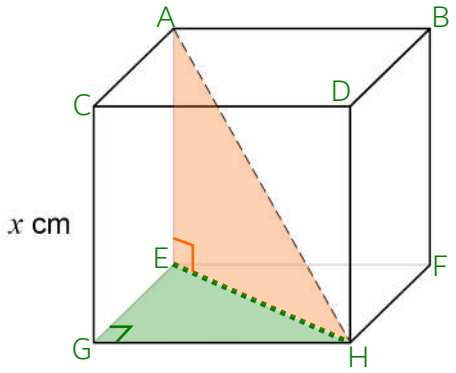
Substitute D for 5 in the equation found in part (a)

Answer _____

Do not write outside the box

16 Here is a cube with edge length x cm

One diagonal is shown.



16 (a) Circle the length, in centimetres, of the diagonal.

[1 mark]

$\sqrt{3}x$ $\sqrt[3]{3x^2}$ $\sqrt{x^3}$ $\sqrt[3]{3}x$

Pythagoras' Theorem can be used on the green right angled triangle to find length EH. It can then be used again on the orange right angled triangle to find length AH. $a^2 + b^2 = c^2$, where c is the longest side and a and b are the shorter sides. It is a cube so all of its edges are x

16 (b) The total length, in centimetres, of the edges of the cube is a multiple of 18

Circle the correct statement.

[1 mark]

x is a whole number | x is not a whole number | x might be a whole number

There are 12 edges on the cube. To work out x, the multiple of 18 would be divided by 12. Not all multiples of 18 are multiples of 12 but there are common multiples of 18 and 12

Turn over for the next question

7

Do not write outside the box

17 20 people were asked which device they used more often, laptop or phone.

The table shows the results.

	Laptop	**Phone**
Male	2	9
Female	4	5

17 (a) One male and one female are chosen at random.

Work out the probability that **exactly** one of them said laptop.

[3 marks]

Male laptop AND female phone OR male phone AND female laptop. AND means to multiply the probabilities. OR means to add the probabilities. There are 11 males in total and 9 females in total

Answer _____

17 (b) Two males are chosen at random.

Work out the probability that they **both** said phone.

[2 marks]

Male phone AND male phone. AND means to multiply the probabilities. On the second pick there is one fewer male in total and one fewer who chose phone

Answer _____

Do not write outside the box

18 On the grid, identify the region represented by

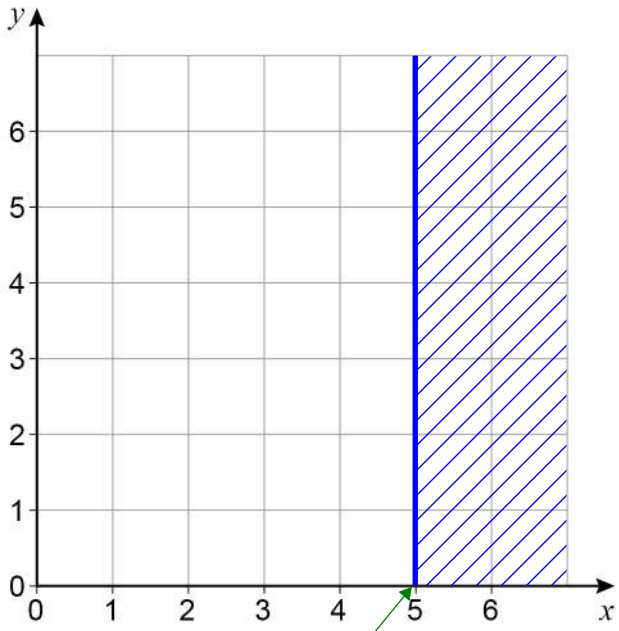
$x \leqslant 5$ $y \leqslant 4$ $x + y > 6$

$y > 6 - x$

Rearranged to make y the subject

Label the region R.

[3 marks]



The line of x = 5. It is solid as x can be equal to 5. Crossing out everything to the right of the line as the region is on the left of the line

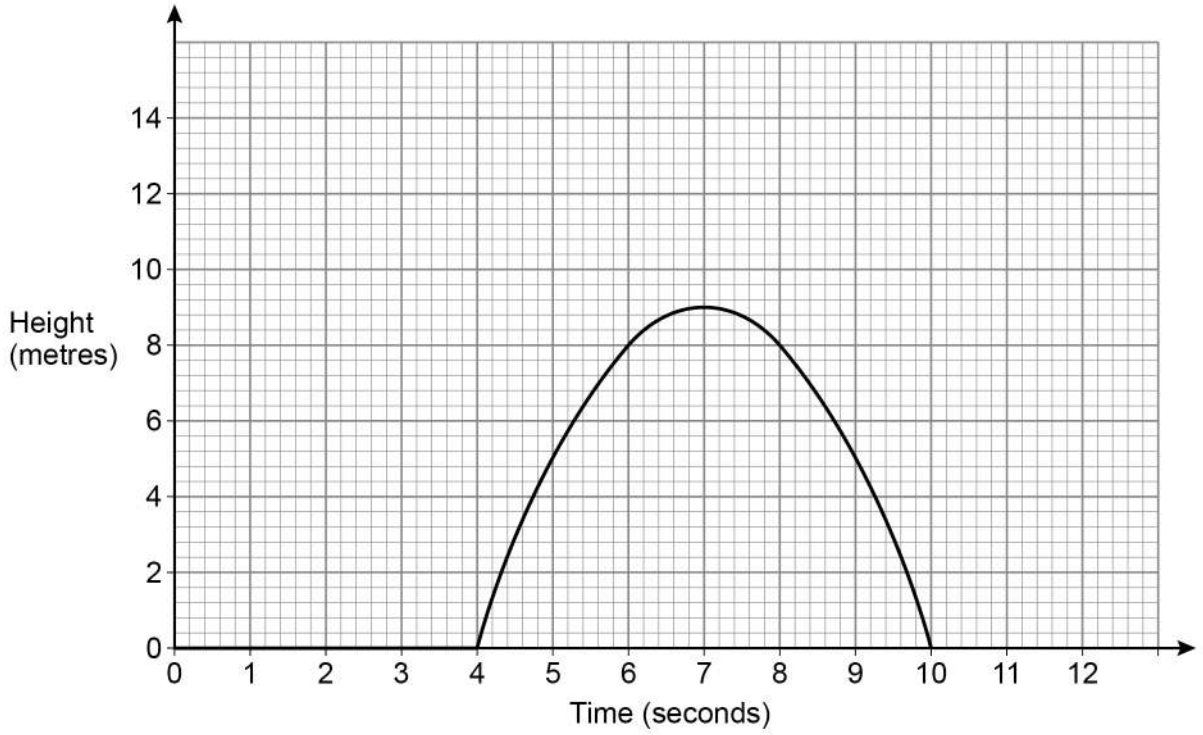
Draw the lines of y = 4 and y = 6 - x. Dash them if the inequality symbol does not involve an equals. Cross out anywhere the region isn't and this will leave the region

Turn over for the next question

8

Do not write outside the box

19 The graph shows the height above ground of a toy rocket for 10 seconds.



19 (a) For how long is the rocket in the air?

Circle your answer.

[1 mark]

10 seconds 9 seconds 6 seconds 4 seconds

The rocket was in the air when its height was more than 0

Do not write outside the box

19 (b) Using the graph, estimate the speed of the rocket after 6 seconds.

State the units of your answer.

[3 marks]

The gradient on a distance-time graph is the speed. Draw a tangent to the curve at 6 seconds to estimate the gradient of the curve at that point. Gradient = (change in y)/(change in x). Work out the unit by considering that the change in y is in metres and the change in x is in seconds and these are divided

Answer _____

20 A square has an area of 0.25 square metres.

Circle the length, in **centimetres**, of one side of the square.

[1 mark]

0.5 cm 5 cm 50 cm 500 cm

Let x be the side length of the the square. x^2 = area = 0.25. Rearranging to find x finds the length in metres

Turn over for the next question

5

Do not write outside the box

21 x is an integer.

Prove that $35 + (3x + 1)^2 - 2x(4x - 3)$ is a square number.

[4 marks]

Expand the square bracket using 'square the first term, double the product of the two terms, square the last term'. Expand the other bracket. Collect like terms to simplify. Factorise the expression which should be in the form $ax^2 + bx + c$ by finding two numbers which add together to give b and multiply to c and putting these in brackets with x. Both brackets should be the same so it can be expressed as a square bracket, which shows it is a square number

Do not write outside the box

22 Liam is trying to remember a 3-digit code.

He knows the rule that

the first digit is a cube number

the second digit is a factor of 16

the third digit is an odd number.

Liam tries at random a code that matches the rule.

Work out the probability that this is the correct code.

[4 marks]

List the single digit cube numbers. List the single digit factors of 16. List the single digit odd numbers. Use the product rule for counting by multiplying the number of outcomes for each digit together to work out how many possible codes there are. 1 out of these is correct

Answer _____

8

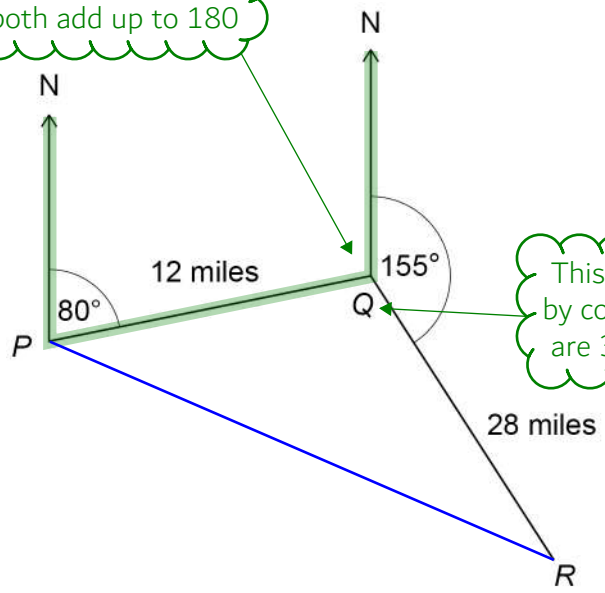
Do not write outside the box

23 A ship sails from *P* to *Q* and then from *Q* to *R*.

Q is 12 miles from *P*, on a bearing of 080°

R is 28 miles from *Q*, on a bearing of 155°

This angle is co-interior to the 80° angle so they both add up to 180



Not drawn accurately

This angle can be found by considering that there are 360° around a point

Work out the direct distance from *P* to *R*.

[4 marks]

$a^2 = b^2 + c^2 - 2bc\cos A$

It is not a right angled triangle so Pythagoras' Theorem can't be used. There aren't two pairs of opposite sides and angles so the sine rule can't be used. Therefore the cosine rule needs to be used

Side a is opposite angle A, which must be angle PQR. b and c are the other sides

Answer _____ miles

Do not write outside the box

24 The flight of a plane was in two stages.

The table shows information about the flight.

	Distance (miles)	Speed (mph)	Time (hours)
1st stage	731	x	$\frac{731}{x}$
2nd stage	287	$x - 24$	$\frac{287}{x - 24}$

In total, the flight lasted 2 hours.

Work out the value of x.

[5 marks]

The distances and speeds are irrelevant so can be ignored. Adding the times must give 2. Using this fact an equation in terms of x can be created. Multiply all terms on both sides by any denominators to eliminate them. Expand any brackets this creates. Bring into the quadratic form $ax^2 + bx + c = 0$ so that it can be solved using the quadratic formula:

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

Answer _____

9

Do not write outside the box

25 The equation of a curve is $y = x^2 + 14x + 52$

By completing the square, work out the coordinates of the turning point.

You **must** show your working.

[3 marks]

Complete the square: $y = x^2 + bx + c$ becomes $y = (x + b/2)^2 + c - (b/2)^2$.
The turning point occurs when the $(x + b/2)^2 = 0$ as this is the minimum a squared number can be. Work out what x and y are when this is the case

Answer (_____ , _____)

END OF QUESTIONS

3