AQA

.CG Maths.
Hints

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE MATHEMATICS

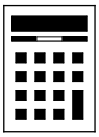
H

Higher Tier Paper 3 Calculator

Tuesday 12 June 2018 Morning 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.
- 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 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

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Answer **all** questions in the spaces provided

Do not write outside the box

1 Circle the decimal that is closest in value to $\frac{11}{20}$

[1 mark]

0.56 0.6 0.525 0.5

Subtract each of the decimals from 11/20 to work out the distance between each decimal and the 11/20. The result which has the smallest magnitude (amount ignoring any negative signs) is the closest

2 Circle the list of **all** the integers that satisfy $-2 < x \leqslant 4$

[1 mark]

–2, –1, 0, 1, 2, 3 –1, 0, 1, 2, 3

–2, –1, 0, 1, 2, 3, 4 –1, 0, 1, 2, 3, 4

The integers which are greater than -2 and less than or equal to 4

3 Circle the largest number.

[1 mark]

The dots above the digits mean they recur, so they keep repeating

3.27 3.27 3.277 3.207

3.2777... 3.2700

Writing each number truncated to 4 decimal places is enough to work out which is largest

Do not write outside the box

4 What is the size of an exterior angle of a regular decagon?

Circle your answer.

[1 mark]

18° 36° 144° 162°

The sum of the exterior angles in any polygon is 360. Decagons have 10 sides and 10 exterior angles and the shape is regular meaning all of them are the same

5 a is a common factor of 72 and 120

b is a common multiple of 6 and 9

Work out the highest possible value of $\frac{a}{b}$

[4 marks]

Express the highest common factor of 72 and 120 over the lowest common multiple of 6 and 9. The HCF of 72 and 120 is found by expressing them both as a product of prime factors then multiplying together the lowest power of each prime in both. The LCM of 6 and 9 is found by counting up in 9s until a multiple of 6 is reached

FACT 8 o , ,,

To express a number as a product of prime factors, enter the number, press =, SHIFT then FACT (the button on the left)

Answer _____

Turn over for the next question

8

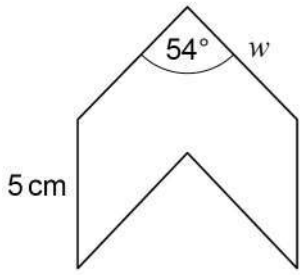
Do not write outside the box

6 A and B are similar shapes.

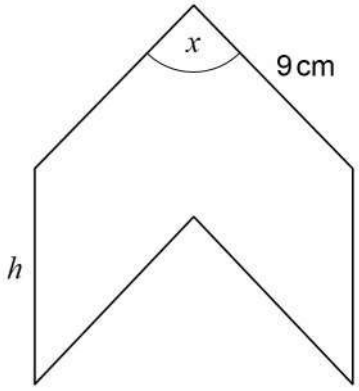
B is an enlargement of A with scale factor 1.5

Not drawn accurately

A



B



Work out the values of x, h and w.

[3 marks]

The angles in similar shapes are the same. Multiplying by the scale factor works out the bigger version of the same side. Dividing by the scale factor works out the smaller version of the same side

x = _____ degrees

h = _____ cm

w = _____ cm

Do not write outside the box

7 Investment A Save £150 per month for 2 years.
2.5% interest is added to the total amount saved.

Investment B Invest £3500
Compound interest is added at 3% per year.

After 2 years, how much **more** is investment B worth than investment A?

[4 marks]

Subtracting the worth of investment A from the worth of investment B works out the difference and therefore how much more investment B is worth than investment A. To increase by x%, multiply by (100 + x)/100. Multiply by this twice (or raise it to the power of 2) to increase by x% twice. There are 12 months in a year so multiplying the amount saved per month in investment B by this works out how much is saved in 1 year

Answer £_____

Turn over for the next question

7

Do not write outside the box

8 (a) Show that the lines $y = 3x + 7$ and $2y - 6x = 8$ are parallel.

Do **not** use a graphical method.

[3 marks]

Parallel lines have the same gradient. Rearrange both equations into the form y = mx +c, where m is the gradient

8 (b) Is the point (–5, –6) above, below or on the line $y = 3x + 7$?

Tick **one** box.

☐ Above ☐ Below ☐ On the line

You **must** show your working.

Do **not** use a graphical method.

[2 marks]

Substitute the x coordinate of the point into the equation to find what y should be on the line. Compare -6 to the value it should be

Do not write outside the box

9 The cost of a ticket increases by 10% to £19.25

Work out the original cost.

[3 marks]

If it is increased by 10%, it is now at 110% of the original value. Dividing by 110 works out 1% of the original value. Multiplying by 100 works out 100%, the full amount, of the original value

Answer £ _____

10 The nth term of a sequence is $12n - 5$

Work out the numbers in the sequence that

have two digits

and

are **not** prime.

[3 marks]

Using table mode by pressing MENU then 3. f(x) = 12x - 5. Ignore g(x). Start: 1. End: 30. Step: 1

This lists out the sequence up to the 30th term. Write down the ones which have two digits

FACT 8

Enter each number, press = then SHIFT then FACT (the button on the left)

This expresses each number as a product of prime factors. If it comes back as itself it must be prime

Answer _____

11

Do not write outside the box

11 $\mathbf{a} = \begin{pmatrix} 6 \\ -10 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ $\mathbf{c} = \begin{pmatrix} -4 \\ 7 \end{pmatrix}$

11 (a) Work out $\mathbf{a} + \mathbf{b} + \mathbf{c}$

[2 marks]

Add together the x components and y components separately. Column vectors are in the form $\binom{x}{y}$

Answer ( )

11 (b) Show that $\mathbf{a} + 2\mathbf{c}$ is parallel to $\mathbf{b}$

[2 marks]

Work out the x components and y components separately. $z\binom{x}{y} = \binom{zx}{zy}$. After working out a + 2c as a column vector, express it as a multiple of vector b

Do not write outside the box

12 $\text{pressure} = \dfrac{\text{force}}{\text{area}}$

A force of 40 Newtons is applied to an area of 3.2 square metres.

Work out the pressure.

Give the units of your answer.

[2 marks]

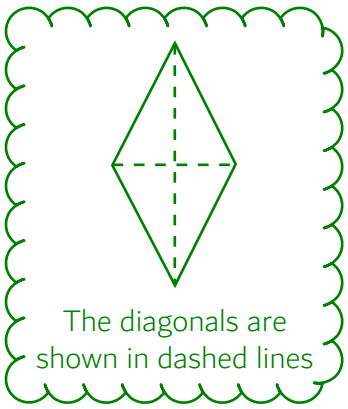
Dividing the force by the area works out the pressure. To work out the unit, consider than the force in Newtons (represented by N) is divided by the area in square metres. Per (represented by /) means to divide

Answer _____

13 Tick **all** the statements that are true for any rhombus.

[1 mark]

- ☐ The diagonals are lines of symmetry
- ☐ The diagonals bisect each other
- ☐ The diagonals are perpendicular
- ☐ The diagonals are equal in length



The diagonals are shown in dashed lines

Turn over for the next question

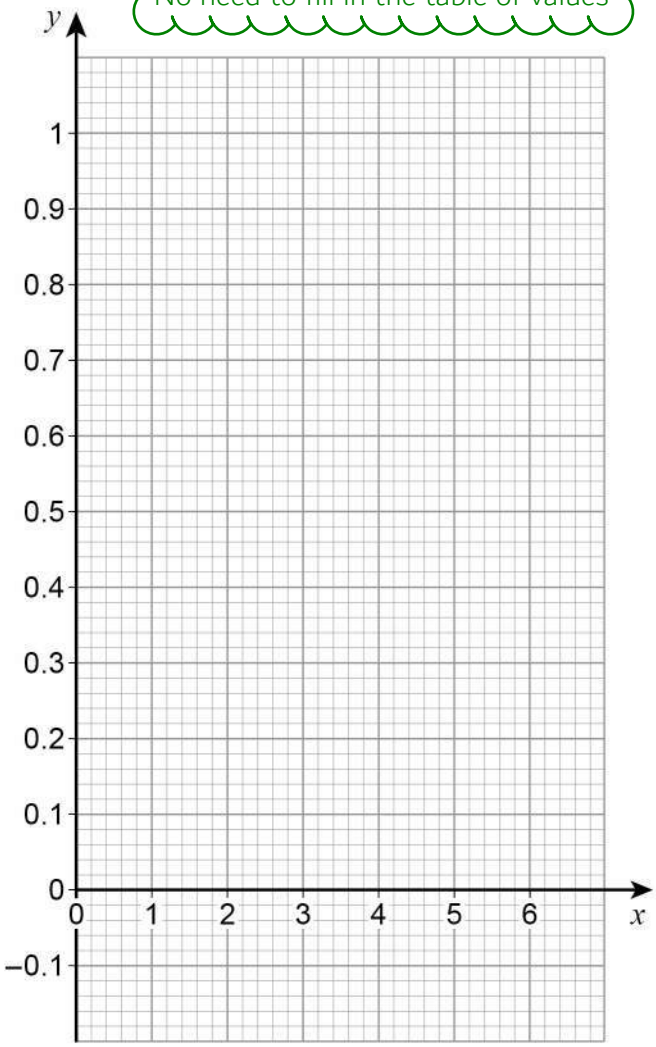
7

14 Draw the graph of $y = 0.8^x$ for values of x from 0 to 6

[3 marks]

x	0	1	2	3	4	5	6
y							

No need to fill in the table of values



Using table mode by pressing MENU then 3. $f(x) = 0.8^x$. Ignore g(x). Start: 0. End: 6. Step: 1

This gives a table of values on the calculator. The points can be plotted to the nearest half a box by rounding each of the values to 2 decimal places

Do not write outside the box

15 Amy has x beads.

Billy has three more beads than Amy.

Carly has four times as many beads as Billy.

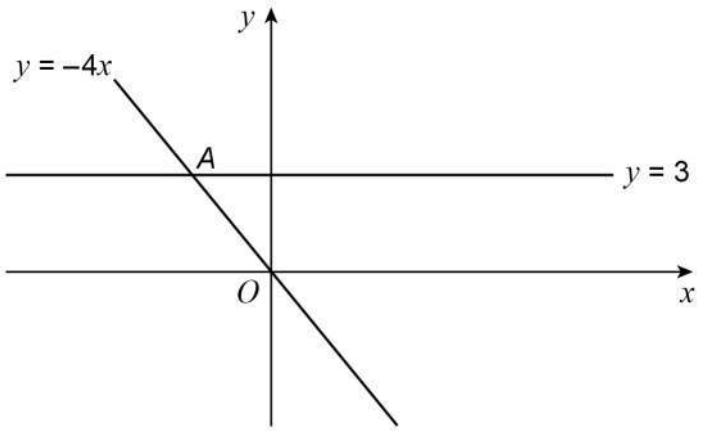
Circle the expression for the number of beads that Carly has.

[1 mark]

$4x + 3$ $3x + 4$ $4(x + 3)$ $x + 12$

Billy has x + 3. Multiplying this by 4 expresses how many Carly has

16 Two straight lines intersect at point *A*.



Not drawn accurately

Circle the coordinates of *A*.

[1 mark]

$(-\frac{3}{4}, 3)$ $(-4, 3)$ $(-12, 3)$ $(-\frac{4}{3}, 3)$

The y coordinate must be 3 as it is on the line y = 3. Doing simultaneous equations finds the coordinates of intersection

5

Do not write outside the box

17 Here are two methods to make a 4-digit code.

Codes can have repeated digits.

Method A

For the first two digits use an odd number between 30 and 100

For the last two digits use a multiple of 11

Method B

Use four digits in the order even odd even odd

Do **not** use the digit zero

Which method gives the **greater** number of possible codes?

You **must** show your working.

[3 marks]

Using the product rule for counting works out the total number of possible codes by multiplying the number of possibilities for the first two and last two digits in method A and by multiplying the number of possibilities for each digit in method B.

Answer _____

Do not write outside the box

18 Show that, for $x \neq 0$

$$\frac{x+4}{3x} - \frac{5}{2x}$$

can be written in the form $\frac{ax+b}{cx}$ where a, b and c are integers.

[3 marks]

To subtract fractions the denominators need to be the same. Multiply both denominators by a value so that they are the same and multiply the numerators by the same as what its denominator was multiplied by to keep them equivalent. Then the numerators can be subtracted

Answer _____

19 The equation of a straight line is $3x + 2y = 24$

Circle the point where the line crosses the x-axis.

[1 mark]

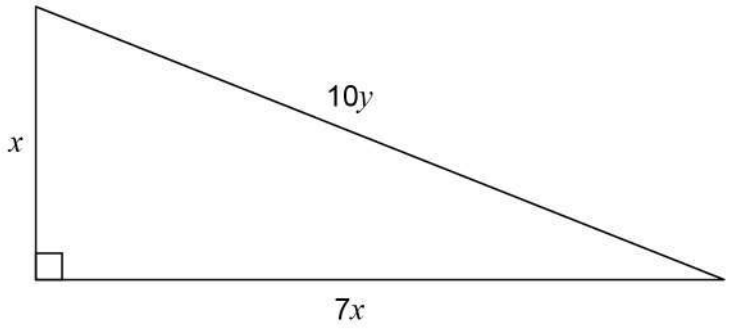
(0, 8) (12, 0) (0, 12) (8, 0)

y = 0 when the line crosses the x-axis

7

Do not write outside the box

20 All dimensions are in centimetres.



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Use Pythagoras' theorem to work out the exact value of $\frac{x}{y}$

[3 marks]

Pythagoras' theorem: $a^2 + b^2 = c^2$, where c is the longest side and a and b are the shorter sides. Substitute in the sides, expand the square brackets, simplify by collecting like terms then rearrange to get x^2/y^2. Square rooting both sides then finds x/y

Answer _____

Do not write outside the box

21 The mass of an ornament is m grams.

The height of the ornament is h centimetres.

m is directly proportional to the cube of h.

m = 1600 when h = 8

21 (a) Work out an equation connecting m and h.

[3 marks]

$m = kh^3$

m ∝ h^3. The right side of the proportion can be multiplied by anything and still be directly proportional. Using k to represent what it is multiplied by to convert it into an equation

Rearrange to make k the subject then substitute in the values of m and h given, which must satisfy the equation, to find k

Answer _____

21 (b) Work out the mass of an ornament of height 12 centimetres.

[2 marks]

Make m the subject, if it isn't already, in the equation found in part (a) so that it tells us how to find m. Substitute in 12 for h

Answer _____ grams

Turn over for the next question

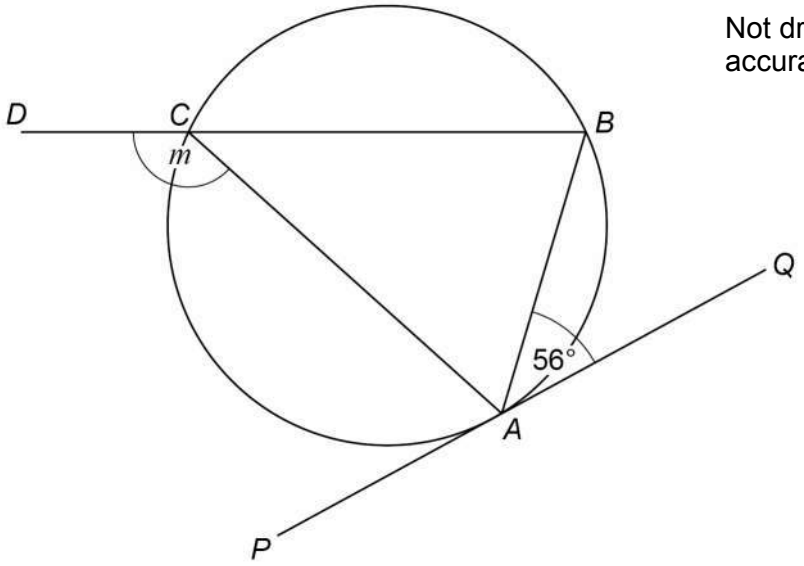
8

Do not write outside the box

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

DCB is a straight line.

PAQ is a tangent to the circle.



Sam is trying to work out the size of angle m.

Here is his working.

angle *ACB* = 56°	angles in the same segment are equal
m = 180° – 56°	angles at a point on a straight line add up to 180°
m = 124°	

Make a criticism of his working.

[1 mark]

Do not write outside the box

23 A sequence of numbers is formed by the iterative process

$$u_{n+1} = \frac{3}{u_n + 1}, \qquad u_1 = 4$$

Work out the values of u_2 and u_3

[2 marks]

Enter 4 then press =. Enter 3/(ANS + 1) then press = to get u_2. Press = again to get u_3

$u_2 =$ _____

$u_3 =$ _____

Turn over for the next question

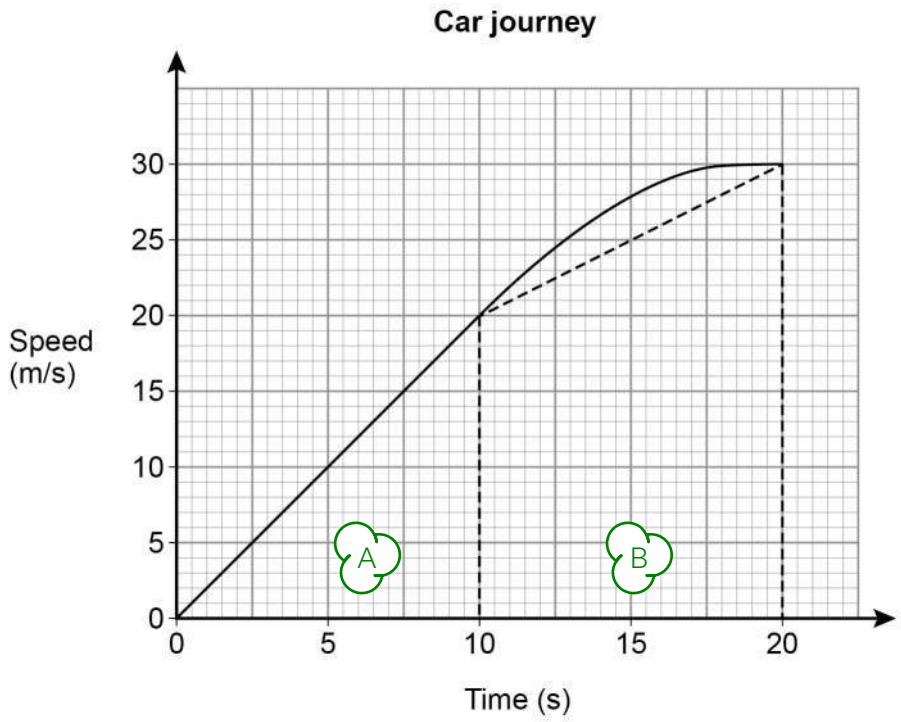
3

Do not write outside the box

24 The speed-time graph shows 20 seconds of a car journey.

Harry wants to estimate the distance the car travels in this time.

He uses a triangle and a trapezium, as shown, to estimate the area under the graph.



24 (a) Complete Harry's method to estimate the distance the car travels.

[3 marks]

Adding the area of shapes A and B works out an estimate of the total area under the graph, which is an estimate of the distance. Area of triangle = 1/2 x base x height. Area of trapezium = 1/2 (a + b)h, where a and b are the parallel sides and h is the distance between them

Answer _____ m

Do not write outside the box

24 (b) For this journey, which of these is true for Harry's method?

Tick **one** box.

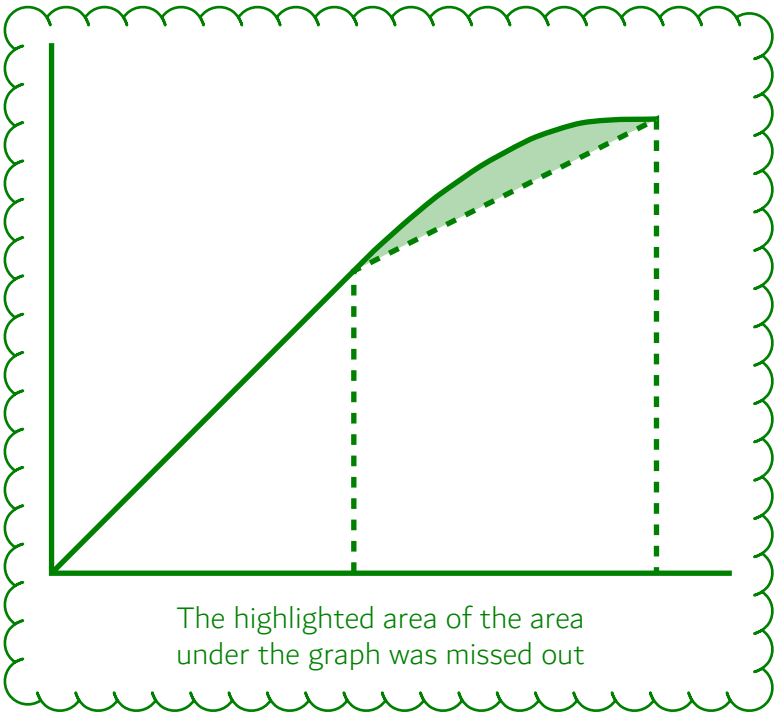
[1 mark]

☐ It works out an overestimate of the distance

☐ It works out an underestimate of the distance

☐ It could work out an overestimate or an underestimate of the distance

Turn over for the next question



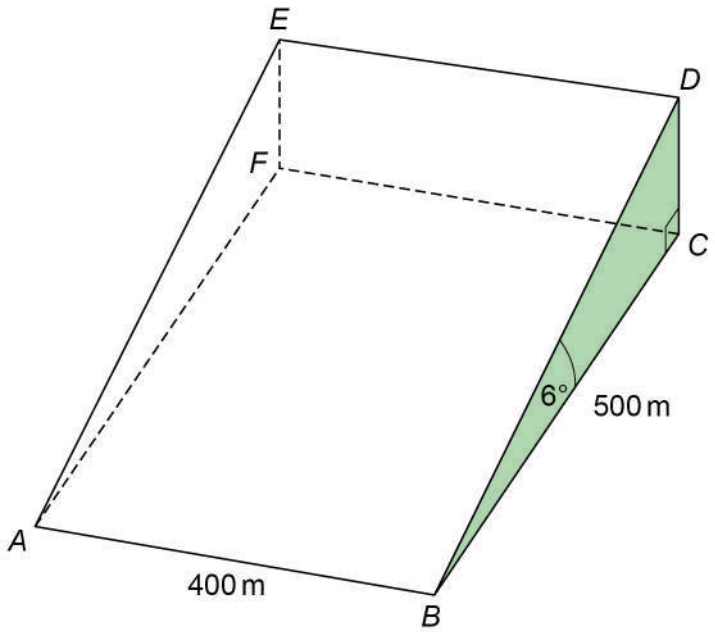
4

Do not write outside the box

25 *ABCDEF* is a triangular prism which represents part of a hill.

ABCF is the horizontal rectangular base.

D is vertically above *C*.



25 (a) Work out the height *CD*.

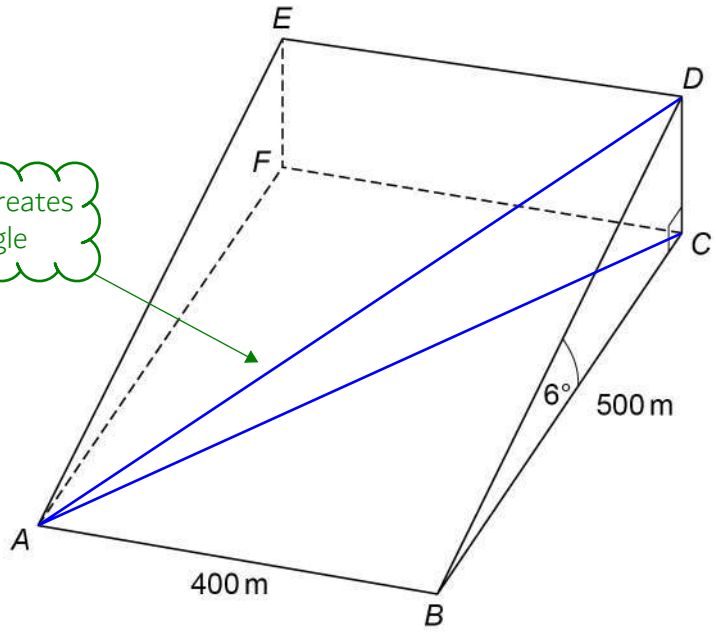
[2 marks]

SOHCAHTOA ← Right angled trigonometry can be used on the highlighted triangle

Answer _____ m

Do not write outside the box

25 (b) Jamil walks in a straight line from *A* to *D*.



Drawing on the angle creates a right angled triangle

Work out the size of angle *DAC*.

You **must** show your working.

[4 marks]

$S^{O}H\,C^{A}H\,T^{O}A$ ← Right angled trigonometry can be used to find the angle

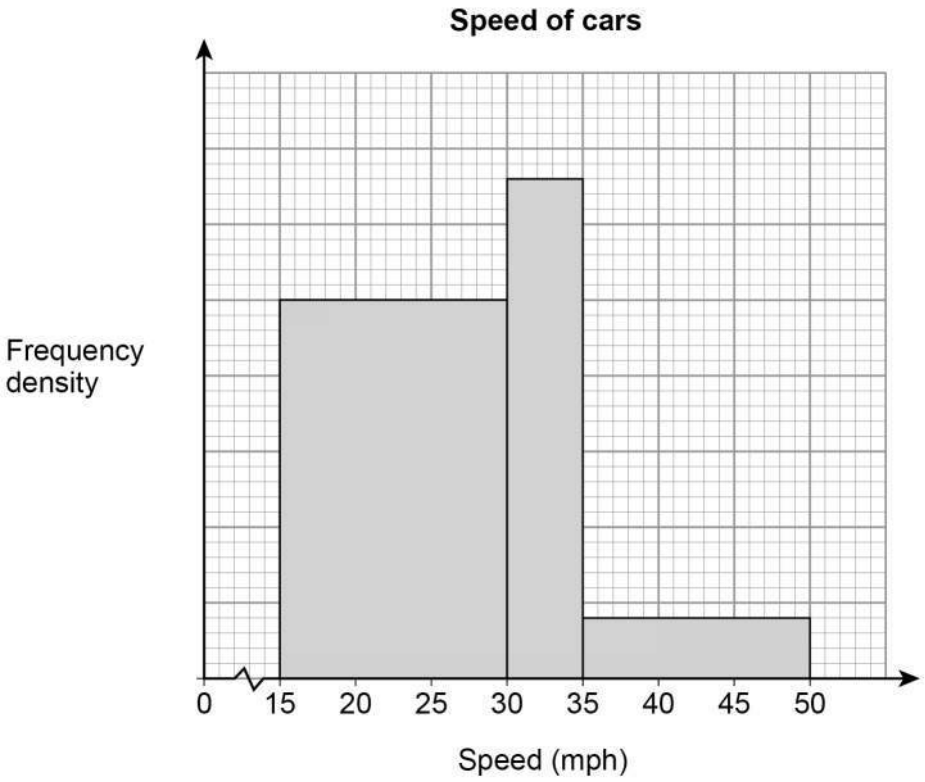
$a^2+b^2=c^2$ ← Stating Pythagoras' theorem, where c is the longest side and a and b are the shorter sides. This can be used to find side AC in right angled triangle ABC

Answer _____ degrees

6

26 The histogram shows information about the speed of cars as they pass a checkpoint.

The scale on the frequency density axis is missing.



The histogram shows information about 480 cars.

26 (a) How many cars does the first bar represent?

[4 marks]

Let x be the frequency density represented by one small box. Frequency = class width x frequency density. Adding all of the expressions for the frequencies of each bar together represents the total frequency. Form an equation which can be solved to find x. Then work out the frequency of the first bar now that we know the scale on the frequency density axis

Answer _____

Do not write outside the box

26 (b) Cars with a speed greater than 40 mph are over the speed limit.

Use the histogram to estimate the number of cars that are over the speed limit.

[2 marks]

Splitting the last bar gives a bar from 40mph to 50mph. Frequency = class width x frequency density

Answer _____

Turn over for the next question

6

Do not write outside the box

27 A bag contains 30 discs.

10 are red and 20 are blue.

One disc is taken out at random and replaced by **two** of the other colour.

Another disc is then taken out at random and replaced by **two** of the other colour.

Another disc is then taken out at random.

Work out the probability that all three discs taken out are **red**.

[3 marks]

Red AND red AND red. AND means to multiply the probabilities. There is one fewer red each time but one more in total each time, as one is taken out and two are added in

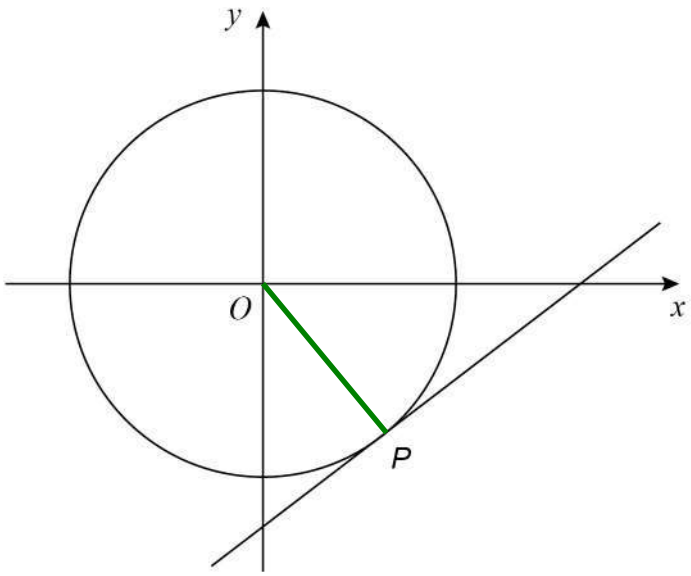
Answer _____

Do not write outside the box

28 *P* is a point on the circle with equation $x^2 + y^2 = 80$

P has x-coordinate 4 and is below the x-axis.

Not drawn accurately



Work out the equation of the tangent to the circle at *P*.

[5 marks]

The tangent is a straight line. The general equation of a straight line is y = mx + c, where m is the gradient and c is a constant which can be found by rearranging the equation and substituting in the gradient and the x and y coordinate of a point on the line. The gradient of the tangent is the negative reciprocal of the gradient of the radius drawn above as they are perpendicular. Gradient = (change in y)/(change in x). The y coordinate of P can be found by making y the subject of the equation of the circle and substituting in the x coordinate of P. As it is below the x-axis it must be negative

Answer _____

END OF QUESTIONS

8