

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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# GCSE MATHEMATICS

# H

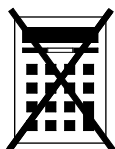
Higher Tier      Paper 1 Non-Calculator

Thursday 2 November 2017      Morning      Time allowed: 1 hour 30 minutes

### Materials

For this paper you must have:

- mathematical instruments



You must **not** use a calculator.

### Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- 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.

| 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              |      |
| 26–27              |      |
| <b>TOTAL</b>       |      |

### 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](mailto:curtis@cgmaths.co.uk)

Answer **all** questions in the spaces provided

- 1 Work out  $\sqrt{2^6 + 6^2}$   
Circle your answer.

[1 mark]

10                      14                      50                      100

$2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2$ . Keep doubling works this out as 2, 4, 8, 16, 32, 64.  $6^2 = 6 \times 6 = 36$ .  $64 + 36 = 100$ .  $\sqrt{100} = 10$

- 2 What is 800 million in standard form?  
Circle your answer.

[1 mark]

$800 \times 10^6$                        $8 \times 10^8$                        $8 \times 10^9$                        $0.8 \times 10^{10}$

$800 = 8 \times 10^2$ . A million =  $10^6$ .  $8 \times 10^2 \times 10^6 = 8 \times 10^8$

- 3 Circle the expression that is equivalent to  $(4a^5)^2$

[1 mark]

$16a^{10}$                        $16a^7$                        $8a^{10}$                        $8a^7$

$4^2 = 16$ .  $(a^5)^2 = a^{10}$



4  $y = \frac{10}{x}$

If the value of  $x$  doubles, what happens to the value of  $y$ ?

Circle your answer.

[1 mark]

$\div 2$ 
  $\times 2$ 
  $\div 5$ 
  $\times 5$

Doubling the denominator means dividing by twice the amount, which is basically dividing by 2

5 (a) Factorise  $x^2 - 100$

[1 mark]

Answer  $(x+10)(x-10)$

Factorised using difference of two squares.  $A^2 - B^2 = (A + B)(A - B)$

5 (b) Solve  $7x + 6 > 1 + 2x$

[2 marks]

$5x > -5$

Subtracting  $2x$  from both sides to get the  $x$  terms on the same side and subtracting 6 from both sides to get them on their own

Dividing both sides by 5

Answer  $x > -1$



6 Work out the value of  $(\sqrt{3})^2 \times (\sqrt{2})^2$

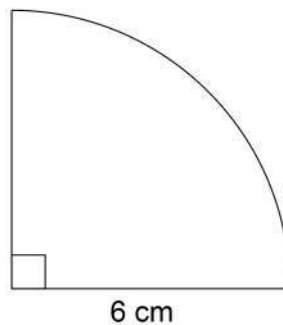
[2 marks]

$$3 \times 2$$

The square and the square root cancel out as they are opposites

Answer 6

7 Here is a quarter circle of radius 6 cm



Not drawn accurately

Work out the area of the quarter circle.

Give your answer in terms of  $\pi$ .

[2 marks]

$$\frac{1}{4} \pi \times 6^2$$

Area of circle =  $\pi \times \text{radius}^2$ . Doing a quarter of this as it is a quarter circle

Answer  $9\pi$   $\text{cm}^2$

$6^2 = 36$ . Multiplication can be done in any order so  $1/4 \times 36 = 36/4 = 9$ .  $\pi$  is left in the answer as it needs to be in terms of  $\pi$



- 8 Three **whole** numbers are each rounded to the nearest 10  
The sum of the rounded numbers is 70

Work out the **maximum** possible sum for the original three numbers.

[2 marks]

$$30 + 20 + 20 = 70$$

These could be the three numbers  
when rounded to the nearest 10

$$34 + 24 + 24 = 82$$

These are the highest the three whole  
numbers could be and still round down

Answer 82

- 9 Circle the expression for the range of  $n$  consecutive integers.

[1 mark]

$$\frac{n+1}{2}$$

$$n-1$$

$$n$$

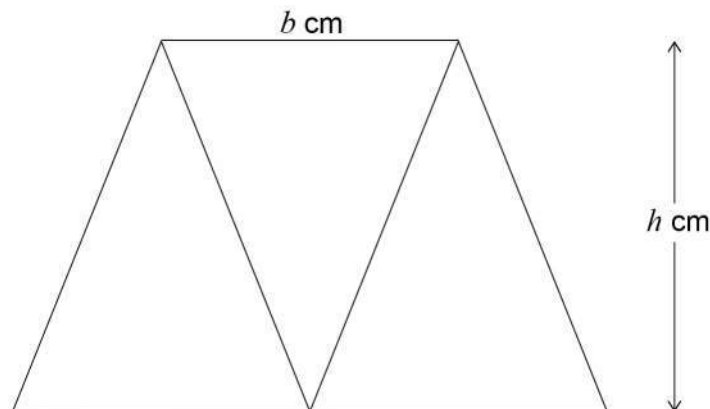
$$n+1$$

Take for example the consecutive integers 4, 5, 6, 7. There are 4 of them  
so  $n$  is 4. The range is largest - smallest =  $7 - 4 = 3$ . Only  $n - 1$  works

Turn over for the next question



- 10** Three identical isosceles triangles are joined to make this trapezium.  
Each triangle has base  $b$  cm and perpendicular height  $h$  cm



- 10 (a)** Work out an expression, in terms of  $b$  and  $h$ , for the area of the trapezium.  
Give your answer in its simplest form.

[2 marks]

$$\frac{1}{2}bh \times 3$$

Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $b$  is the base and  $h$  is the height. Multiplying the area of one of the triangles by 3 expresses the area of the trapezium as it is made of 3 identical triangles

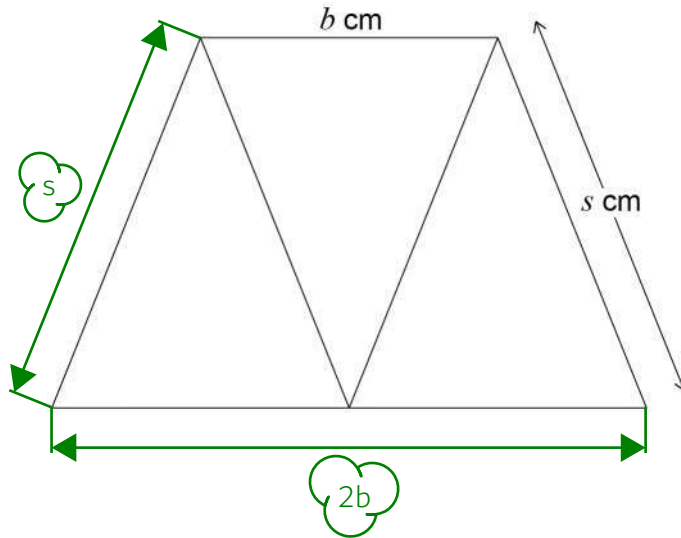
Multiplication can be done in any order so the  $\frac{1}{2} \times 3$  is done first to give  $\frac{3}{2}$

Answer  $\frac{3}{2}bh$  cm<sup>2</sup>



10 (b) This diagram shows the same trapezium.

Not drawn  
accurately



$$b : s = 2 : 3$$

Work out an expression, in terms of  $b$ , for the perimeter of the trapezium.

[2 marks]

$s$  is  $\frac{3}{2} \times b$  as 3 is  $\frac{3}{2} \times 2$ . Adding all of the outside edges together expresses the perimeter. There is no need to simplify the expression

Answer  $b + 2b + \frac{3}{2}b + \frac{3}{2}b$  cm

Turn over for the next question

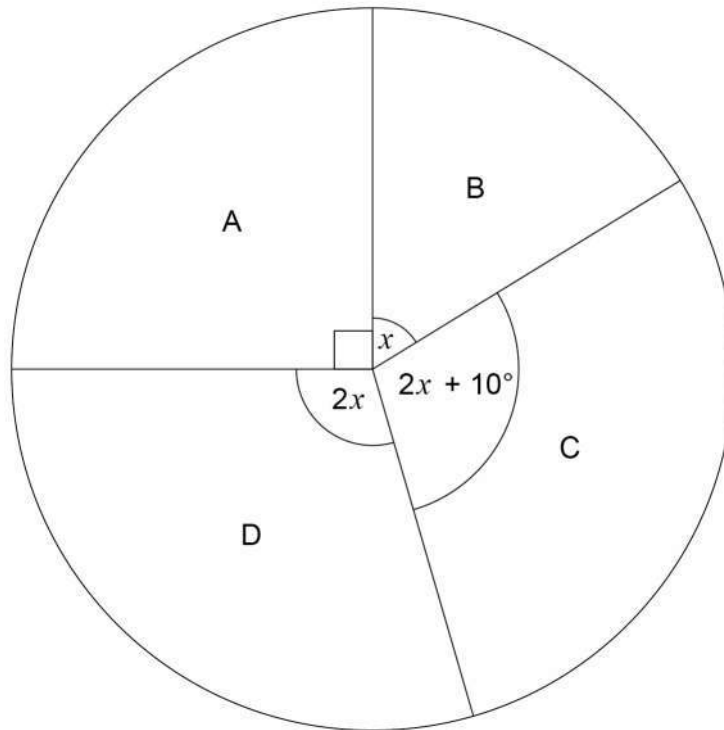
Turn over ►





- 11 The four candidates in an election were A, B, C and D.  
The pie chart shows the proportion of votes for each candidate.

Proportion of votes

Not drawn  
accurately

Work out the probability that a person who voted, chosen at random, voted for C.

[4 marks]

$$90 + x + 2x + 10 + 2x = 360$$

Adding all of the  
angles must give 360

$$5x + 100 = 360$$

Collecting like terms to simplify and then subtracting  
100 from both sides to get the x term on its own

$$5x = 260$$

$$\begin{array}{r} 052 \\ 5 \overline{)260} \end{array}$$

Dividing 260 by 5 works out x

$$\begin{array}{r} 52 \\ \times 2 \\ \hline 104 + 10 \end{array}$$

Working out the angle for C

Answer

$$\frac{114}{360}$$

114 out of the 360  
degrees represent C



12

Use approximations to 1 significant figure to estimate the value of

$$\frac{0.526 \times 39.6^2}{\sqrt{97.65}}$$

You **must** show your working.**[3 marks]**

$$40^2$$

39.6 to 1 significant figure is 40.  $4^2 = 16$  so  $40^2 = 1600$

$$0.5 \times 1600$$

0.526 to 1 significant figure is 0.5.  $0.5 = 1/2$  so multiplying by 0.5 is basically dividing by 2.  $1600/2 = 800$

$$\frac{800}{10}$$

97.65 to 1 significant figure is 100.  $\sqrt{100} = 10$ .  
Dividing by 10 removes a zero from the end

Answer 80

**Turn over for the next question**

Turn over ►



13

$x : y = 7 : 4$

$x + y = 88$

Work out the value of  $x - y$ **[3 marks]**

$7 + 4$

$88 \div 11$

$8 \times 7$

$8 \times 4$

$$\begin{array}{r} 56 \\ - 32 \\ \hline 24 \end{array}$$

There are 11 parts in total and these represent a total of 88. Dividing 88 by 11 works out what 1 part is worth

Multiplying the worth of 1 part by 7 and 4 works out the value of x and y

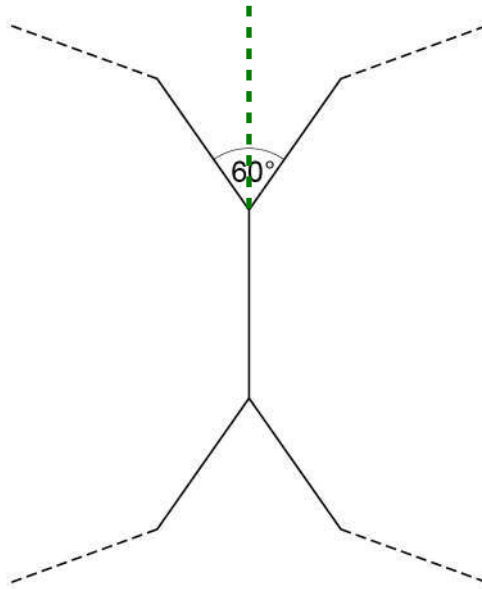
Subtracting the value of y from the value of x

Answer \_\_\_\_\_

24



- 14 Two congruent regular polygons are joined together.



Work out the number of sides on each polygon.

[3 marks]

$$60 \div 2$$

The line drawn above divides the angle into 2 and creates exterior angles of both of the polygons

$$30 \overline{) 360} \begin{array}{r} 012 \\ \underline{30} \\ 360 \\ \underline{360} \\ 0 \end{array}$$

The sum of the exterior angles of a polygon is  $360^\circ$ . As they are regular, all of the exterior angles are the same. So dividing  $360^\circ$  by the exterior angle of  $30^\circ$  works out how many exterior angles there are. There are as many sides as there are exterior angles

Answer

12

Turn over for the next question



15

**Meal Deal**

Choose one sandwich, one drink and one snack

There are

7 different sandwiches

5 different drinks

and

3 different snacks.

15 (a) How many different Meal Deal combinations are there?

[2 marks]

$$\begin{array}{r} 35 \\ \times 3 \\ \hline 105 \end{array}$$

The product rule for counting can be used. Multiplying the number of possible outcomes of each individual event works out the total number of possible outcomes. So  $7 \times 5 \times 3$  works out the number of combinations.  $7 \times 5 = 35$  then multiplying this by 3

Answer 105

15 (b) Two of the sandwiches have cheese in them.

Three of the drinks are fizzy.

Eva picks a Meal Deal at random.

Work out the probability that the sandwich has cheese in it **and** the drink is fizzy.

Give your answer as a fraction.

[2 marks]

$$2 \times 3 \times 3$$

Using the product rule for counting again to work out how many combinations there are where the sandwich has cheese in it and the drink is fizzy. There are also still 3 different snacks

Answer  $\frac{18}{105}$

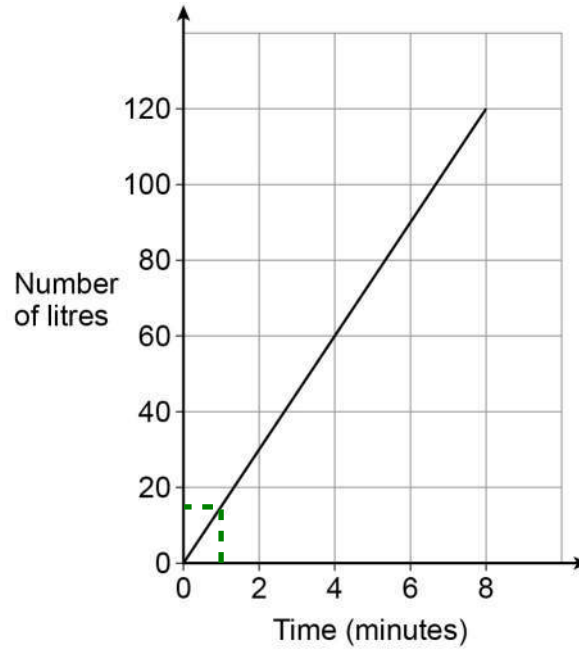
18 out of the 105 possible combinations are where the sandwich has cheese in it and the drink is fizzy



16

Water is poured into a tank.

The graph shows the number of litres of water in the tank.



How much water is poured into the tank each minute?

Circle your answer.

[1 mark]

1.5 litres

15 litres

30 litres

120 litres

Reading up from 1 minute to the line then across. The answer can only be 15 litres as the others aren't close

**Turn over for the next question**

Turn over ►



17 A and B are **similar** solids.

| Solid | length (cm) |
|-------|-------------|
| A     | $l$         |
| B     | $2l$        |

Alex says,

“The volume of B is double the volume of A  
because the length of B is double the length of A.”

Is he correct?

Tick a box.

Yes

No

Give a reason for your answer.

[1 mark]

Volume scale factor is  $2^3$

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18 Circle the **two** roots of  $(2x + 3)(5x - 2) = 0$

[1 mark]

$$\left(-\frac{3}{2}\right)$$

$$-\frac{2}{5}$$

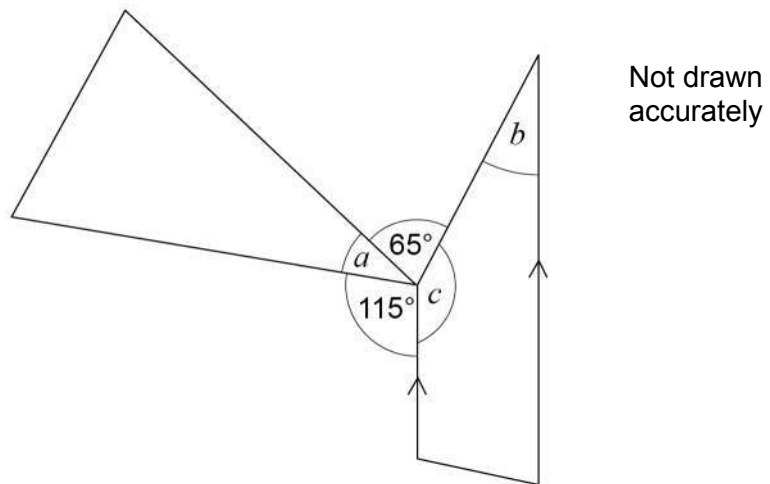
$$\left(\frac{2}{5}\right)$$

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

Either  $2x + 3 = 0$  or  $5x - 2 = 0$ . Rearranging the first equation by subtracting 3 from both sides then dividing both sides by 2 works out that  $x = -3/2$ . Rearranging the second equation by adding 2 to both sides then dividing both sides by 5 works out that  $x = 2/5$



19 The diagram shows a triangle and a trapezium.



Prove that  $a = b$

[3 marks]

$c = 180 - b$  as co-interior angles add up to 180

$b$  and  $c$  are co-interior angles

$a + 65 + 115 + 180 - b = 360$  as angles around a point add up to 360

Substituted  $c$  for  $180 - b$

$a - b = 0$

$65 + 115 + 180 = 360$ . Subtracting 360 from both sides of the equation above give this

$a = b$

Adding  $b$  to both sides

Turn over for the next question





20

In one month, the number of hours of exercise taken by 10 people are

4    7    2    8    6    5    1    82    3    9

Which is the appropriate average to use in this situation?

Tick a box.

Mean

Median

Mode

Give one reason for each of the other two averages as to why they are **not** appropriate.

[2 marks]

Reason 1

82 is an outlier

This will increase the mean a lot and the average will not represent the data very well

Reason 2

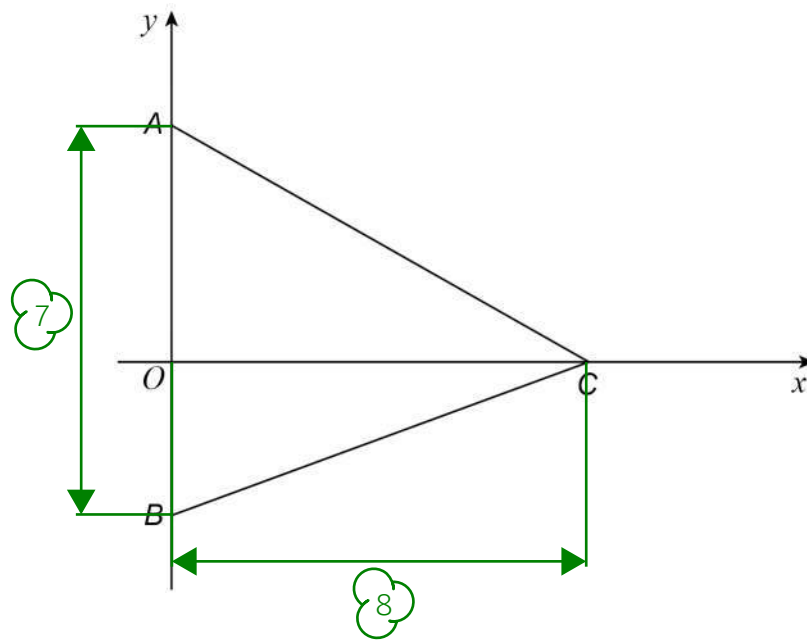
There is no mode

All of the numbers only appear once so none of them are the most frequent



21

A, B and C are points on the axes as shown.

Not drawn  
accurately

The area of triangle ABC is 28 square units.

Work out possible coordinates for A, B and C.

**[2 marks]**

$$\frac{1}{2}bh = 28$$

Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ 

$$\begin{array}{r} 28 \\ \times 2 \\ \hline 56 \end{array}$$

Multiplying both sides by 2 eliminates  
the  $\frac{1}{2}$  and works out the base  $\times$  height

$$A ( \underline{0} , \underline{5} ) \quad B ( \underline{0} , \underline{-2} ) \quad C ( \underline{8} , \underline{0} )$$

**Turn over for the next question**

The base (length AB) could be 7 and the height (length OC) could be 8 as  $7 \times 8 = 56$ .  
The x coordinate of A and B must be 0 as they are on the y axis. The y coordinate of A must be positive and the y coordinate of B must be negative. The y coordinate of C must be 0 as it is on the x axis and the x coordinate must be positive

Turn over ►



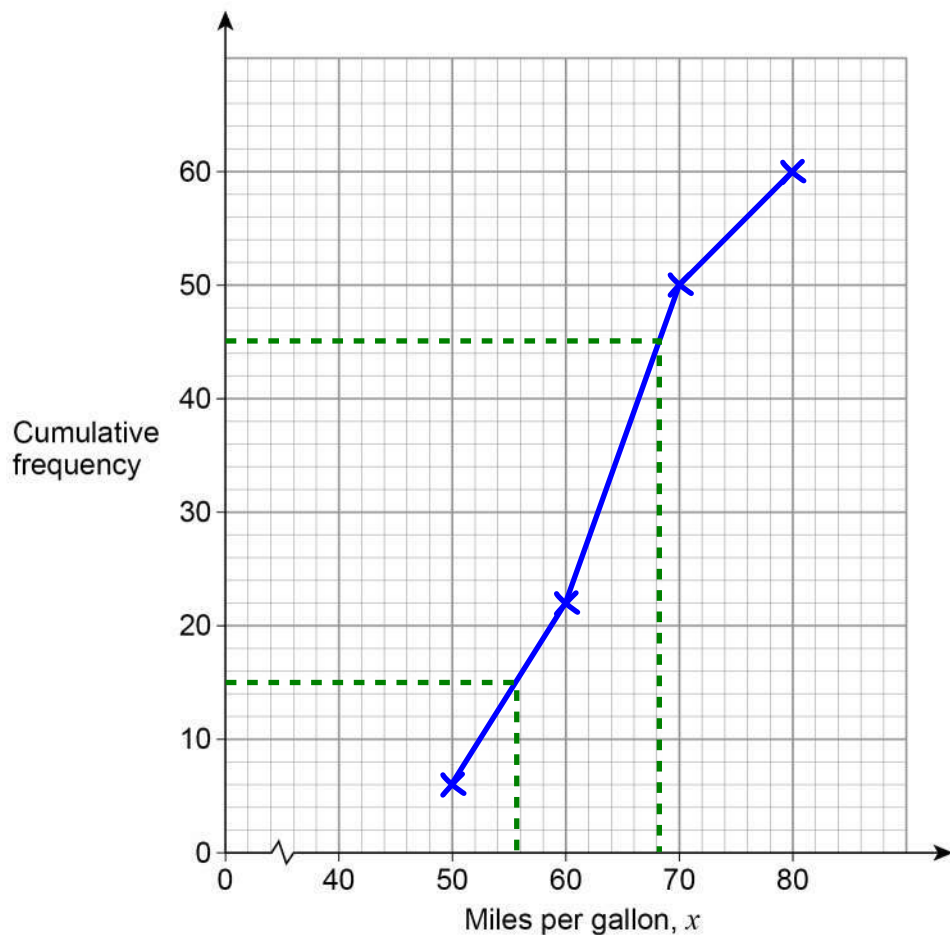
22 Here is some information about the miles per gallon of 60 cars.

| Miles per gallon, $x$ | Frequency | Cumulative frequency |
|-----------------------|-----------|----------------------|
| $40 < x \leq 50$      | 6         | 6                    |
| $50 < x \leq 60$      | 16        | 22                   |
| $60 < x \leq 70$      | 28        | 50                   |
| $70 < x \leq 80$      | 10        | 60                   |

Adding the frequency up as they go works out the cumulative frequency

22 (a) Draw a cumulative frequency graph.

[3 marks]



The cumulative frequencies are plotted at the end point of each category as it is reached by the end of the category. Joining up the points with a series of straight lines (a curve may be used but it is harder) completes the graph



22 (b) Use the graph to work out the interquartile range.

[2 marks]

$$\begin{array}{r} 68 \\ -56 \\ \hline 12 \end{array}$$

Interquartile range = upper quartile - lower quartile. The lower quartile is  $\frac{1}{4}$  of the way through the data and this is roughly the 15th frequency as  $60/4 = 15$ . Reading across from 15 to the line then down works out an estimate of the lower quartile. The upper quartile is  $\frac{3}{4}$  of the way through the data and this is roughly the 45th frequency as  $15 \times 3 = 45$ . Reading across from 45 to the line then down works out an estimate of the upper quartile

Answer 12 miles per gallon

23 The equation of a curve is  $y = (x + 3)^2 + 5$

Circle the coordinates of the turning point.

[1 mark]

(5, 3)

(5, -3)

(3, 5)

(-3, 5)

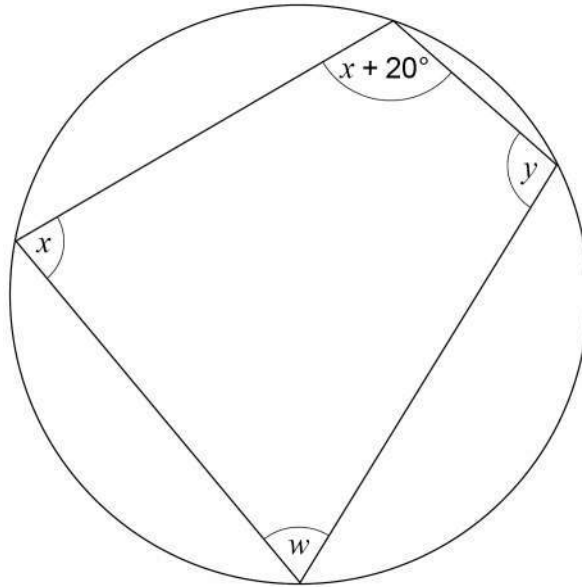
The turning point occurs when  $x + 3 = 0$  as  $0^2$  is the minimum a squared number can be.  $x = -3$  and  $y = 5$  when this is the case

Turn over for the next question



24

Here is a cyclic quadrilateral.

Not drawn  
accurately

$$x : y = 5 : 7$$

Work out the size of angle  $w$ .**[4 marks]**

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

$x$  and  $y$  are opposite angles in a cyclic quadrilateral so they add up to 180. This total is represented by a total of 12 parts in the ratio as  $5 + 7 = 12$ . Dividing the 180 by 12 works out the value of 1 part of the ratio

$$\begin{array}{r} 15 \\ \times 5 \\ \hline 75 + 20 \end{array}$$

$x$  is represented by 5 parts in the ratio so multiplying the value of 1 part by 5 works out that  $x$  is 75. Adding 20 to this works out the value of the  $x + 20$  angle

$$\begin{array}{r} 180 \\ - 95 \\ \hline 85 \end{array}$$

$w$  and the  $x + 20$  angle are opposite angles in a cyclic quadrilateral so they add up to 180. Subtracting the value of the  $x + 20$  angle from 180 leaves the value of  $w$

Answer 85 degrees

25

15 machines work at the same rate.

Together, the 15 machines can complete an order in 8 hours.

3 of the machines break down after working for 6 hours.

The other machines carry on working until the order is complete.

In total, how many hours does **each** of the other machines work?

[3 marks]

$$\begin{array}{r} 15 \\ \times 8 \\ \hline 120 \end{array} \quad \begin{array}{r} 15 \\ \times 6 \\ \hline 90 \end{array}$$

15 machines working for 8 hours do a total of 120 hours worth of work. 15 machines working for 6 hours do a total of 90 hours worth of work. Subtracting the 90 hours from the 120 hours works out that there are another 30 hours worth of work to be done once the 3 machines have broken down

$$12 \overline{) 30.0} + 6$$

Dividing the 30 hours worth of work by the 12 machines doing the work ( $15 - 3 = 12$  after the 3 machines have broken down) works out how long it will take. Adding the 6 hours already done works out the total number of hours the other machines work

Answer 8.5 hours

Turn over for the next question

Turn over ►



26 (a)  $0.\dot{7} = \frac{7}{9}$

Use this fact to show that  $0.0\dot{7} = \frac{7}{90}$

[1 mark]

$$\begin{array}{l} 0.\dot{7} \div 10 = 0.0\dot{7} \\ \frac{7}{9} \div 10 = \frac{7}{90} \end{array}$$

Dividing by 10 moves the decimal point once to the left

$\frac{7}{9} \div \frac{10}{1} = \frac{7}{9} \times \frac{1}{10} = \frac{7}{90}$

26 (b) Using part (a) or otherwise, convert  $0.2\dot{7}$  to a fraction.

Give your answer in its simplest form.

[3 marks]

$$\frac{2}{10} + \frac{7}{90}$$

0.2 is worth  $\frac{2}{10}$ . Adding this to  $0.0\dot{7}$  gives  $0.2\dot{7}$

$$\frac{18}{90} + \frac{7}{90}$$

Converting  $\frac{2}{10}$  into  $\frac{18}{90}$  so both of the denominators are the same by multiplying the numerator and denominator by 9

$$\frac{25}{90}$$

$18 + 7 = 25$ . The denominator stays the same

$$\frac{5}{18}$$

Answer

$$\frac{5}{18}$$

Dividing both the numerator and denominator by 5 simplifies the fraction. 5 and 18 cannot be divided by the same amount any more to get whole numbers



27

There are 11 pens in a box.

8 are black and 3 are red.

Two pens are taken out at random **without** replacement.

Work out the probability that the two pens are the **same** colour.

[4 marks]

$$\frac{8}{11} \times \frac{7}{10} + \frac{3}{11} \times \frac{2}{10}$$

$$\frac{56}{110} + \frac{6}{110}$$

Black AND black OR red AND red. AND means to multiply and OR means to add. There is 1 fewer pen in total after the first is picked so the denominators go down to 10 for the second pick. There is 1 fewer black pen once the first black is picked so the number of black pens goes down to 7 for the second black. There is 1 fewer red pen once the first red is picked so the number of red pens goes down to 2 for the second red

Answer \_\_\_\_\_

$$\frac{62}{110}$$

The fractions are multiplied by multiplying the numerators and denominators together. The denominators are the same so the numerators can then be added

8

Turn over ►





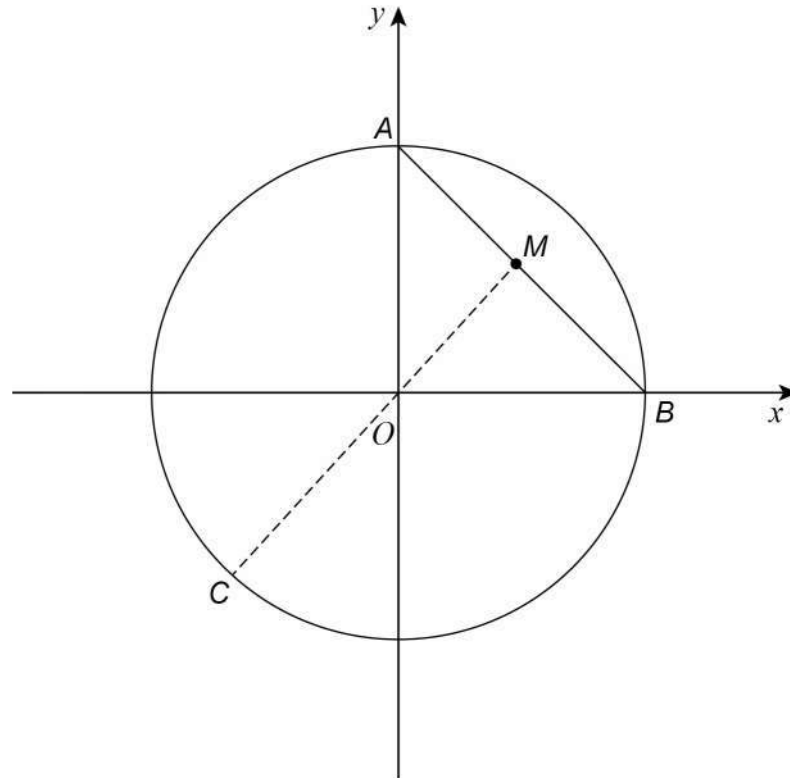
28  $A, B$  and  $C$  are points on the circle  $x^2 + y^2 = 36$  as shown.

$A$  is on the  $y$ -axis.

$B$  is on the  $x$ -axis.

$M$  is the midpoint of  $AB$ .

$COM$  is a straight line.



28 (a) Show that the coordinates of  $A$  are  $(0, 6)$

[1 mark]

$$0^2 + 6^2 = 36$$

Substituting the  $x$  and  $y$  coordinate of point  $A$  into the equation of the circle to show that the coordinates satisfy the equation shows that  $A$  is on the circle and the  $x$  coordinate is  $0$  so it is on the  $y$  axis

28 (b) Work out the coordinates of  $B$ .

[1 mark]

The  $y$  coordinate must be  $0$  as it is on the  $x$  axis. Substituting  $0$  for  $y$  in the equation gives  $x^2 + 0^2 = 36$  so  $x^2 = 36$ . Square rooting both sides gives that  $x = 6$ .  
The negative solution is ignored as the  $x$  coordinate of  $B$  must be positive

Answer ( 6 , 0 )



28 (c) Show that the equation of the straight line passing through C, O and M is  $y = x$

[2 marks]

$$\left(\frac{0+6}{2}, \frac{6+0}{2}\right) = (3, 3)$$

Point M is the midpoint of AB so working out the mean of the x coordinates and y coordinates of points A and B works out the coordinates of point M

$$\frac{3-0}{3-0} = 1$$

Gradient = (change in y)/(change in x). The coordinates of O are (0, 0). This shows that the gradient is 1

The general equation of a straight line is  $y = mx + c$ , where m is the gradient and c is the y intercept. The gradient is 1 and the y intercept is 0 so  $y = 1x + 0$ , which is  $y = x$

28 (d) Work out the coordinates of C.

Give your answers in surd form.

[3 marks]

$$2x^2 = 36$$

The lines  $x^2 + y^2 = 36$  and  $y = x$  meet at point C. So doing simultaneous equations works out the coordinates of the intersection at C. Substituting x for y in  $x^2 + y^2 = 36$  gives  $x^2 + x^2 = 36$

$$x = \sqrt{\frac{36}{2}}$$

Dividing both sides by 2 then square rooting finds x

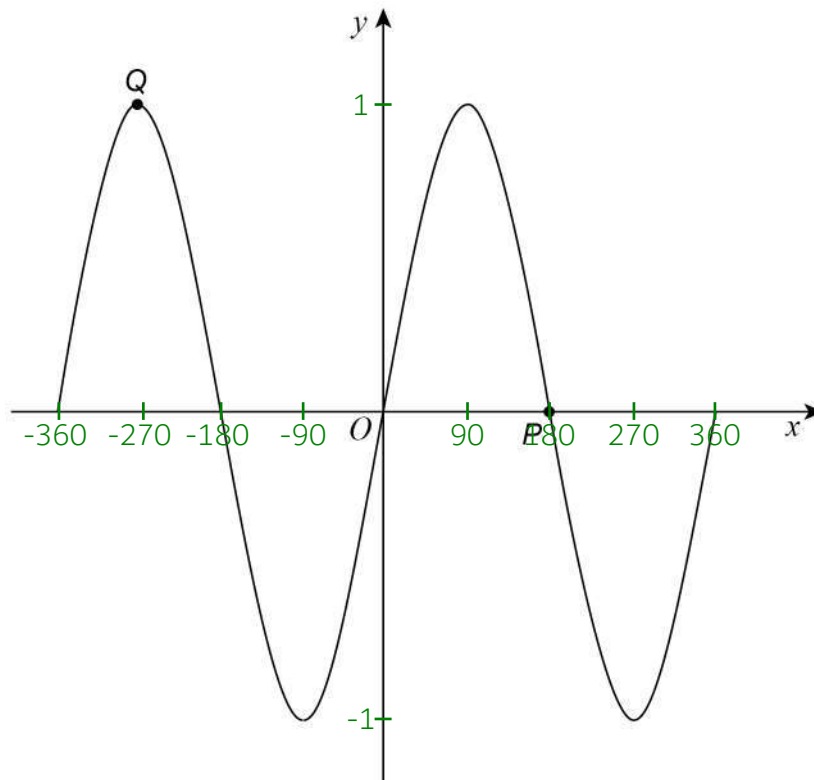
Answer (  $-\sqrt{18}$  ,  $-\sqrt{18}$  )

The x coordinate must be negative as it is on the left of the y axis. As  $y = x$ , the y coordinate is the same as the x coordinate

**Turn over for the next question**



29 Here is a sketch of  $y = \sin x^\circ$  for  $-360 \leq x \leq 360$



29 (a) Write down the coordinates of  $P$ .

[1 mark]

Answer ( 180 , 0 )

29 (b) Write down the coordinates of  $Q$ .

[1 mark]

Answer ( -270 , 1 )



30 (a) Work out the value of  $81^{-\frac{1}{4}}$

[2 marks]

The power of  $1/4$  means to do the positive fourth root, which is the square root of the square root.  $\sqrt{81} = 9$ .  $\sqrt{9} = 3$ . Then the negative power means to do the reciprocal

Answer  $\frac{1}{3}$

30 (b) Write  $16 \times 8^{2x}$  as a power of 2 in terms of  $x$ .

[3 marks]

$$2^4 \times (2^3)^{2x}$$

Writing both 16 and 8 as powers of 2

$$2^4 \times 2^{6x}$$

A power to a power means to multiply the powers.  $(a^x)^y = a^{xy}$

Answer  $2^{4+6x}$

$$a^x \times a^y = a^{x+y}$$

END OF QUESTIONS

