



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

Model Solutions

# H

Higher Tier

Paper 1 Non-Calculator

Thursday 2 November 2017

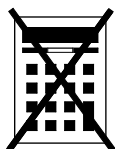
Morning

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.



N 0 V 1 7 8 3 0 0 1 H 0 1

Answer **all** questions in the spaces provided

- 1 Work out  $\sqrt{2^6 + 6^2}$   
Circle your answer.  $\sqrt{2^6 + 6^2} = \sqrt{64 + 36} = \sqrt{100} = 10$  [1 mark]
- 10      14      50      100
- 2 What is 800 million in standard form?  
Circle your answer. *million*  $\rightarrow 10^6$   $800 \times 10^6 = 8 \times 10^8$  [1 mark]
- $800 \times 10^6$        $8 \times 10^8$        $8 \times 10^9$        $0.8 \times 10^{10}$
- 3 Circle the expression that is equivalent to  $(4a^5)^2$   $4^2 \times (a^5)^2 = 16a^{10}$  [1 mark]
- $16a^{10}$        $16a^7$        $8a^{10}$        $8a^7$



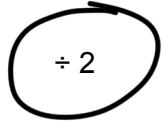
4  $y = \frac{10}{x}$

$$y = \frac{10}{2x} = \frac{5}{x}$$
 so the value of  $y$  is halved.

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

Circle your answer.

[1 mark]



÷ 2

× 2

÷ 5

× 5

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

$$a^2 - b^2 = (a+b)(a-b)$$

[1 mark]

$$x^2 - 100 = (x+10)(x-10)$$

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

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

[2 marks]

$$7x + 6 > 1 + 2x$$

$$7x - 2x > 1 - 6$$

$$5x > -5$$

$$x > -1$$

Answer  $x > -1$



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

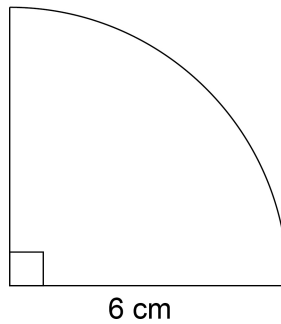
[2 marks]

$$\begin{array}{c} (\sqrt{3})^2 \times (\sqrt{2})^2 \\ \hline 3 \times 2 = 6 \end{array}$$

Answer 6

7 Here is a quarter circle of radius 6 cm

area of a full  
circle =  $\pi r^2$



Not drawn  
accurately

Work out the area of the quarter circle.

Give your answer in terms of  $\pi$ .

[2 marks]

$$\begin{array}{c} \text{area of quarter circle} = \frac{1}{4} \times \pi \times 6^2 \\ \hline = 9\pi \text{ cm}^2 \end{array}$$

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



- 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]

each number must have units  
digits 4, from units of original  
digits:  $4 \times 3 = 12$

$$70 + 12 = 82$$

So, 82 is the maximum possible  
sum for the first 3 numbers.

Answer 82

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

$n$  consecutive integers:  $1, 2, 3 \dots, n$  [1 mark]

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

$$n-1$$

$$n$$

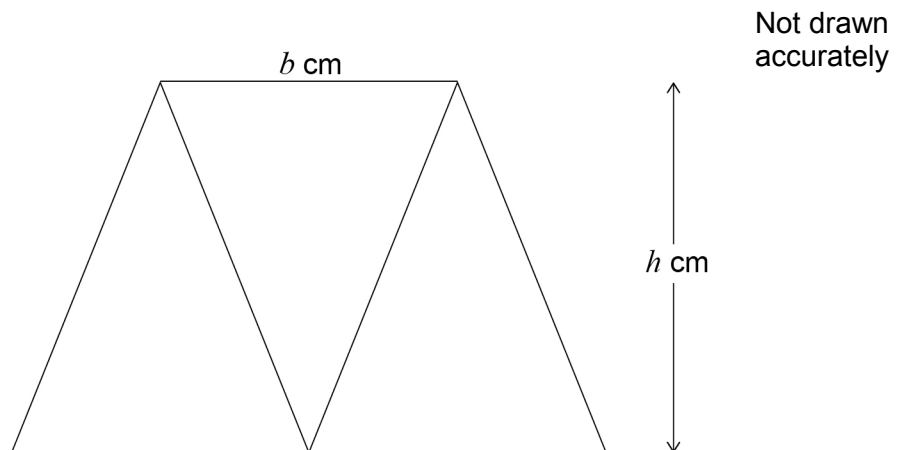
$$n+1$$

range = largest value - smallest  
value

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]

$$\text{area of trapezium} = 3 \times \text{area of triangle}$$

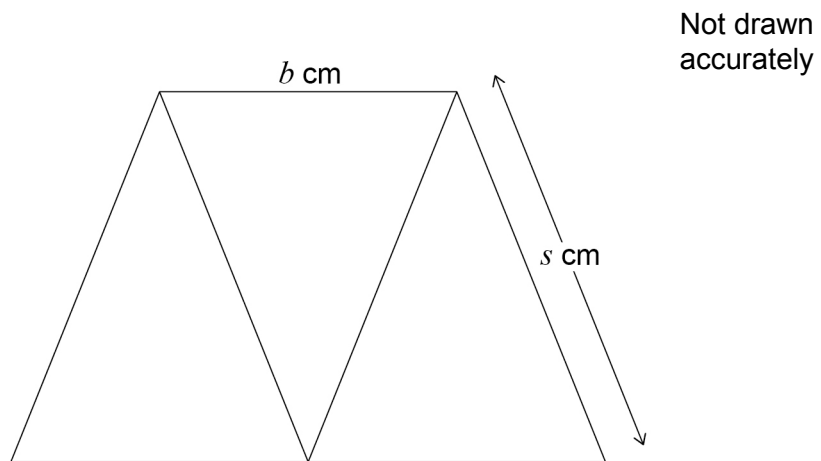
$$\text{area of triangle} = \frac{\text{base} \times \text{height}}{2}$$

$$\text{area of trapezium} = 3 \times \frac{bh}{2} = \frac{3bh}{2}$$

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



10 (b) This diagram shows the same trapezium.



$$b : s = 2 : 3$$

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

[2 marks]

$$\text{perimeter} = b + s + 2b + s = \textcircled{1} 3b + 2s$$

$$\text{as } b : s = 2 : 3$$

$$3b = 2s \textcircled{2}$$

$$\text{put } \textcircled{2} \text{ into } \textcircled{1} \quad \text{perimeter} = 3b + 3b = 6b \text{ cm}$$

Answer          $6b$          cm

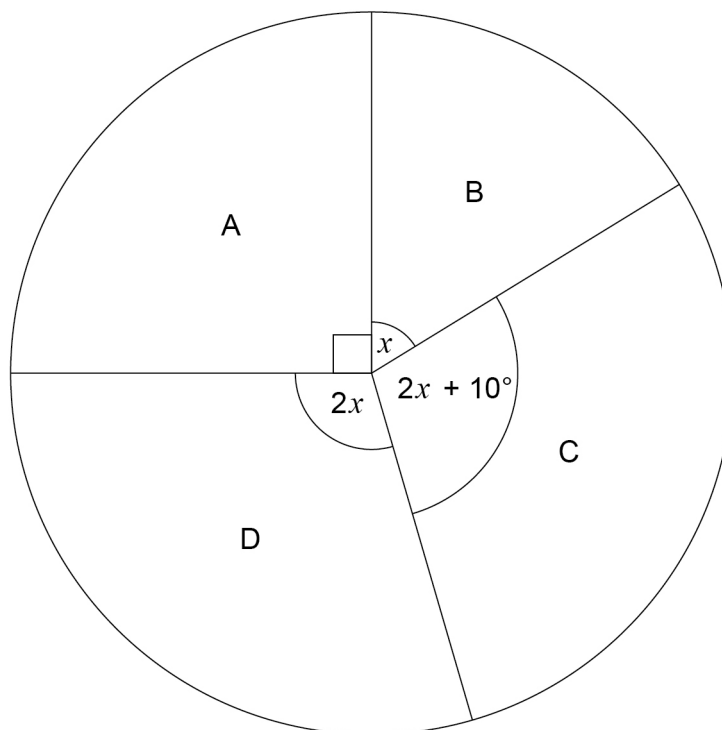
Turn over for the next question

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]

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

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

$$360 = 100 + 5x$$

$$260 = 5x$$

$$x = 52$$

$$\text{probability of C} = \frac{2x + 10}{360}$$

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

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

Answer





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]

$$0.526 = 0.5 \text{ (1.s.f.)}$$

$$39.6 = 40 \text{ (1.s.f.)}$$

$$97.65 = 100 \text{ (1.s.f.)}$$

$$\text{so } \frac{0.526 \times 39.6^2}{\sqrt{97.65}} = \frac{0.5 \times 40^2}{\sqrt{100}}$$

$$= \frac{800}{10} = 80$$

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]**

$$x : y = 7 : 4$$

$$7 + 4 = 11$$

$$88 \div 11 = 8$$

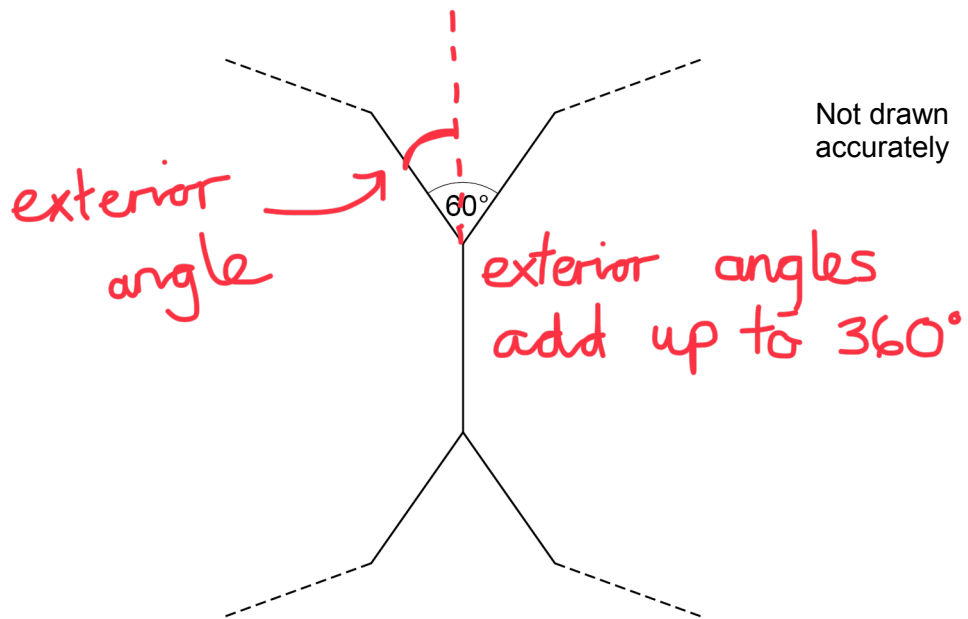
$$x \rightarrow 7 \times 8 = 56$$

$$y \rightarrow 4 \times 8 = 32$$

$$x - y = 56 - 32 = 24$$

Answer 24

- 14 Two congruent regular polygons are joined together.



Work out the number of sides on each polygon.

[3 marks]

$$\text{exterior angle of 1 polygon} = \frac{60}{2}$$

$$\frac{360}{30} = 12 = 30^\circ$$

Answer 12 sides

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]

$$7 \times 5 \times 3 = 105$$

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]

$$\text{probability a sandwich has cheese} \\ = \frac{2}{7}$$

$$\text{probability a drink is fizzy} = \frac{3}{5}$$

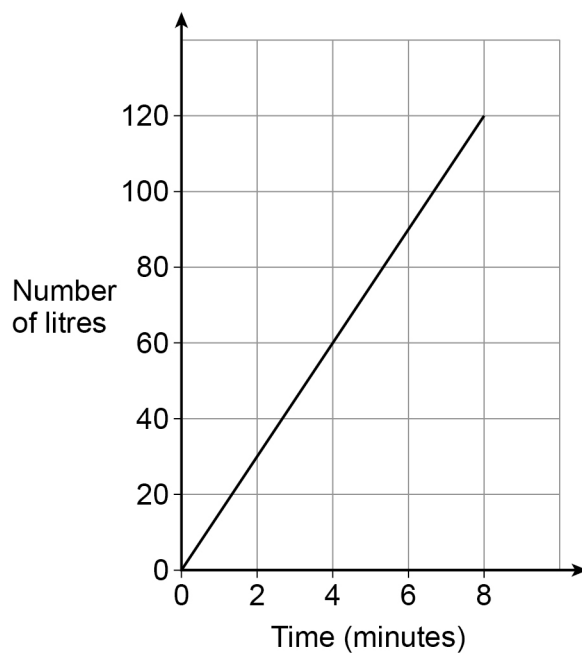
$$\frac{2}{7} \times \frac{3}{5} = \frac{6}{35}$$

Answer  $\frac{6}{35}$ 

16

Water is poured into a tank.

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



gradient  

$$\frac{\Delta y}{\Delta x}$$

How much water is poured into the tank each minute?

Circle your answer.

$$\frac{120}{8} = 15$$

[1 mark]

1.5 litres

15 litres

30 litres

120 litres

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]

because the volume scale factor  
is  $2^3 = 8$  and not 2 (double.)  
The volume of B is  $8 \times$  larger.

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

[1 mark]

$$\left(-\frac{3}{2}\right) \quad -\frac{2}{5} \quad \left(\frac{2}{5}\right) \quad \frac{3}{2}$$

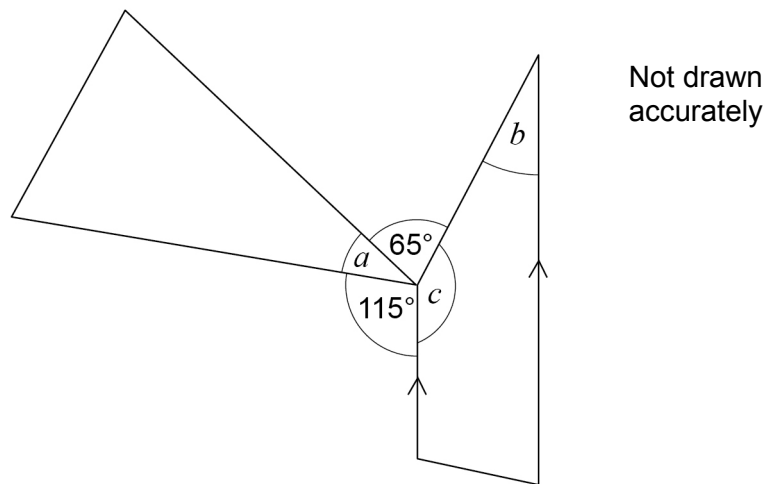
$$2x + 3 = 0 \qquad 5x - 2 = 0$$

$$2x = -3 \qquad 5x = 2$$

$$x = -\frac{3}{2} \qquad x = \frac{2}{5}$$



- 19 The diagram shows a triangle and a trapezium.



Prove that  $a = b$

*sum of angles at a point equals  $360^\circ$*  [3 marks]

$$a + 65 + c + 115 = 360$$

$$a + c = 360 - (65 + 115)$$

$$a + c = 180^\circ$$

$$b + c = 180^\circ$$

*interior angles equal  $180^\circ$*

$$\text{hence } c \rightarrow 180 - b = 180 - a$$

$$a = b$$

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]

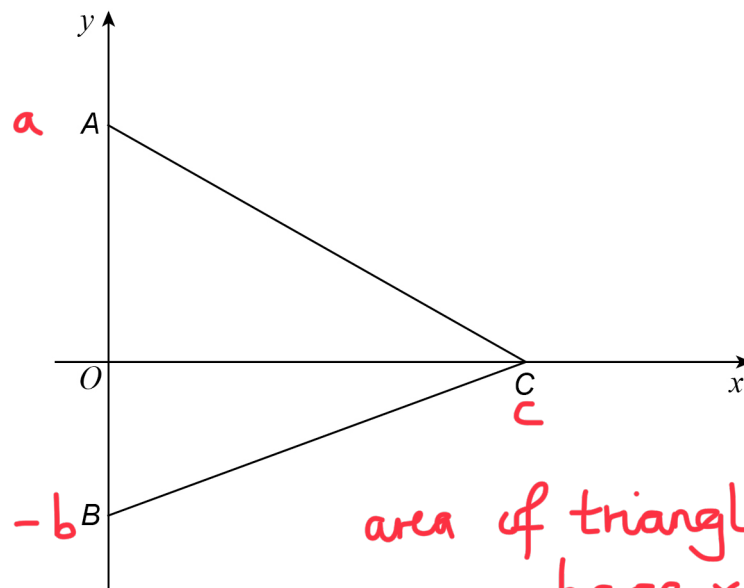
Reason 1 cannot use the mode because  
all the numbers are different.

Reason 2 mean is not appropriate because  
82 is much longer than the other  
numbers, so the mean would be skewed.





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



Not drawn  
accurately

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

The area of triangle ABC is 28 square units.

Work out possible coordinates for A, B and C.

[2 marks]

$$\frac{(a+b) \times c}{2} = 28$$

$$(a+b) \times c = 56$$

e.g.  $8 \times 7 = 56$

$$\uparrow 8 = 6 + 2$$

$$\begin{aligned} a &= 6 \\ b &= 2 \\ c &= 7 \end{aligned}$$

$$A(0, 6) \quad B(0, -2) \quad C(7, 0)$$

Turn over for the next question

Turn over ►



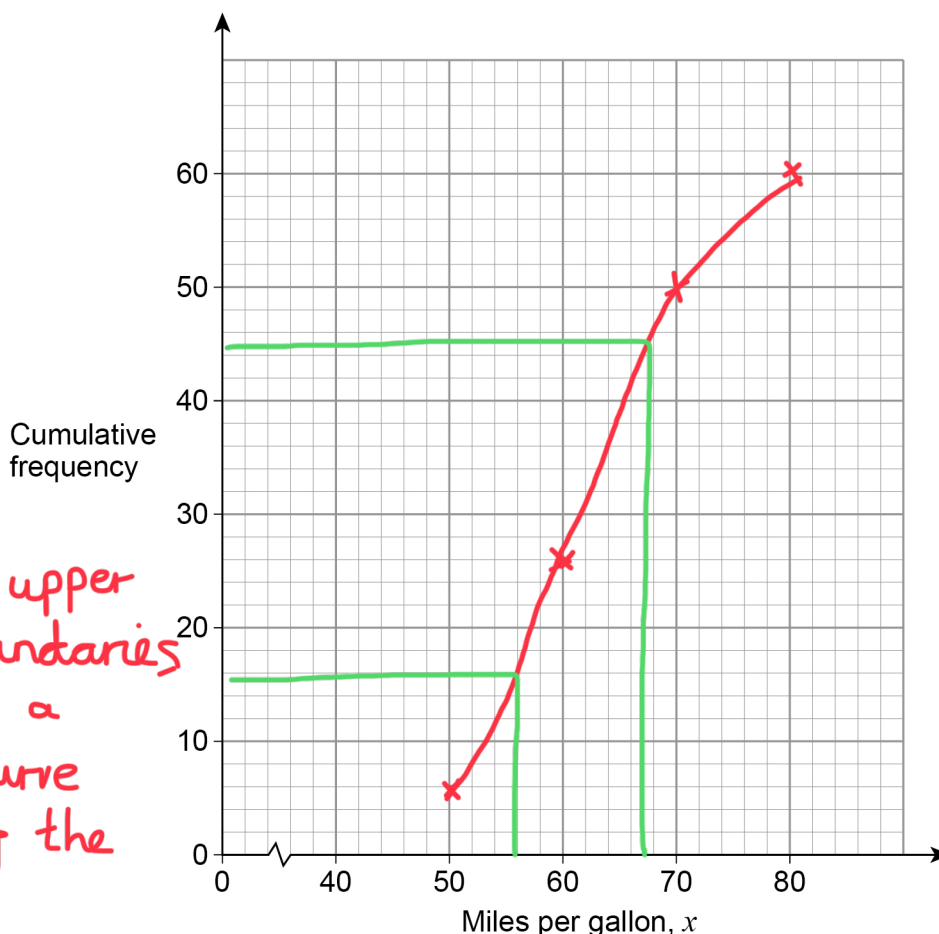
22 Here is some information about the miles per gallon of 60 cars.

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

22 (a) Draw a cumulative frequency graph.

[3 marks]

(a)  
 plot at upper class boundaries  
 and draw a smooth curve  
 connecting the points



22 (b) Use the graph to work out the interquartile range. [2 marks]

$$Q_1 = \frac{1}{4} \times 60 = \frac{60}{4} = 15$$

$$x = 55$$

$$Q_3 = \frac{3}{4} \times 60 = 3 \times 15 = 45$$

$$x = 68$$

Answer 13 miles per gallon

$$\text{interquartile range} = 68 - 55 = 13$$

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

Circle the coordinates of the turning point.

(5, 3)

(5, -3)

(3, 5)

(-3, 5)

[1 mark]

$$y = (x + 3)^2 + 5$$

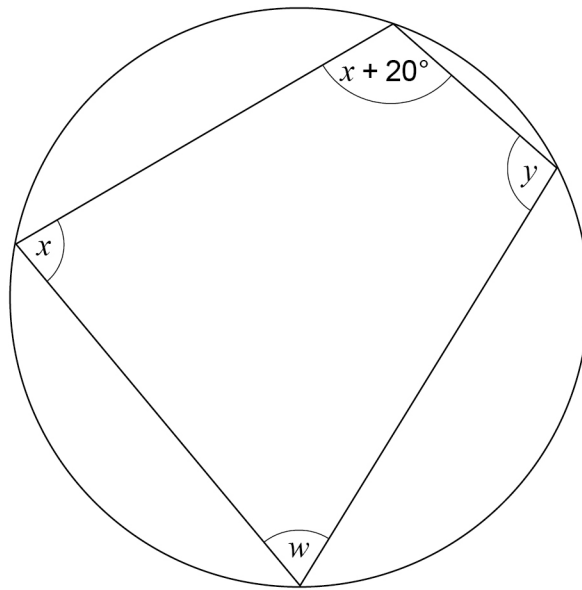
$(x + p)^2 + q$        $(-p, q)$  is turning point

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]

$$x : y = 5 : 7$$

$$7x = 5y$$

$$x = \frac{5}{7}y$$

$$x + y = 180^\circ$$

$$\frac{5}{7}y + y = 180$$

$$\frac{5}{7}y + \frac{7}{7}y = 180$$

$$\frac{12}{7}y = 180$$

$$y = 105^\circ$$

$$x = 180 - 105 = 75^\circ$$

Answer

85

degrees

$$180 = x + 20 + w$$

$$180 = 75 + 20 + w$$

$$180 = 95 + w$$

$$w = 85^\circ$$



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]

$$15 \times 8 = 120 \text{ hours in total}$$

$$3 \text{ break after 6 hours: } 3 \times 6 = 18$$

$$120 - 18 = 102$$

$$\frac{102}{12} = 8.5 \text{ hours}$$

Answer 8.5 hours

Turn over for the next question



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

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

[1 mark]

$$0.0\dot{7} = 0.\dot{7} \div 10$$


---


$$\text{so, } 0.0\dot{7} = \frac{0.\dot{7}}{10} = \frac{7}{9 \times 10} = \frac{7}{90}$$

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

Give your answer in its simplest form.

[3 marks]

$$0.2\dot{7} = 0.2 + 0.0\dot{7}$$


---


$$= \frac{1}{5} + \frac{7}{90}$$


---


$$= \frac{18}{90} + \frac{7}{90} = \frac{25}{90} = \frac{5}{18}$$

Answer  $\frac{5}{18}$



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]

Same colour :

$$\textcircled{1} \text{ black and black} = \frac{8}{11} \times \frac{7}{10} = \frac{56}{110}$$

$$\textcircled{2} \text{ red and red} = \frac{3}{11} \times \frac{2}{10} = \frac{6}{110}$$

probability they are the same

$$\text{colour: } \frac{56}{110} + \frac{6}{110} = \frac{62}{110} = \frac{31}{55}$$

(pens are not replaced, so the total number of pens and the number of black pens both decrease by 1)

Answer  $\frac{31}{55}$



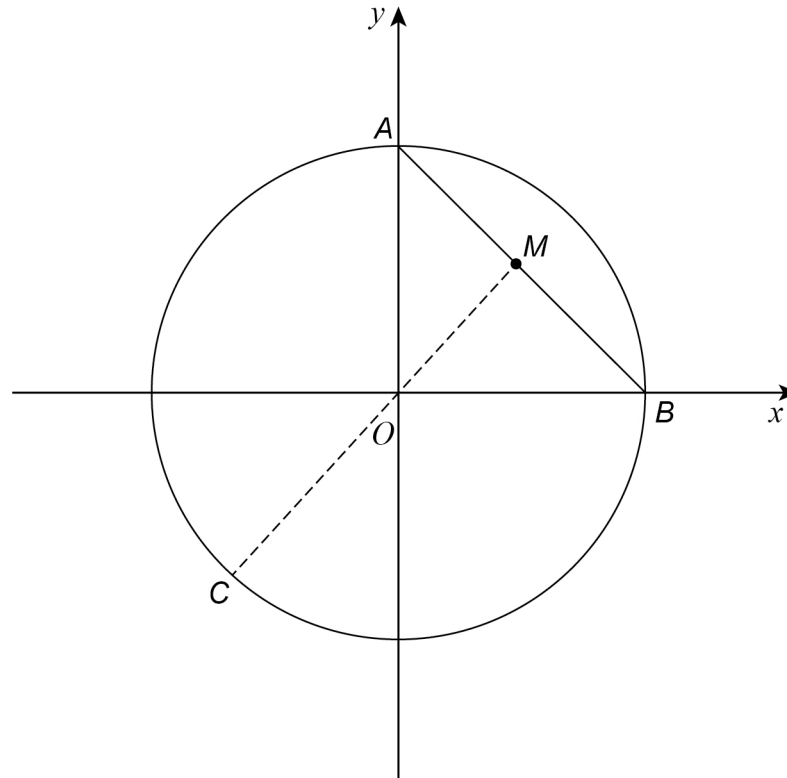
28  $A, B$  and  $C$  are points on the circle  $x^2 + y^2 = 36$  as shown.

$A$  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]

$$\text{radius} = \sqrt{36} = 6$$

$$\text{so } A \text{ is at } (0, 6)$$

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

[1 mark]

$$B \text{ is on the positive } x\text{-axis}$$

$$\text{so } (6, 0)$$

Answer ( 6 , 0 )





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

midpoint of AB:  $\left(\frac{6+0}{2}, \frac{6+0}{2}\right) = (3, 3)$  [2 marks]  
 gradient of OM = gradient of OC  
 $= \frac{3-0}{3-0} = 1$

goes through the origin, so y-intercept is 0,

- 28 (d) Work out the coordinates of C.  
Give your answers in surd form.

hence  $y = x$ .

[3 marks]

C is on the line  $y = x$ , so the x-coordinate is the same as the y-coordinate.

$$x^2 + x^2 = 36$$

$$2x^2 = 36$$

$$x = -\sqrt{18}$$

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

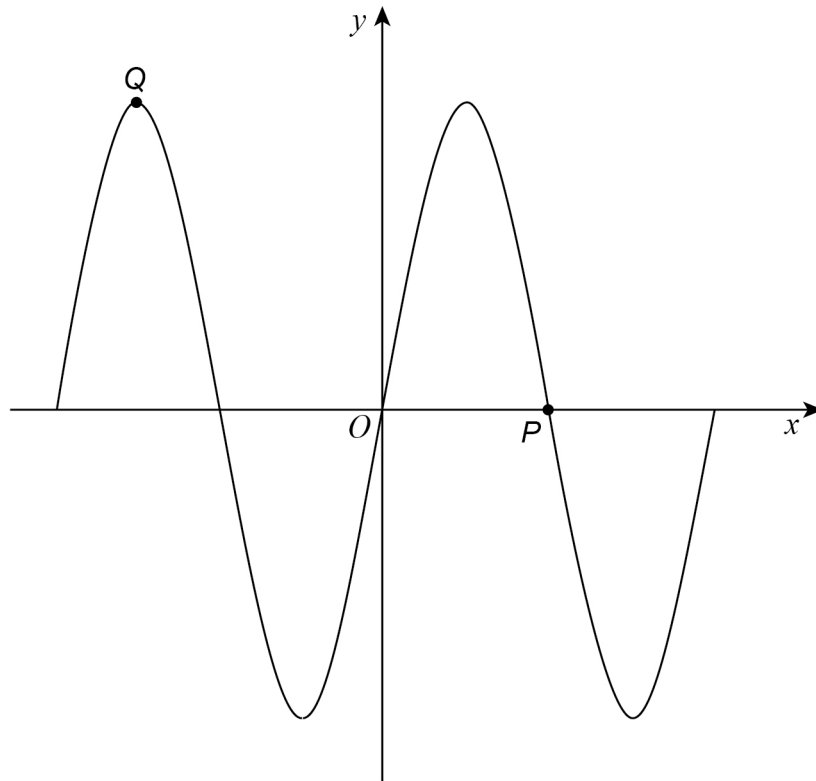
$$\text{so } y = -\sqrt{18}$$

negative value  
because x and y  
are negative in  
this quadrant.

Turn over for the next question



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

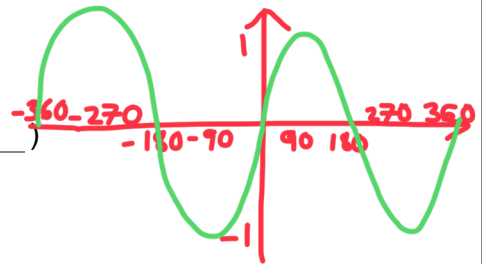


29 (a) Write down the coordinates of P.

graph of  $\sin x$

[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]

$$81^{-\frac{1}{4}} = \frac{1}{81^{\frac{1}{4}}} = \frac{1}{\sqrt[4]{81}}$$

$$\sqrt[4]{81} = 3 \quad \text{so} \quad \frac{1}{\sqrt[4]{81}} = \frac{1}{3}$$

Answer  $\frac{1}{3}$

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

[3 marks]

$$16 = 2 \times 2 \times 2 \times 2 = 2^4$$

$$8 = 2 \times 2 \times 2 = 2^3$$

$$2^4 \times (2^3)^{2x} = 2^4 \times 2^{6x} = 2^{4+6x}$$

Answer  $2^{4+6x}$

END OF QUESTIONS



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