Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

S17-C300UA0-1

C300UA0-1

MATHEMATICS – Component 1
Non-Calculator Mathematics
HIGHER TIER

THURSDAY, 25 MAY 2017 – MORNING

2 hours 15 minutes

ADDITIONAL MATERIALS

The use of a calculator is not permitted in this examination.

A ruler, protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

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

If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

Take π as 3·14.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the need for good English and orderly, clear presentation in your answers.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**8**	
3.	**4**	
4.	**5**	
5.	**4**	
6.	**5**	
7.	**3**	
8.	**3**	
9.	**9**	
10.	**5**	
11.	**4**	
12.	**8**	
13.	**5**	
14.	**8**	
15.	**9**	
16.	**7**	
17.	**4**	
18.	**4**	
19.	**7**	
20.	**5**	
21.	**9**	
Total	**120**	

C300UA01
01

Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

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

Volume of a cone = $\frac{1}{3}\pi r^2 h$

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Examiner only

1. Sasha is carrying out a survey into the amount of chocolate teenagers eat in a day.

(a) Here is a question from her survey:

> Too much chocolate is bad for your health.
> How many pieces of chocolate did you eat yesterday?
> Tick (✓) one box.
>
> 1-2 ☐ 3-4 ☐ 5-6 ☐

(i) Explain why this is a biased question. [1]

The statement "too much chocolate is bad for your health" will encourage lower answers.

(ii) State **one** other criticism of the question. [1]

There is no zero

or// no option for 7 or more

or// a piece of chocolate could have different sizes

(b) Sasha stands outside a supermarket on a Monday morning and surveys 10 people as they go in.

Are her results likely to be reliable?

Yes ☐ No ☑

Give **two** reasons to support your answer. [2]

Reason 1:

The sample size is too small

Reason 2:

Monday morning will limit the people in the sample

Examiner only

2. *(a)* Solve $7x + 2 = 3x + 4$. [2]

$-3x \quad -3x$

$4x + 2 = 4$

$4x = 2$

$x = \frac{1}{2}$

(b) Solve $3 - 2(x - 9) = 5x$. [3]

$3 - 2x + 18 = 5x$

$+2x \quad +2x$

$21 = 7x$

$x = 3$

(c) (i) Solve $7 - 3x < 1$. [2]

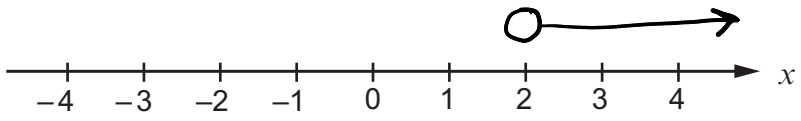
$7 < 1 + 3x$

$6 < 3x$

$2 < x$

$x > 2$

(ii) Represent your answer to part *(c)*(i) on the number line below. [1]



Examiner only

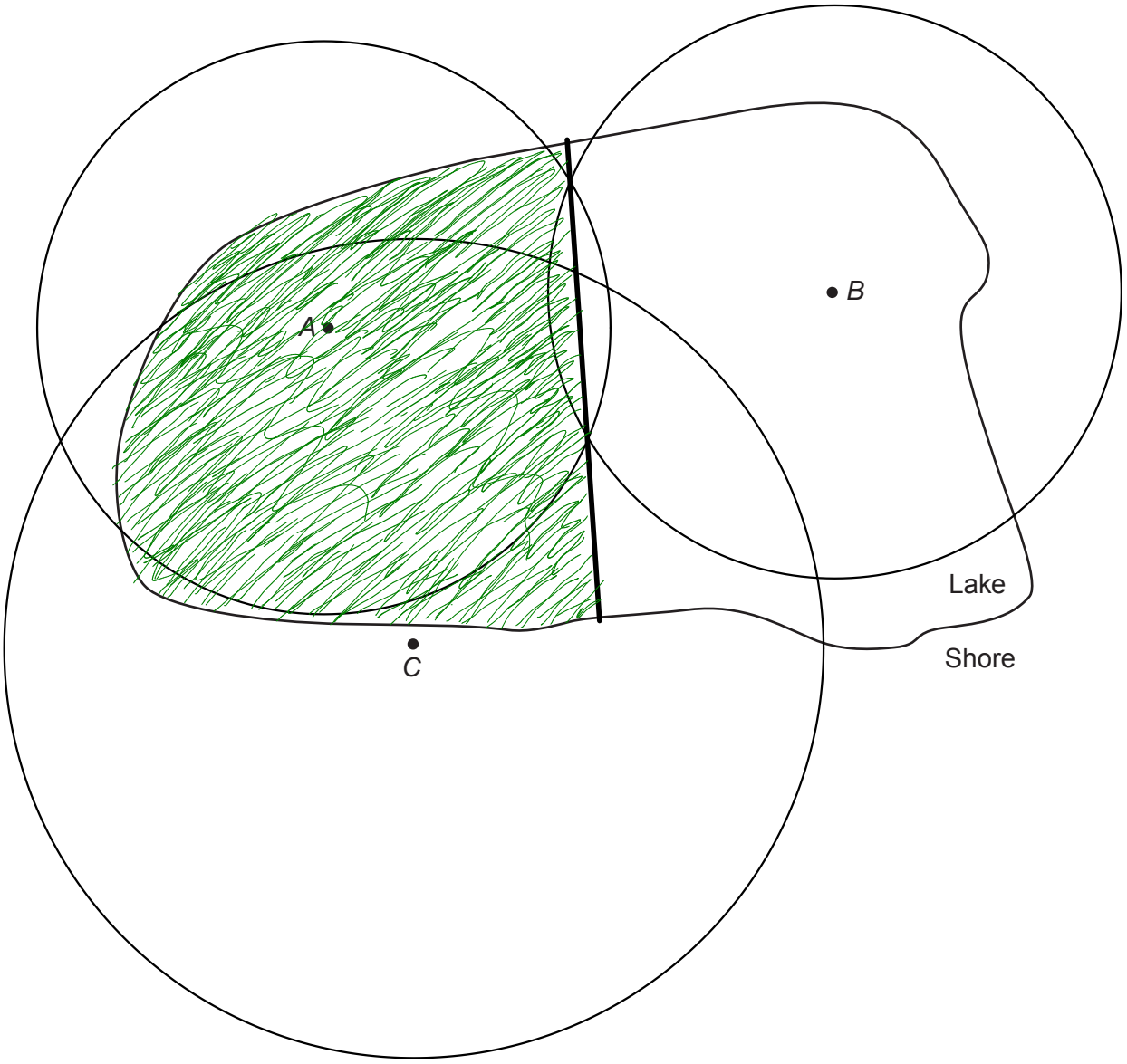
3. The scale drawing below shows a lake.
There are two small islands in the lake at *A* and *B*.
The lifeguard station is marked at *C*.

Swimming is only allowed in the area of the lake that is,
- nearer to *A* than it is to *B* and
- less than 60 metres from *C*.

Using a ruler and a pair of compasses, show accurately on the diagram the area where swimming is allowed.
Shade the area where swimming is allowed.

Use the scale 1 cm represents 10 m. [4]

less than 6 cm from C



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4.

$$\mathbf{p} = \begin{pmatrix} 6 \\ -1 \end{pmatrix} \text{ and } \mathbf{q} = \begin{pmatrix} -4 \\ 7 \end{pmatrix}$$

(a) Work out the column vector $\mathbf{p} + 3\mathbf{q}$. [2]

$3q = \begin{pmatrix} -12 \\ 21 \end{pmatrix}$

$\begin{pmatrix} 6 \\ -1 \end{pmatrix} + \begin{pmatrix} -12 \\ 21 \end{pmatrix} = \begin{pmatrix} -6 \\ 20 \end{pmatrix}$

(b) When $\mathbf{p} + m\mathbf{q} = \begin{pmatrix} 10 \\ n \end{pmatrix}$, find the value of m and the value of n. [3]

$\begin{pmatrix} 6 \\ -1 \end{pmatrix} + m\begin{pmatrix} -4 \\ 7 \end{pmatrix} = \begin{pmatrix} 10 \\ n \end{pmatrix}$

$6 - 4m = 10$

$-4m = 4$

$m = -1$

$-1 - 1(7) = n$

$m =$ -1 $n =$ -8

Examiner only

5. The table shows the cost of sending items using a delivery service.

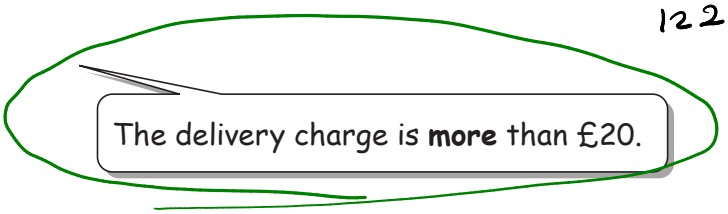
Mass less than	Full insurance against being lost: £250	£750	£1500
100 g	£5	£7	£9
250 g	£7.50	£9.50	£11.50
1000 g	£9.25	£11.25	£13.25
1750 g	£11	£13	£15
2500 g	£13.50	£15.50	£17.50
5000 g	£18	£20	£22

Riley is planning to send **two** laptops to James using this delivery service.
The laptops are to be sent with full insurance against being lost.

Each laptop is worth £700 and has a mass of 1250 g, **correct to the nearest 50 g**.

$1225 \leq m < 1275$

Riley says,



James says,

Explain how Riley and James could have come to their conclusions.
Show all your working and state any assumption that you make. [4]

If sent separately the laptops cost £13 each to send $2 \times 13 = £26$

If sent together (and the total mass is under 2500 g) the cost is £17.50

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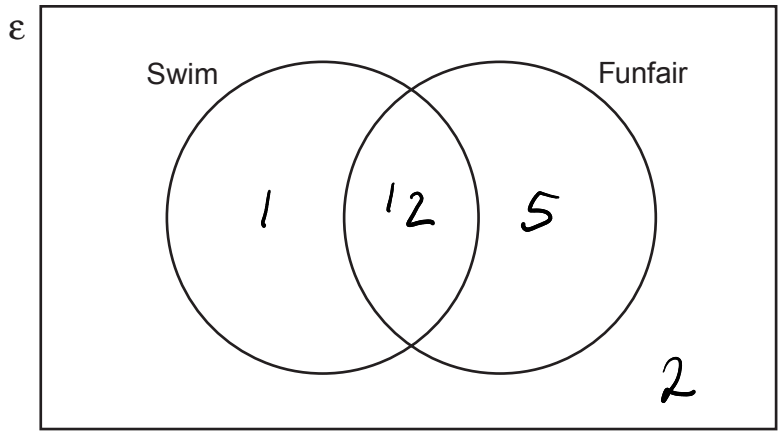
6. Twenty people go on a trip to the seaside.

Of these 20 people
- 13 swim in the sea
- 17 go to the funfair
- 2 do not swim in the sea or go to the funfair.

(a) Complete the Venn diagram below to show this information. [2]

$13 + 17 - x = 18$

$x = 12$



(b) One person is chosen at random.
Find the probability that this person swims in the sea and goes to the funfair. [1]

$\frac{12}{20}$

(c) One person is chosen at random from those who swim in the sea.
Find the probability that this person does not go to the funfair. [2]

$\frac{1}{13}$

Examiner only

7. Make y the subject of this formula. [3]

$$9x = p(8 + y) + 5$$

$9x = 8p + py + 5$

$9x - 8p - 5 = py$

$y = \dfrac{9x - 8p - 5}{p}$

8. A shop sells *Brand X* trainers in three colours only.
The proportion of gold trainers sold is 0·04.
The proportion of black trainers sold is 5 times the proportion of lime trainers.

Find the proportion of black trainers sold. [3]

Colour	Gold	Lime	Black
Proportion	0·04	x	$5x$

$6x + 0.04 = 1$

$6x = 0.96$

$x = 0.16$

$5x = 0.8$

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Examiner only

9. *(a)* The diagram shows a large shipping container at rest on horizontal ground.

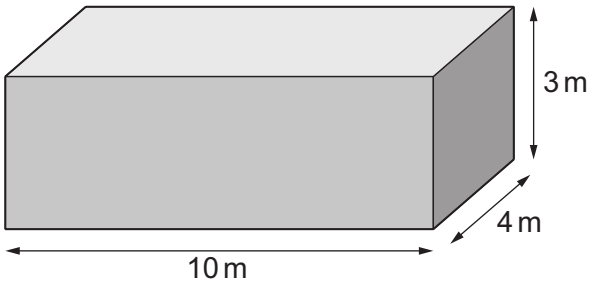


Diagram not drawn to scale

The weight of the container is 32 000 N.

Work out the pressure exerted on the ground by the shipping container.
Give your answer in **N/m²**. [2]

Area of base = $10 \times 4 = 40 m^2$

Pressure = $\frac{32000}{40}$

$= 800 N/m^2$

Examiner only

(b) A table is at rest on horizontal ground.
The table has 4 legs.
Each leg has a height of 50 cm.
The volume of material in one leg is 450 cm^3.
The table weighs 54 N.

By considering the base of the table legs, work out the pressure exerted on the ground by the table.
Give your answer in **N/cm^2**.
You must show all your working. [5]

Volume = area of cross section × height

450 = area × 50

area = 9 cm^2

Total area in contact with the ground = 9 × 4
= 36 cm^2

pressure = $\frac{54}{36}$ = 1.5 N/cm^2

(c) (i) State **one** assumption you have made in your answer to part *(b)*. [1]

The legs have a constant cross section (prism or cylinder)

(ii) How would your answer to part *(b)* change if you had not made this assumption? [1]

If the area is smaller the pressure would be greater.

Examiner only

10. *(a)* Show that the interior angle of a regular octagon is 135°. [2]

Exterior angle $= \frac{360}{8} = 45°$

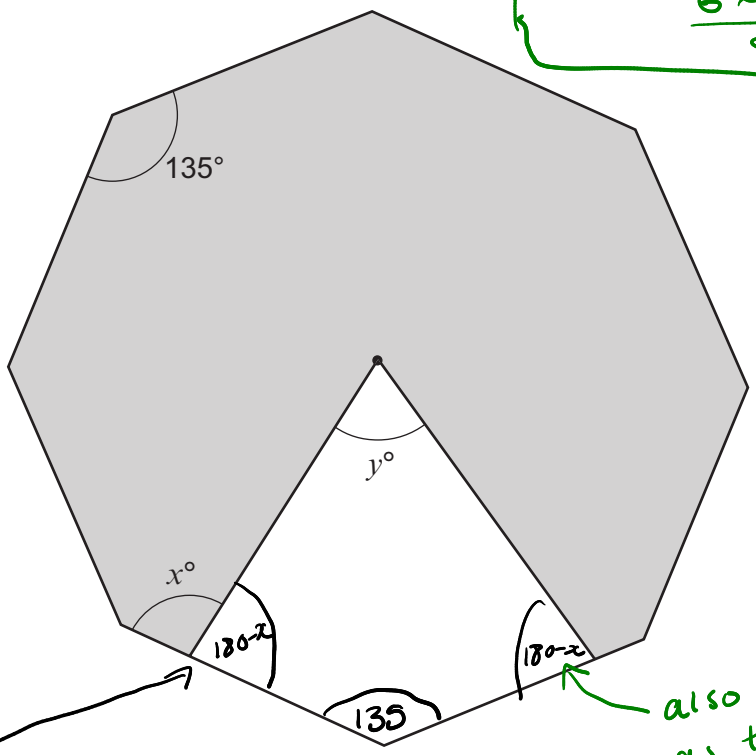
Interior angle $= 180 - 45$

$= 135°$

or $\frac{(n-2) \times 180}{8}$

$\frac{6 \times 180}{8} = 135°$

(b)



also 180 − x as the shape is a kite ∴ symmetrical

Diagram not drawn to scale

The shaded shape is formed by cutting a kite from a regular octagon as shown in the diagram.

Prove that $y = 2x - 135$.
You must give reasons to support your statements. [3]

angles on a straight line add to 180

$y + 180 - x + 180 - x + 135 = 360$

$y + 495 - 2x = 360$

$y = 2x - 135$

angles in a quadrilateral sum to 360°

Examiner only

11. Gabby buys a chest of drawers and a computer desk to fit side by side between two walls in her bedroom.

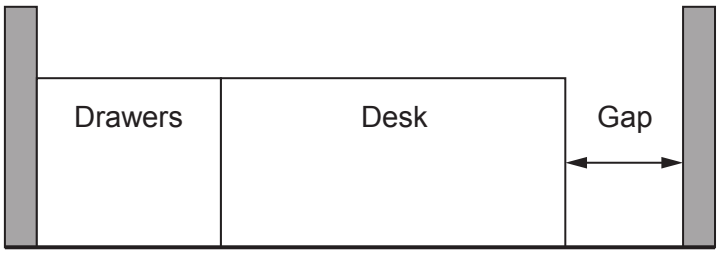


Diagram not drawn to scale

The width of the chest of drawers is 45 cm, correct to the nearest cm.
The width of the computer desk is 60 cm, correct to the nearest cm.
The two walls are 1·2 m apart, correct to the nearest 10 cm.

Calculate the least possible width of the gap remaining when Gabby's furniture is in place. [4]

Max width of drawers = 45.5 cm

Max width of desk = 60.5 cm

Min wall gap = 1.15 m = 115 cm

115 − 45.5 − 60.5

115 − 106 = 9 cm

Examiner only

12. The table shows information about the length (in minutes) of phone calls made between two college friends during March.

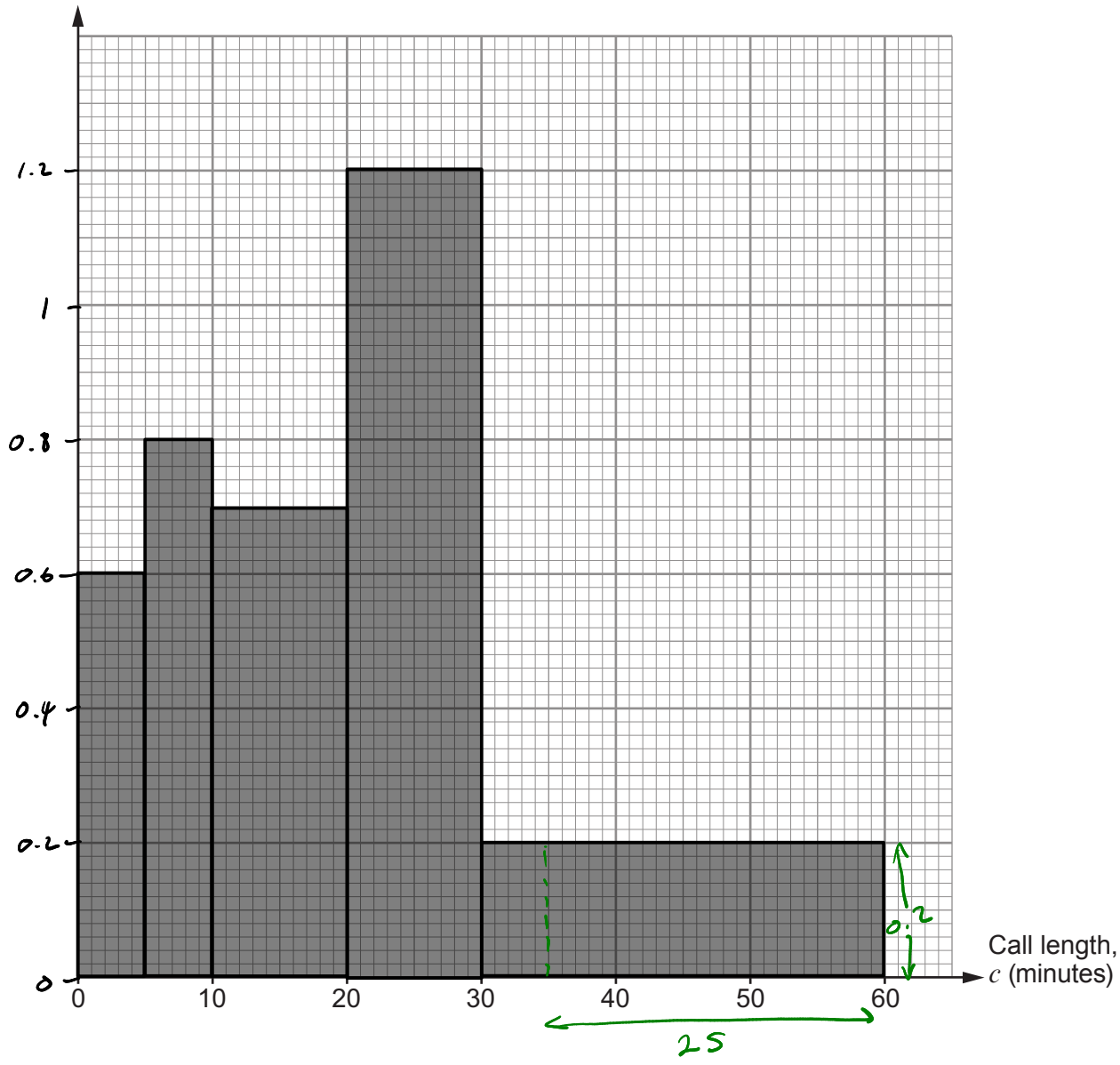
Call length, c (minutes)	$0 < c \leqslant 5$	$5 < c \leqslant 10$	$10 < c \leqslant 20$	$20 < c \leqslant 30$	$30 < c \leqslant 60$
Frequency	3	4	7	12	6
Frequency density	0.6	0.8	0.7	1.2	0.2

(a) Complete the frequency density row in the table above. [1]

F.d = Freq / class width

$\frac{3}{5} = 0.6$ $\frac{4}{5} = 0.8$ $\frac{7}{10} = 0.7$ $\frac{12}{10} = 1.2$ $\frac{6}{30} = \frac{2}{10} = 0.2$

(b) Draw a histogram to illustrate the data in the table. [2]



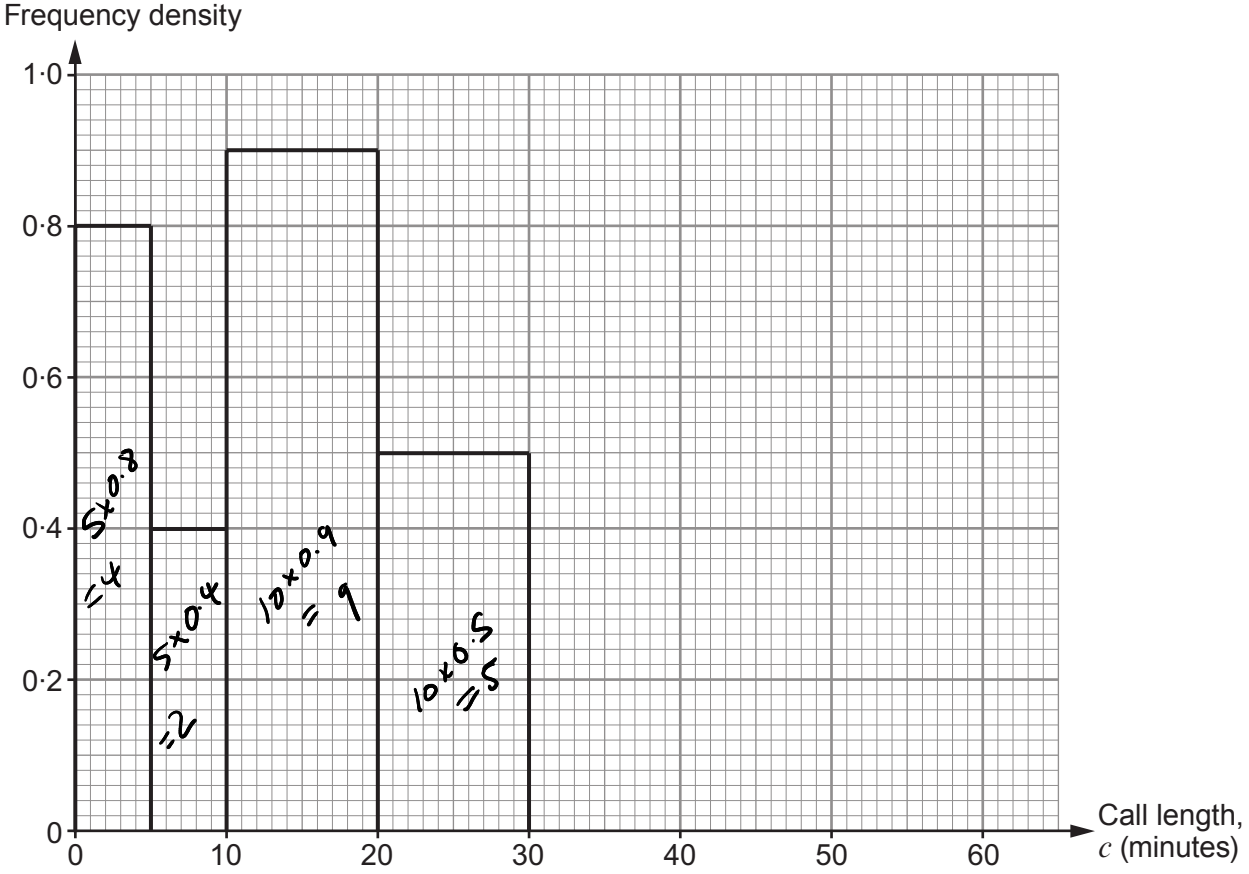
Examiner only

(c) Estimate the fraction of calls that lasted for more than 35 minutes. [2]

$25 \times 0.2 = 5$

$\frac{5}{32}$

(d) This histogram shows the length of calls made between the same two college friends during April.



How many phone calls were made during April? [2]

$4 + 2 + 9 + 5 = 20$

(e) During one of the months, the college friends had examinations.
Compare the two histograms and explain which month this is likely to be. [1]

It is likely to be April if they were busy they would have less time for phone calls

Examiner only

13. *(a)* Evaluate each of the following. [3]

$\left(\frac{49}{4}\right)^{\frac{1}{2}} =$ $\frac{7}{2}$ $125^0 =$ 1 $8^{\frac{2}{3}} =$ 4 $0{\cdot}75^{-1} =$ $\frac{4}{3}$

$\sqrt{\frac{49}{4}}$ 2^2 $\left(\frac{3}{4}\right)^{-1}$

(b) $\sqrt[4]{100}$ lies between two consecutive whole numbers.

Complete the following statement:

$\sqrt[4]{100}$ lies between the two consecutive whole numbers 3 and 4 [2]

Space for working:

$2^4 = 16$

$3^4 = 81$

$4^4 = 256$

Examiner only

14. The diagram shows the points $P(1, -4)$ and $Q(7, q)$, joined by a straight line.

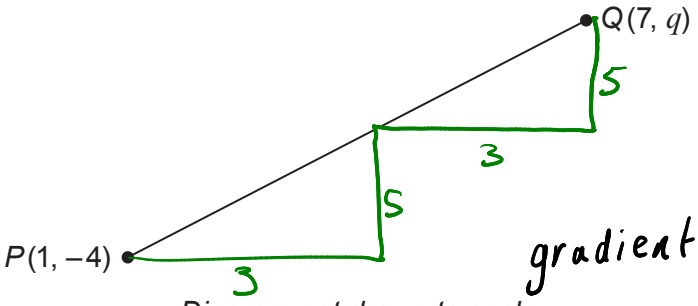


Diagram not drawn to scale

gradient = change in y / change in x

The gradient of PQ is $\frac{5}{3}$.

(a) Find the value of q. [3]

$-4 + 10 = 6$

(b) The line L_1 is parallel to the line PQ and passes through the point (3, 0).
Where does the line L_1 cross the y-axis? [2]

$y = \frac{5}{3}x + c$

$0 = \frac{5}{3}(3) + c$

$0 = 5 + c \qquad c = -5$

(c) The line L_2 is perpendicular to the line PQ and passes through the point (–5, 1).
Find the equation of L_2. [3]

perpendicular $m = -\frac{3}{5}$

$y = -\frac{3}{5}x + c$

$1 = -\frac{3}{5}(-5) + c$

$1 = 3 + c$

$c = -2$

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

Examiner only

15. *(a)* *PQRS* is a cyclic quadrilateral of a circle, centre *O*.

$S\hat{P}Q = 54°$.

The ratio of $O\hat{S}R$ to $O\hat{Q}R$ is 2 : 1.

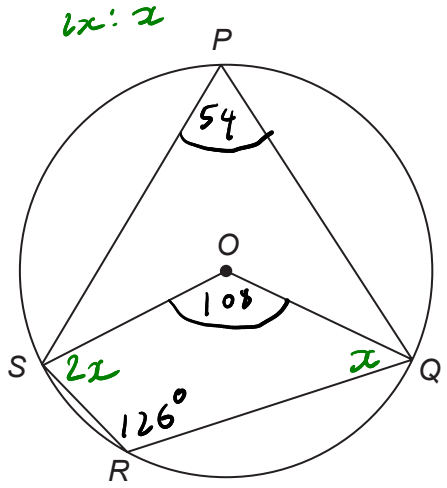


Diagram not drawn to scale

(i) Find $S\hat{O}Q$.
Give a reason for your answer. [2]

$2 \times 54 = 108°$

The angle at centre is twice the angle at the circumference

(ii) Find $S\hat{R}Q$. [1]

$180 - 54 = 126°$

opposite angles in a cyclic quadrilateral sum to $180°$

(iii) Calculate the size of $O\hat{S}R$. [3]

$2x + x + 108 + 126 = 360$

$3x + 234 = 360$

$3x = 126$

$x = 42°$

$2x = 84°$

Examiner only

(b) The diagram shows points *A*, *B*, *C* and *D* on the circumference of a circle. *AC* and *BD* intersect at the point *E*.

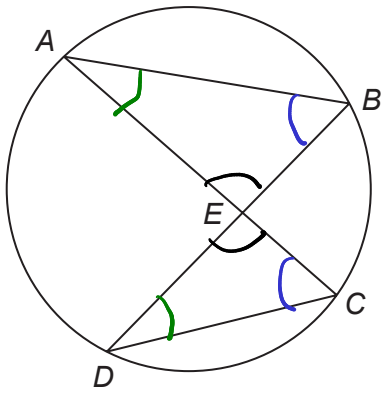


Diagram not drawn to scale

Show clearly that triangle *AEB* is similar to triangle *DEC*.
Give a reason for each step of your answer. [3]

BAE = BDC Angles in the same segment

ABE = DCE Angles in the same segment

AEB = DEC opposite angles are equal

AAA ∴ Similar

Examiner only

16. *(a)* Simplify each of the following.

(i) $\frac{15}{\sqrt{5}}$ [2]

$\frac{15}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$

$\frac{15\sqrt{5}}{5} = 3\sqrt{5}$

(ii) $\sqrt{300} - \sqrt{27}$ [2]

$\sqrt{100}\sqrt{3} - \sqrt{9}\sqrt{3}$

$10\sqrt{3} - 3\sqrt{3} = 7\sqrt{3}$

(b) Tom says:

> "Expanding and simplifying $(a+\sqrt{2})(b-\sqrt{2})$, where a and b are integers, can never have an integer answer."

Show that Tom's statement is incorrect.
Give the reasons to support your decision. [3]

If a and b are equal:

$(a+\sqrt{2})(a-\sqrt{2})$

$a^2 - a\sqrt{2} + a\sqrt{2} - 2$

$a^2 - 2$

if a is an integer $a^2 - 2$ is an integer.

Examiner only

17. In this question all dimensions are in centimetres.
The diagram shows a sketch of two circles, both with centre *O*.

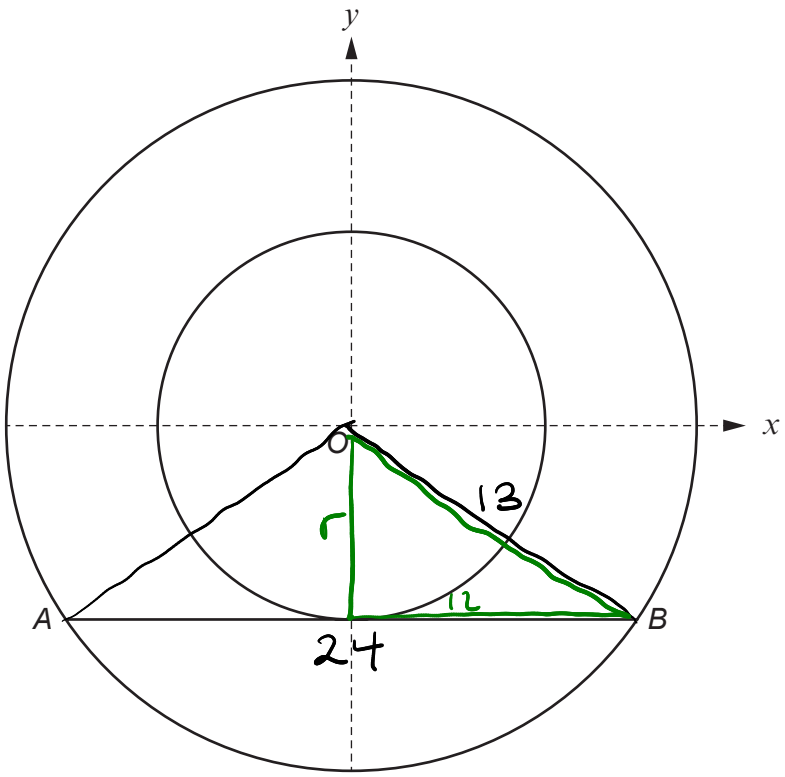


Diagram not drawn to scale

The line *AB* is a chord of the outer circle and a tangent to the inner circle.
The length of *AB* is 24.
The equation of the outer circle is $x^2 + y^2 = 13^2$.

Find the equation of the inner circle. [4]

$r^2 + 12^2 = 13^2$

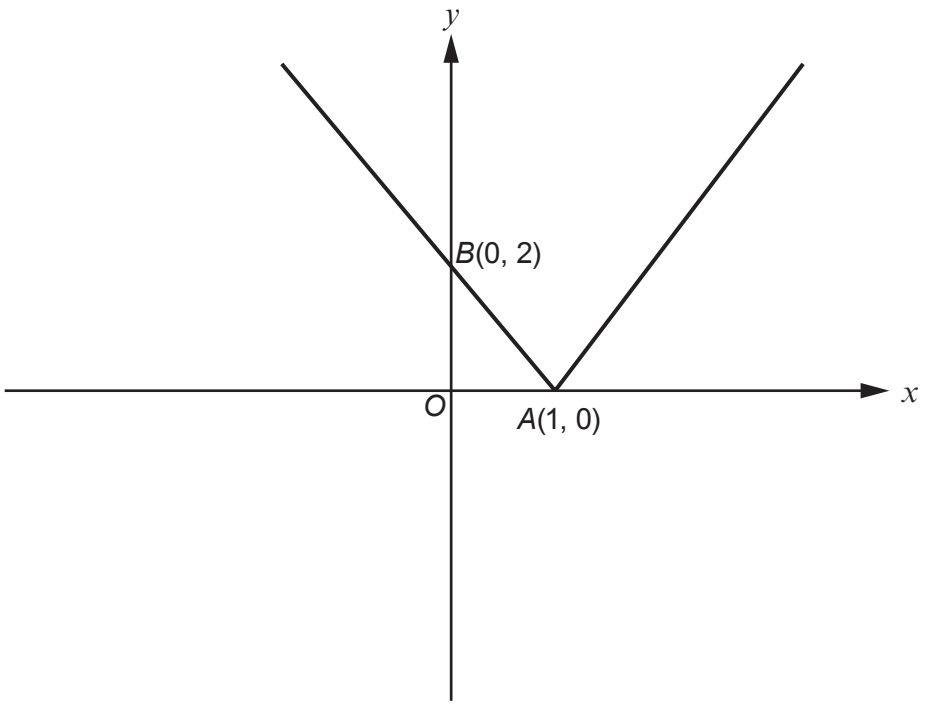
$r^2 = 25$

$r = 5$

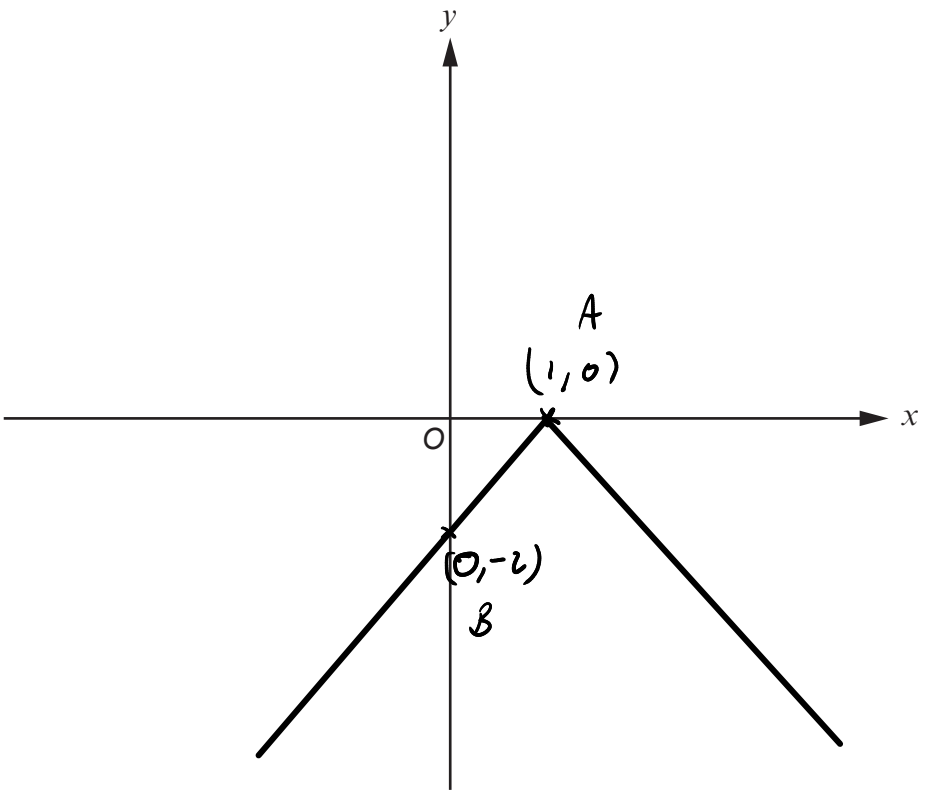
$x^2 + y^2 = 25$

Examiner only

18. The diagram shows a sketch of the graph of $y = f(x)$.
The point *A* has coordinates (1, 0) and the point *B* has coordinates (0, 2).

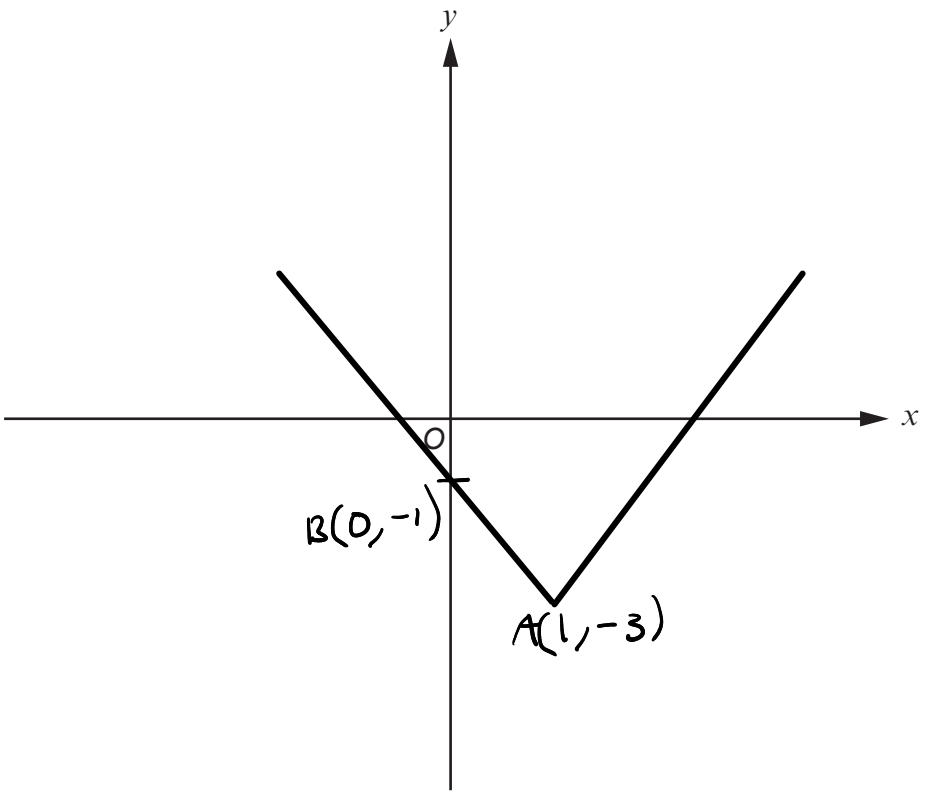


(a) Sketch the graph of $y = -f(x)$ on the axes below.
You must indicate the coordinates of the new positions of the points *A* and *B*. [2]



Examiner only

(b) Sketch the graph of $y = f(x) - 3$ on the axes below.
You must indicate the coordinates of the new positions of the points *A* and *B*. [2]



Examiner only

19. Water in a tank is x cm deep.
The tank has a tap which is slightly open.
The rate, R cm^3 per minute, at which the volume of water decreases is proportional to the square root of x.
When the water is 81 cm deep, the volume of water decreases at the rate of 900 cm^3 per minute.

(a) Find the rate at which the volume of water decreases when the depth of the water is 9 cm. [5]

$R = k\sqrt{x}$

$900 = k\sqrt{81}$

$900 = 9k$

$k = 100$

$R = 100\sqrt{x}$

$R = 100\sqrt{9}$

$= 300$ cm^3 per min

(b) Find the depth of the water when the rate at which the volume of water decreases is 400 cm^3 per minute. [2]

$400 = 100\sqrt{x}$

$4 = \sqrt{x}$

$16 = x$

16 cm

Examiner only

20. The functions $g(x)$ and $h(x)$ are defined, for $x > 2$, by

$$g(x) = x^2 - 1,$$
$$h(x) = 3x.$$

(a) Find the value of $hg(9)$. [2]

$g(9) = 9^2 - 1$
$= 80$
$h(80) = 3(80) = 240$

(b) Find and simplify an expression for $gh(2x)$. [3]

$h(2x) = 3(2x)$
$= 6x$
$g(6x) = (6x)^2 - 1$
$= 36x^2 - 1$

Examiner only

21. A manufacturer wants to test the performance of a new fuel.
In the test, a total of 20 litres of the fuel is shared between a car and a motorbike.

(a) The car uses x litres of fuel in the test.
Write an expression in terms of x for the number of litres used by the motorbike. [1]

$20 - x$

(b) The vehicles are driven and the distance travelled is recorded.
The table shows some of the test results.

	Distance travelled (miles)	Fuel used (litres)	Fuel consumption (Miles per litre)
Car	160	x	$\frac{160}{x}$
Motorbike	48	$20 - x$	$\frac{48}{20-x}$

The motorbike averaged 2 miles per litre more than the car in the test.

(i) Show that x satisfies the equation [5]

$$x^2 + 84x - 1600 = 0.$$

$\frac{48}{20-x} = \frac{160}{x} + 2$

$\frac{48}{20-x} = \frac{160}{x} + \frac{2x}{x}$

$\frac{48}{20-x} = \frac{160+2x}{x}$

$48x = (160+2x)(20-x)$

$48x = 3200 - 160x + 40x - 2x^2$

$48x = 3200 - 120x - 2x^2$

$24x = 1600 - 60x - x^2$

$x^2 + 84x - 1600 = 0$

Examiner only

(ii) Using an algebraic method, find the number of litres of fuel used by the motorbike. [3]

$x^2 + 84x - 1600 = 0$

1600
16 x 100

$(x + 100)(x - 16) = 0$

$x = -100 \quad x = 16$

$x = 16$

$\therefore \quad 20 - x = 4$

END OF PAPER

Examiner only

For continuation only.