

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 2 Calculator

Thursday 6 June 2019

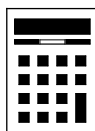
Morning

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.

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	

Advice

In all calculations, show clearly how you work out your answer.



Answer **all** questions in the spaces provided

- 1 Circle the point that lies on the curve $y = x^2 - 4x + 1$

[1 mark]

Substitute in the points

 $(-1, 4)$ $(-1, -4)$ $(-1, -2)$ $(-1, 6)$

$$6 = (-1)^2 - 4(1) + 1$$

$$6 = 1 + 4 + 1 \quad \checkmark$$

- 2 The height of a tree is 12 metres, correct to the nearest metre.

Circle the error interval.

[1 mark]

Include the lower interval, not the upper $11.5 \text{ m} \leq \text{height} < 12.5 \text{ m}$ $11.5 \text{ m} \leq \text{height} \leq 12.5 \text{ m}$ $11.5 \text{ m} < \text{height} \leq 12.5 \text{ m}$ $11.5 \text{ m} < \text{height} < 12.5 \text{ m}$ 

3 $2a$ is five times bigger than b .

Circle the ratio $a : b$

use the fact $2a = 5b$

[1 mark]

10 : 1

1 : 10

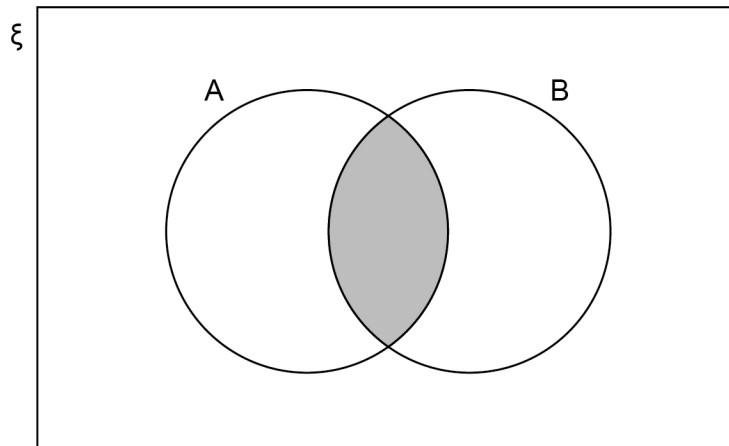
5 : 2

2 : 5

$$2 \times 5 = 5 \times 2$$

$$2 \times 2 = 5 \times 5$$

4



Which of these represents the shaded region?

Circle your answer.

[1 mark]

$A \cup B$

$(A \cap B)'$

$A \cap B$

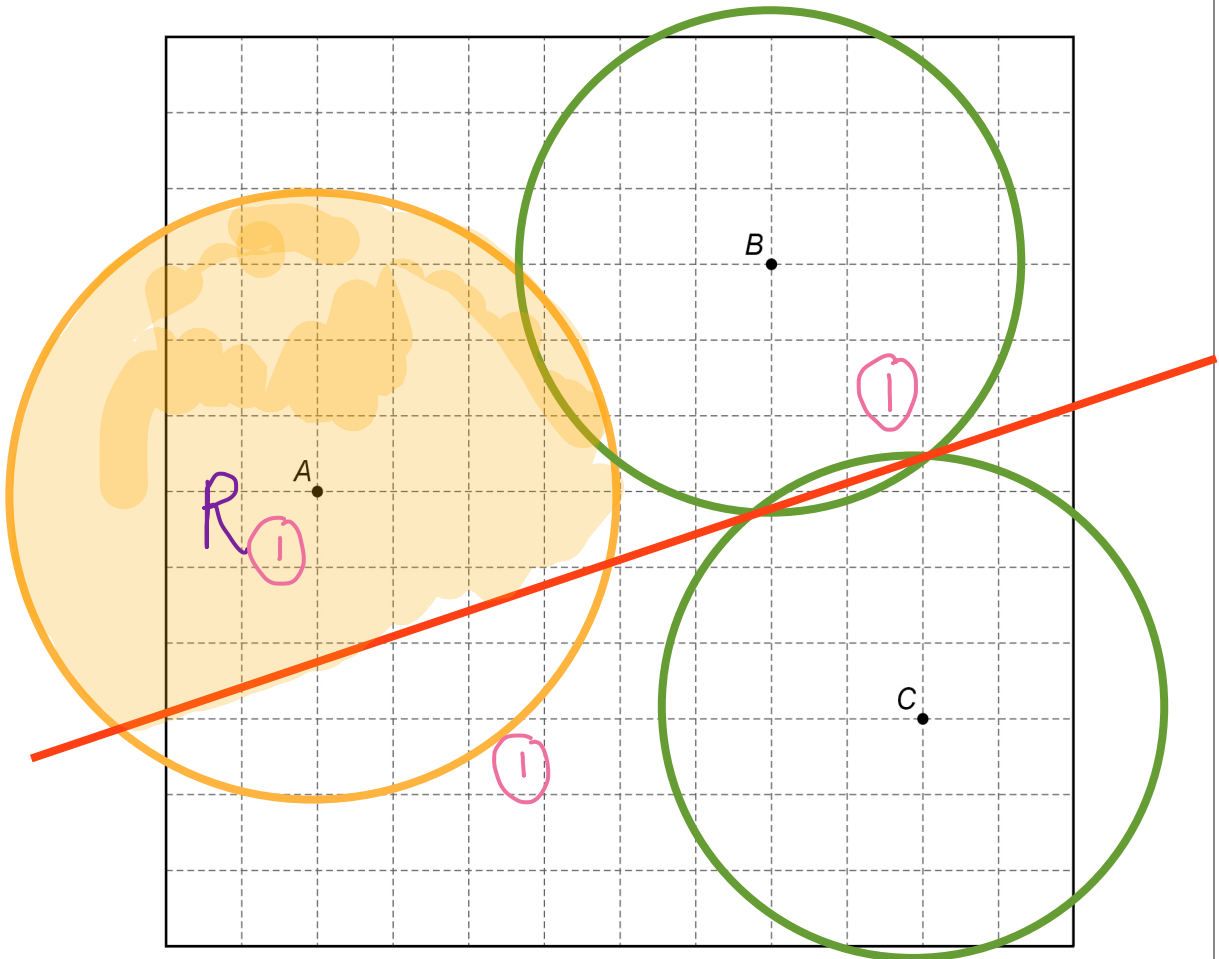
$A' \cup B'$

$A \cap B \rightarrow$ A and B

Turn over for the next question



- 5 Using ruler and compasses, show the region inside the grid that is
less than 4 cm from A
and
nearer to B than to C .
Label the region R .
Show all your construction lines.

[3 marks]

6

Beth drives 200 miles in 4 hours.

She drives the first 18 miles at an average speed of 36 mph



Work out her average speed for the rest of the journey.

[3 marks]

Calculate the length of time for the first part.

$$\frac{18}{36} = \frac{1}{2} \rightarrow 30 \text{ mins } \textcircled{1}$$

$200 - 18 = 182$ distance of the remaining journey

182 miles in 3.5 hours time of the remaining

$$\frac{182}{3.5} = 52 \text{ mph } \textcircled{1}$$

Answer 52 $\textcircled{1}$ mph

Turn over for the next question

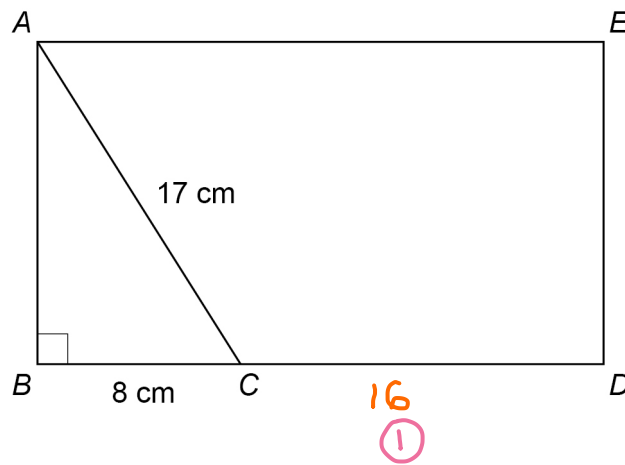


7

The diagram shows rectangle $ABDE$ and right-angled triangle ABC .

$$AC = 17 \text{ cm}$$

$$BC = 8 \text{ cm}$$



Not drawn
accurately

$$BC : CD = 1 : 2$$

Work out the area of rectangle $ABDE$.

[4 marks]

Calculate AB using pythagoras

$$17^2 - 8^2 = 289 - 64 \quad \textcircled{1}$$

$$= 225 \quad \therefore AB = 15 \quad \textcircled{1}$$

Calculate the area

$$15 \times (8 + 16) = 360$$

$\textcircled{1}$

Answer 360 cm²



8

On the axes, sketch the curve $y = x^3 - 2$.
You **must** show the coordinates of the y-intercept.

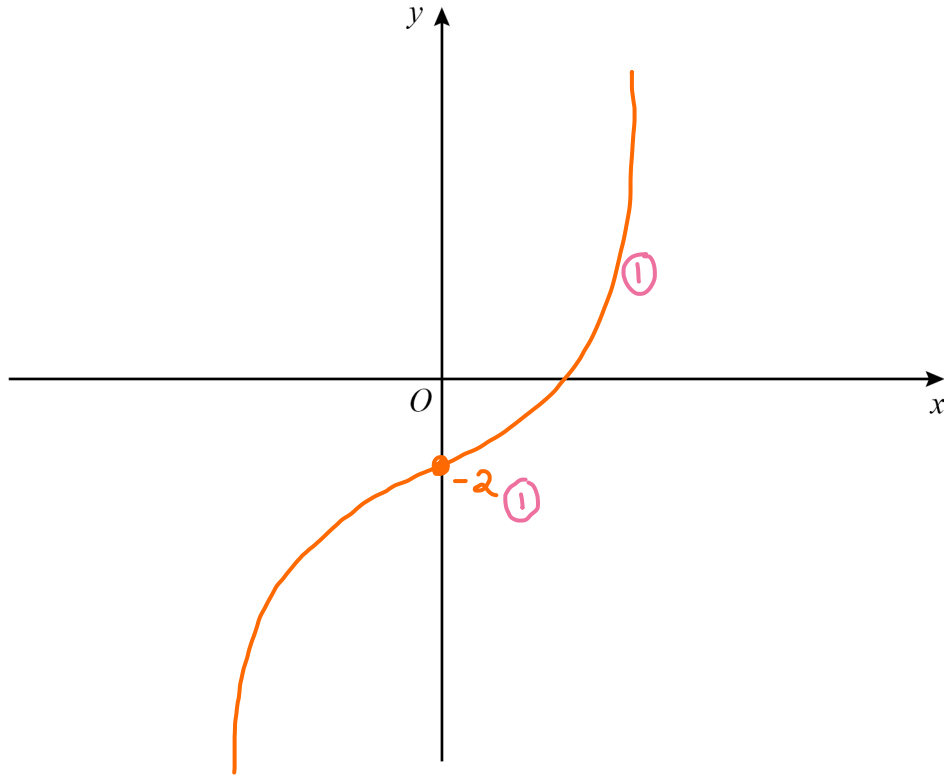
basic cubic

 $y = x^3 - 2$

y-intercept

Do not write
outside the
box

[2 marks]



Turn over for the next question

6

Turn over ►



- 9 In a sport, injury time is added time played at the end of a match.
The table shows the injury time, t (minutes) played in 380 matches.

Injury time, t (minutes)	Frequency	
$0 < t \leq 2$	59	59
$2 < t \leq 4$	158	217
$4 < t \leq 6$	106	323
$6 < t \leq 8$	45	368
$8 < t \leq 10$	12	380

- 9 (a) Circle the **two** words that describe the data.

[1 mark]

continuous

discrete

grouped

ungrouped

- 9 (b) Which class interval contains the median?
You **must** show your working.

[2 marks]

Calculate the running total (cumulative freq)

$$\frac{380}{2} = 190 \text{ (estimate)}$$

2 (1)

Answer 2 $< t \leq$ 4 (1)



9 (c) What percentage of the matches had **more than 6 minutes** of injury time?

[2 marks]

$$45 + 12 = 57$$

$$\frac{57}{380} = 0.15$$

Answer 15 %

10 x is an integer.

$$-4 < x \leq 2$$

and

$$2 \leq x + 3 < 9$$

Work out all the possible values of x .

[3 marks]

-4 -3 -2 -1 0 1 2 (1)

← +3 ←
2 3 4 5 6 7 8 9 (1)

- * Compare the two intervals
- * Show where the $x+3$ maps onto x .
- * Where they overlap are the values of x

Answer -1, 0, 1, 2 (1)



11 Joe and Kyle share an amount of money in the ratio $7 : n$

Joe gets 35% of the money.

Work out the value of n .

[2 marks]

Find the link between 7 and 35%

$$35\% = 7 \text{ parts}$$

$$65\% = n \text{ parts}$$

$$5\% \textcircled{1} = 1 \text{ part}$$

$$\therefore n = 13 \text{ parts}$$

Answer 13 $\textcircled{1}$

12 A biased coin is thrown 250 times.

The relative frequency of Heads is worked out after every 50 throws.

Choose the
greatest number of
trials

Total number of throws	50	100	150	200	250
Relative frequency	0.4	0.29	0.4	0.32	0.3

Circle the best estimate of the probability of Heads.

[1 mark]

$\textcircled{0.3}$

0.32

0.342

0.4



13

The amounts spent on clothes by 40 boys and 40 girls in one month were recorded. The table shows information about the amounts spent by the boys.

Amount, x (£)	Midpoint	Number of boys	
$0 \leq x < 20$	10	22	220
$20 \leq x < 40$	30	9	270
$40 \leq x < 60$	50	6	300
$60 \leq x < 80$	70	3	210
		Total = 40	1000

Big clue

The mean for the girls was £35

Estimate the mean for the girls as a percentage of the mean for the boys.

[5 marks]

Calculate the mean of boys $\frac{1000}{40} = 25$

Read carefully $\frac{\text{girls}}{\text{boys}} \rightarrow \frac{35}{25} = 1.4$

1.4×100 ← make it a percentage

Answer 140 %



14 Ali and Mel are making 3-digit codes.

The digit 0 is **not** used.

Ali only uses odd digits.

9 7 5 3 1

Mel only uses even digits.

8 6 4 2

14 (a) Ali can make x more codes than Mel.
Assume that digits **cannot** be repeated.

Work out the value of x .

[3 marks]

What digits can be used?

For combinations we multiply (no repeats)

Ali \rightarrow 1st \rightarrow 5 2nd \rightarrow 4 3rd \rightarrow 3

so $5 \times 4 \times 3 = 60$ (1) $60 - 24$ (1)

Mel \rightarrow 1st \rightarrow 4 2nd \rightarrow 3 3rd \rightarrow 2 = 36

so $4 \times 3 \times 2 = 24$

Answer 36 (1)

14 (b) In fact, digits **can** be repeated.

What does this tell you about the actual value of x ?

Tick **one** box.

[1 mark]

(1)

It is bigger than my answer to part (a)

It is smaller than my answer to part (a)

It is the same as my answer to part (a)

If unsure -
test it \rightarrow

Ali $\rightarrow 5 \times 5 \times 5 = 125$

Mel $\rightarrow 4 \times 4 \times 4 = 64$

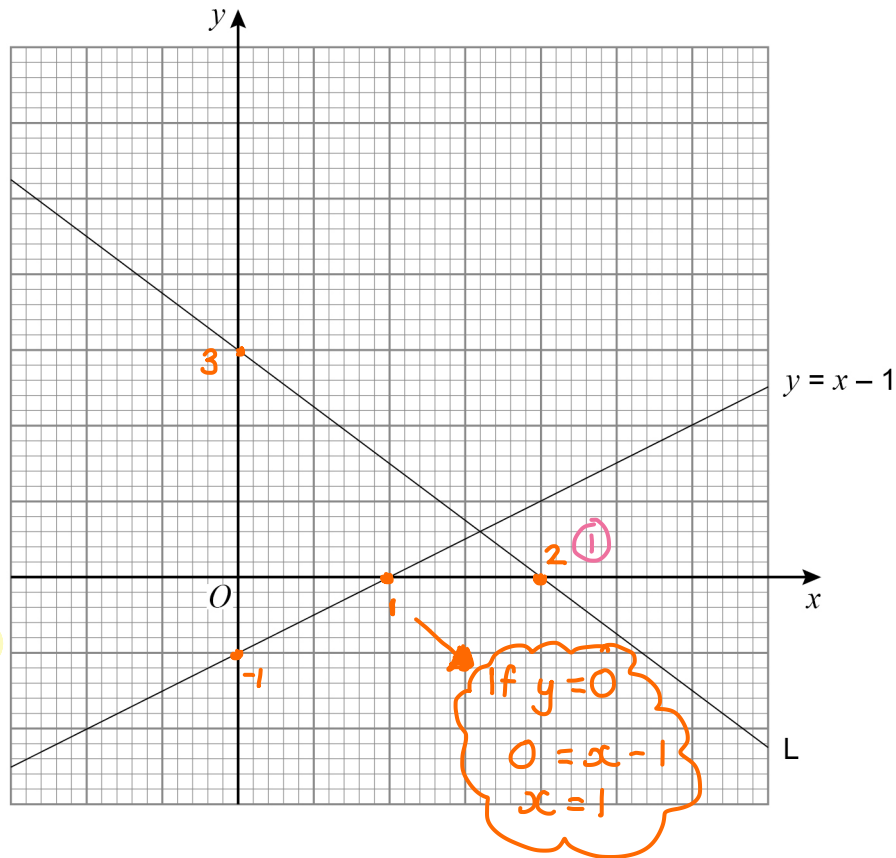
$125 - 64 = 61$



- 15 Here is line L and the graph of $y = x - 1$
The scales of the axes are not shown.

Look for
any clues
on the
graph.

What is
the scale?



Work out the equation of line L.

[4 marks]

Use $y = mx + c$ $y = mx + 3$ (1)

point (2, 0) lies on L

$$\text{so } 0 = 2m + 3$$

$$-3 = 2m$$

$$-3/2 = m$$

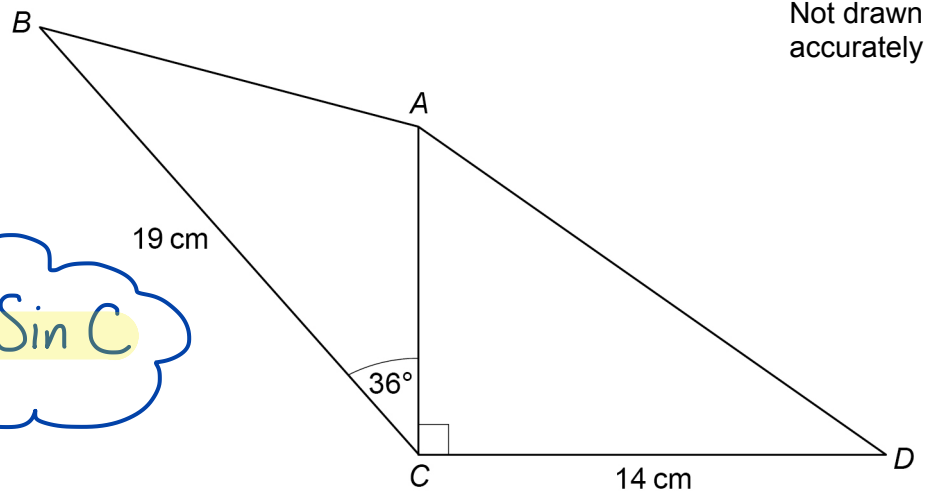
$$\frac{-3}{2} \text{ (1)}$$

$$\therefore y = -\frac{3}{2}x + 3$$

Answer $y = -\frac{3}{2}x + 3$ (1)



16

 ABC and ACD are triangles.Not drawn
accurately

Use $\frac{1}{2}ab \sin C$

The area of ACD is 80.5 cm^2 Work out the area of ABC .

Give your answer to 3 significant figures.

[4 marks]

Calculate AC $80.5 = \frac{AC \times 14}{2}$ (1)

$$161 = AC \times 14$$

$$AC = 11.5$$
 (1)

Calculate Area $\frac{1}{2}ab \sin C$

$$19 \times 11.5 \times \frac{1}{2} \times \sin 36$$

$$109.25 \times \sin 36 = 64.21554$$
 (1)

3 sig figs

Answer 64.2 (1) cm^2



17

$$m = \frac{p - 2b}{2}$$

$p = 68.3$ correct to 1 decimal place.

$b = 8.7$ correct to 1 decimal place.

Work out the lower bound for m .

[3 marks]

Calculate bounds $p = 68.3 \rightarrow 68.25 \leq p < 68.35$ (1)

$b = 8.7 \rightarrow 8.65 \leq b < 8.75$

Select the correct bounds to minimise m

$$\frac{68.25 - 2 \times 8.75}{2} \text{ (1)}$$

Answer 25.375 (1)

Turn over for the next question

Turn over ►



18

In a bag there are blue discs, green discs and white discs.

There are four times as many blue discs as green discs.

number of blue discs : number of white discs = 3 : 5

One disc is selected at random.

Work out the probability that the disc is either blue or white.

[3 marks]

Express ratio of green to blue

1 : 4 (1)

so

G : B : W

Combine the ratios

1 : 4

Finding multiples.

3 : 5

3 : 12 : 20

P(blue or white) = $\frac{32}{35}$

(1)

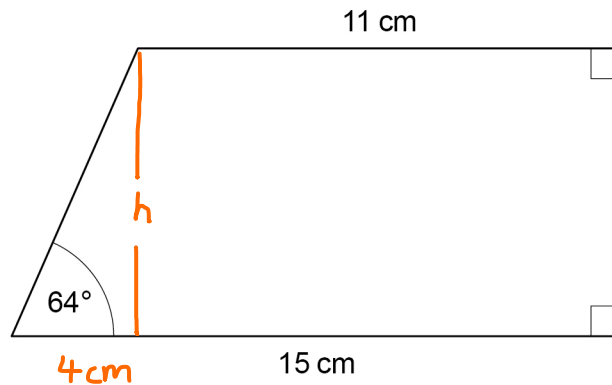
Answer

$\frac{32}{35}$ (1)



19

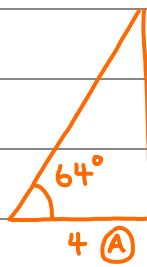
Work out the area of the trapezium.

Not drawn
accurately

[4 marks]

Area of trapezium $\rightarrow (a+b) \times \frac{1}{2} h$

Find the height using trig



$$\begin{aligned} \text{T}^\circ \text{A} &\rightarrow \tan 64 \times 4 \\ &= 8.2012 \end{aligned}$$

Now calculate the area

$$(11 + 15) \times \frac{1}{2} \times 8.2012$$

$$= 106.6157998$$

Answer 106.62 cm²

Turn over for the next question

Turn over ►



20

Expressions for consecutive triangular numbers are

$$\frac{n(n+1)}{2} \quad \text{and} \quad \frac{(n+1)(n+2)}{2}$$

Prove that the sum of two consecutive triangular numbers is always a square number.

[4 marks]

Add the expressions together

$$\frac{n(n+1)}{2} + \frac{(n+1)(n+2)}{2} = \frac{n^2+n+n^2+3n+2}{2} \quad (1)$$

Simplify

$$= \frac{2n^2+4n+2}{2}$$

Factorise

$$= n^2+2n+1 \quad (1)$$

$$(n+1)(n+1) \quad (1)$$

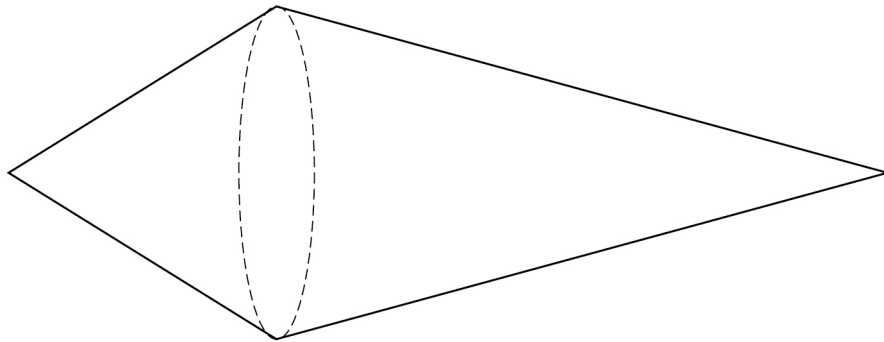
$$\rightarrow (n+1)^2 \quad \therefore \text{a square number}$$



21

A solid shape is made by joining two cones.

Each cone has the same radius.



One cone has slant height = $2 \times$ radius

The other cone has slant height = $3 \times$ radius

The total surface area of the shape is $57.8\pi \text{ cm}^2$

Curved surface area of a cone = $\pi r l$ where r is the radius and l is the slant height

Work out the radius.

[3 marks]

Use information above to write equations for each

cone

$$\pi r l \quad \pi r 2r + \pi r 3r = 57.8\pi$$

$$2\pi r^2 + 3\pi r^2 = 57.8\pi \quad (1)$$

Divide by π $2r^2 + 3r^2 = 57.8$

$$5r^2 = 57.8 \quad (1)$$

$$r^2 = \frac{57.8}{5}$$

$$r^2 = 11.56$$

$$r = 3.4$$

Answer 3.4 (1) cm

7

Turn over ►



22 Show that $(5\sqrt{3} - \sqrt{12})^2$ simplifies to an integer.

[3 marks]

Expand out the bracket

$$(5\sqrt{3} - \sqrt{12})(5\sqrt{3} - \sqrt{12}) = 75 + 12 - 30 - 30$$

$$= \underline{\underline{27}}$$

$$5\sqrt{3} \times 5\sqrt{3} = 75$$

$$-\sqrt{12} \times -\sqrt{12} = 12$$

$$5\sqrt{3} \times -\sqrt{12} = -5\sqrt{36} = -30$$

$$5\sqrt{3} \times -\sqrt{12} = -30$$

23 A and B are similar cuboids.

surface area of A : surface area of B = 16 : 25

Work out volume of A : volume of B

Circle your answer.

[1 mark]

4 : 5

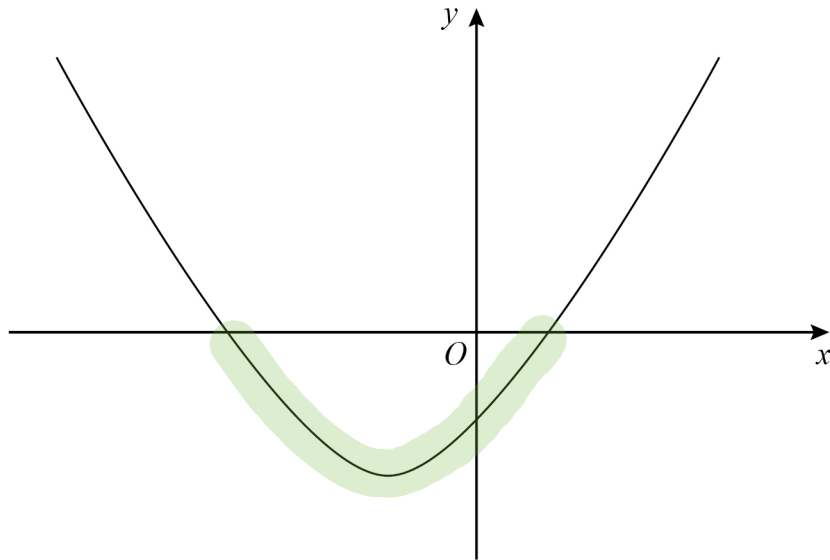
16 : 25

64 : 125

256 : 625



24

Here is a sketch of the curve $y = x^2 + 4x - 12$ Work out the values of x for which $x^2 + 4x - 12 < 0$

Give your answer as an inequality.

less than zero

[3 marks]

Treat it like an equation

$$x^2 + 4x - 12 = 0$$

$$(x + 6)(x - 2) = 0 \quad \textcircled{1}$$

$$x = -6 \text{ or } x = 2$$

Refer back to inequality $x > -6$ or $x < 2$

Answer $x > -6$ or $x < 2$



25

A sample of 50 eggs is taken from Farm A.

The table shows information about the masses of the eggs from Farm A.

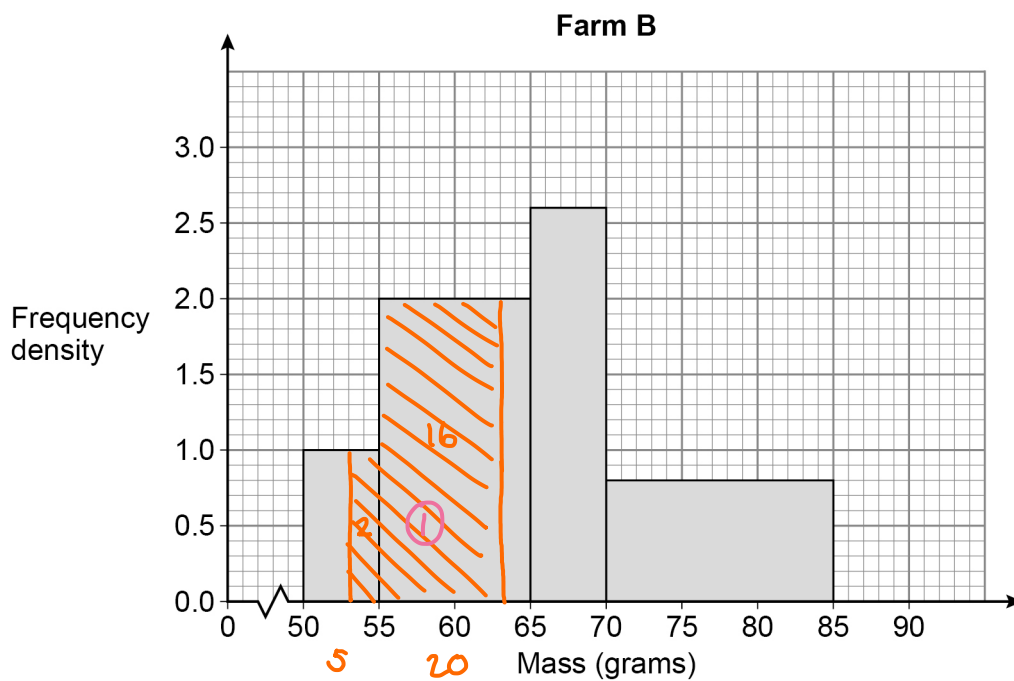
Farm A

Mass, m (grams)	Frequency
$53 < m \leq 58$	8
$58 < m \leq 63$	19
$63 < m \leq 68$	15
$68 < m \leq 73$	8

8
27

A sample of 50 eggs is taken from Farm B.

The histogram shows information about the masses of the eggs from Farm B.



For medium eggs, $53 \text{ g} < \text{mass} \leq 63 \text{ g}$

The Farm A sample has more medium eggs than the Farm B sample.

Using the table and the histogram, estimate how many more.

You **must** show your working.

[4 marks]

Use the table to calculate Sample A - 27 (1)

Use the histogram to calculate Sample B - 18 (1)

$$27 - 18 = 9 \text{ more}$$

Answer 9 more (1)

Turn over for the next question



26

$$(x + 5)(x + 2)(x + a) \equiv x^3 + bx^2 + cx - 30$$

Work out the values of the integers a , b and c .

[3 marks]

Expand brackets and equate coefficients

$$(x + 5)(x + 2) = x^2 + 7x + 10$$

$$(x^2 + 7x + 10)(x + a) = x^3 + 7x^2 + 10x + ax^2 + 7ax + 10a \quad (1)$$

Simplify $x^3 + (7+a)x^2 + (10+7a)x + 10a$

Compare to expression $x^3 + bx^2 + cx - 30$

$$10a = -30 \quad 7+a = b \quad b = 4 \quad 10+7a = c$$

$$a = -3 \quad 7-3 = b \quad 10-21 = c$$

$$a = \underline{-3}$$

$$b = \underline{4} \quad (1)$$

$$c = \underline{-11} \quad (1)$$



27

$$f(x) = \frac{2x}{5} - 1$$

this means the
inverse function.

Work out the value of $f^{-1}(3) + f(-0.5)$

[5 marks]

Calculate the inverse function

$$f(x) = \frac{2x}{5} - 1 \quad \text{let } y = \frac{2x}{5} - 1$$

$$f^{-1}(x) = \frac{5x+5}{2}$$

$$5y = 2x - 5 \quad (1)$$

$$5y + 5 = 2x$$

$$\frac{5y+5}{2} = x$$

Sub in values $f^{-1}(3) = \frac{5(3)+5}{2} = 10 \quad (1)$

$$f(-0.5) = \frac{-1}{5} - 1 = -1\frac{1}{5} \quad (1)$$

$$10 - 1\frac{1}{5} = 8\frac{4}{5}$$

Answer $8\frac{4}{5} \quad (1)$

END OF QUESTIONS



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2 8



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