

Please write clearly in block capitals.

Centre number Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

**GCSE
MATHEMATICS**

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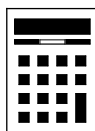
Higher Tier Paper 3 Calculator

Monday 12 November 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.

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	
TOTAL	

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

Answer **all** questions in the spaces provided

- 1 A shape is translated by the vector $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

In which direction does the shape move?

Circle your answer.

[1 mark]

up

down

left

right

The top number of the vector is the x direction.
The bottom number of the vector is the y direction

- 2 What is 1.75 kilometres as a fraction of 700 metres?

Circle your answer.

[1 mark]

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

$$\frac{1}{4}$$

$$\frac{4}{1}$$

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

Convert the kilometres into metres. There are 1000 metres in a kilometre. Then write the number of metres over the 700 metres in the calculator and it will convert it into a fraction in its simplest form

- 3 The first 4 terms of a linear sequence are

3 11 19 27

Circle the expression for the n th term.

[1 mark]

$$8 - 5n$$

~~$$n + 8$$~~

~~$$8n + 3$$~~

$$8n - 5$$

$n = 1$ on the first term. So it can't be $n + 8$ as the first term would be 9 and it can't be $8n + 3$ as the first term would be 11. Try working out the second term of the ones which are left



4 Work out the lowest common multiple (LCM) of 20, 30 and 40

Circle your answer.

[1 mark]

10 is a factor,
not a multiple

~~10~~

120

240

24 000

The number needs to be in the 20, 30 and
40 times tables and be as small as possible

5 The length of a table is 110 cm to the nearest cm

Complete the error interval.

[2 marks]

The resolution is 1cm. Half the resolution then add and
subtract it from 110 to get the upper and lower bound

_____ cm \leq length < _____ cm

Turn over for the next question



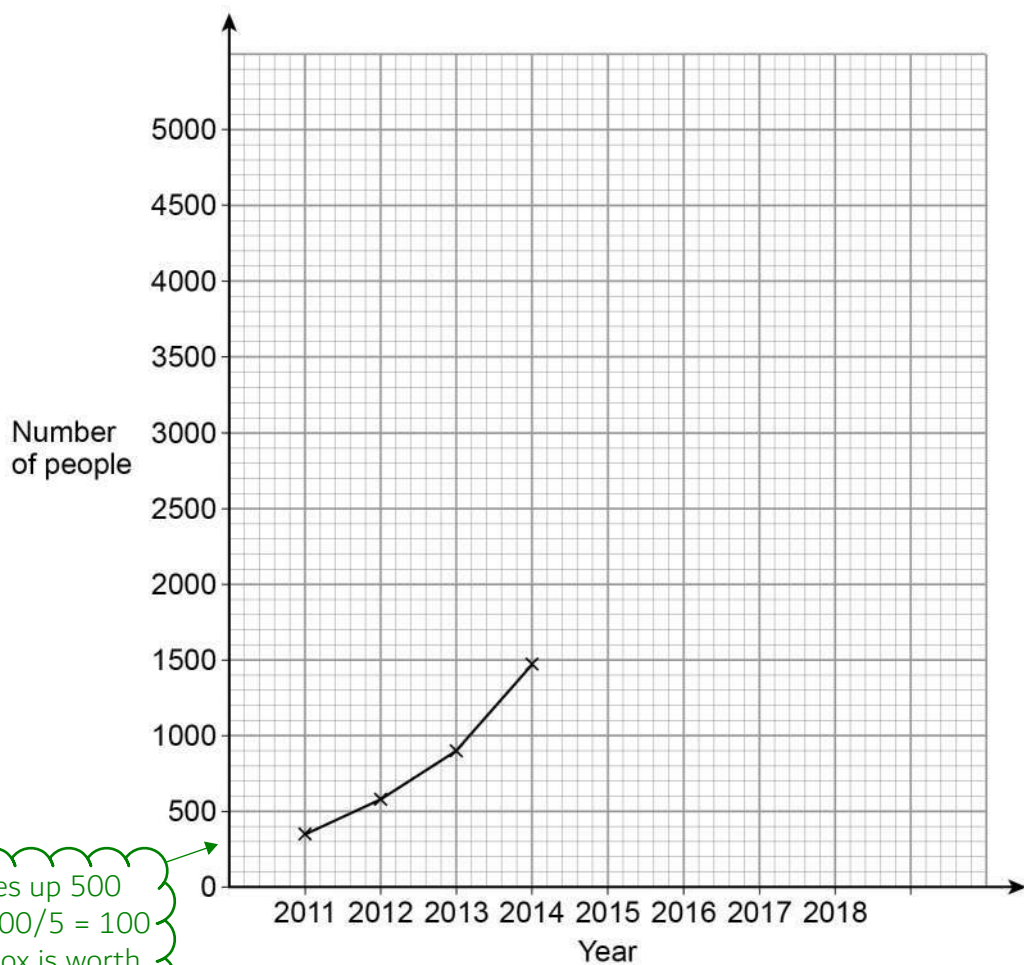
6 A music festival has taken place each year from 2011

The table shows the number of people who attended each year.

Year	2011	2012	2013	2014	2015	2016	2017	2018
Number of people	350	583	906	1471	2023	2612	3251	3780

The festival organisers draw a time series graph to represent the data.

The first four years have been plotted.



The scale goes up 500 over 5 boxes. $500/5 = 100$ so each little box is worth 100 in the y direction



6 (a) Complete the graph.

[2 marks]

Plot the values for 2015, 2016, 2017 and 2018
then join them up with a series of straight lines

6 (b) Use the graph to estimate the number of people who will attend the festival in 2019

[2 marks]

The trend could continue upward with a similar gradient for 2019

Answer _____

Turn over for the next question



7

$$k = n^2 + 9n + 1$$

Mo says,

“ k will be a prime number for all integer values of n from 1 to 9”

Show that Mo is wrong.

You **must** show that your value of k is **not** prime.

[3 marks]

Use table mode by pressing menu then 3. Set $f(x) = x^2 + 9x + 1$. Ignore $g(x)$. Start: 1. End: 9. Step: 1. This lists out all of the values of k needed

Prime numbers only have two factors, themselves and 1

FACT B

0 9 "

To check if a number is prime by using your calculator, enter the number, press equals, press SHIFT then press FACT (the button on the left). This expresses the number as a product of prime factors. If it comes back as itself, it must be prime



8

Doug owes an amount of £600

He wants to pay off this amount in five months.

He says,

“Each month, I will pay back 20% of the amount I still owe.”

Show working to check if his method is correct.

[3 marks]

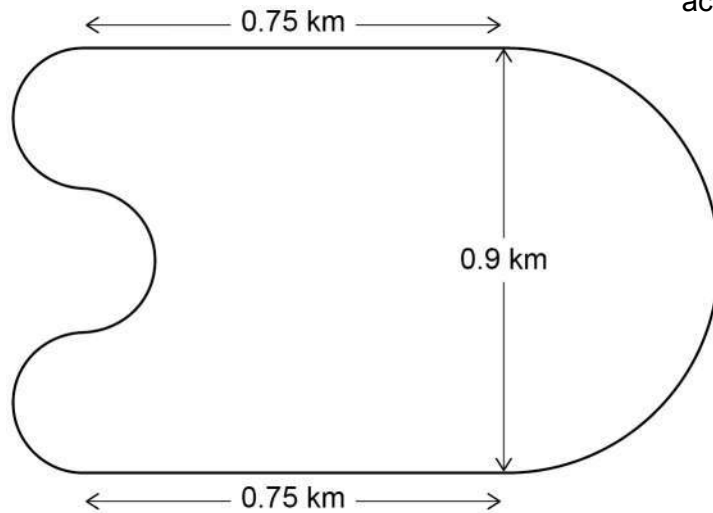
100% - 20% = 80%, so paying back 20% leaves 80% of the amount he owes.
80% as a decimal is 0.8 so multiplying by this reduces the amount by 20%.
Reduce the amount by 20% 5 times to see if he his method is correct

Turn over for the next question



9

A motor racing circuit consists of
two parallel straight sections, each of length 0.75 km
a semicircle of diameter 0.9 km
three equal, smaller semicircles.

Not drawn
accurately

The length of a motor race must be greater than 305 km

What is the lowest number of **full** laps needed at this circuit?

You **must** show your working.

[5 marks]

Dividing the 305km by the distance of one full lap gives the number of laps needed. The result will be a decimal so it needs to be rounded to a whole number.

$$\text{Circumference} = \pi \times \text{diameter}$$

Answer _____



10 Solve $8 > 3 - \frac{1}{2}x$

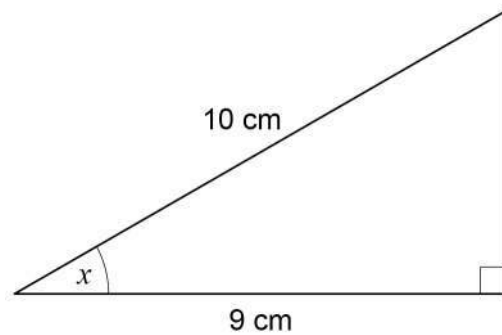
[2 marks]

Rearrange to make x the subject. The inequality behaves in a similar way to an equation but when dividing by a negative, the inequality symbol needs to flip

Answer _____

11 Use trigonometry to work out the size of angle x .

[2 marks]



Not drawn
accurately

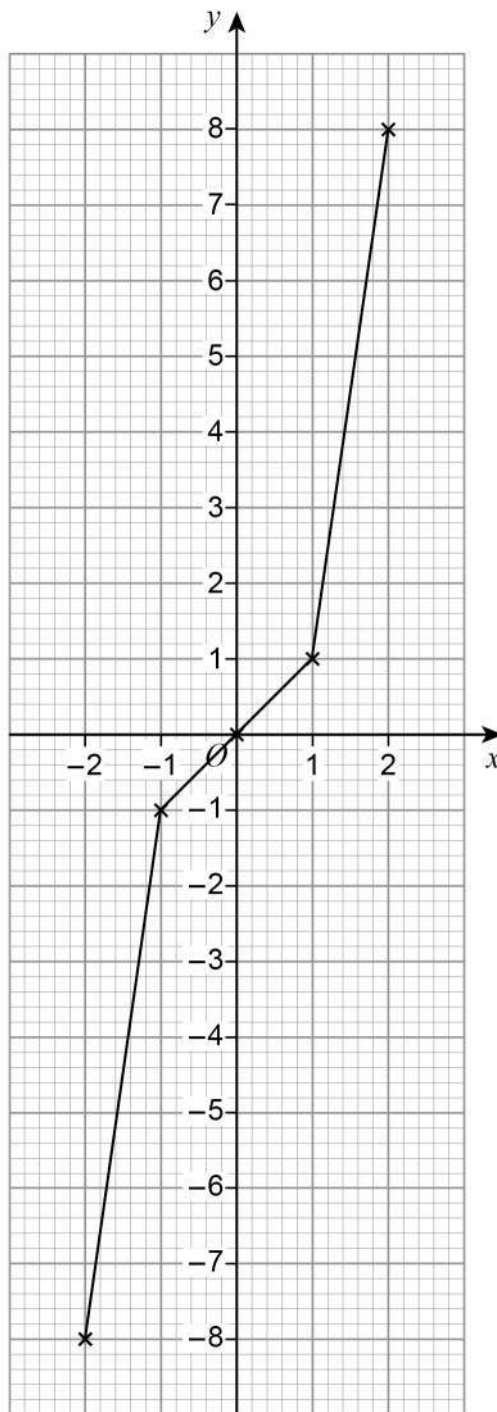
SOHCAHTOA

Listing SOH CAH TOA as formula triangles then ticking what we have.
If there are two ticks on one of the formula triangles, it can be used

Answer _____ degrees



- 12 Lewis wants to draw the graph $y = x^3$ for values of x from -2 to 2 . Here is his graph.



Make **one** criticism of his graph.

[1 mark]

The plotted points are correct but everything between them is incorrect. For example, 0.5^3 is not 0.5



- 13** The probability of Heads when a biased coin is thrown is 0.6
The coin is thrown 500 times.
Circle the expected number of Tails.

[1 mark]

20 200 250 300

0.6 x 500 works out the expected number of Heads

- 14** The mean mass of a squad of 19 hockey players is 82 kg
A player of mass 93 kg joins the squad.
Work out the mean mass of the squad now.

[3 marks]

Mean = total/number, where total is the total mass of the squad and number is the number of players in the squad. Rearranging the formula gives total = mean x number. Work out the total mass of the 19 players then add the 93kg to give the total of all 20 players

Answer _____ kg

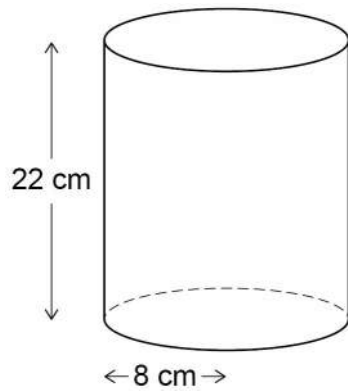


- 15 A company makes two types of lampshade using fabric on wire frames.

Lampshade A

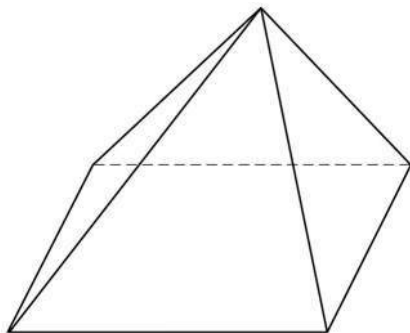
Fabric is used to make the curved surface of a cylinder.

The cylinder has radius 8 cm and height 22 cm

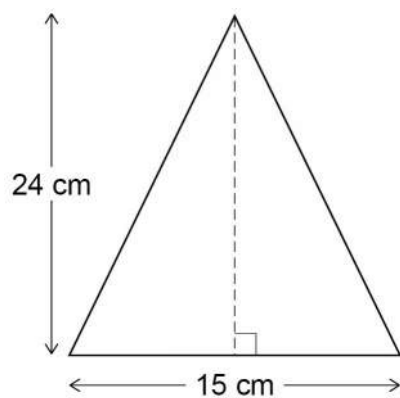


Lampshade B

Fabric is used to make the four triangular faces of a pyramid.



Each triangular face has base 15 cm and perpendicular height 24 cm



Not drawn
accurately



Cost of fabric	£400 per square metre
Other costs for A	£3.50 per lampshade
Other costs for B	£7.50 per lampshade

Work out the ratio cost of one lampshade A : cost of one lampshade B

Give your answer in the form $n : 1$

[5 marks]

To get 1 on the right side of the ratio, the cost of one lampshade B must be divided by the cost of one lampshade B (dividing a number by itself gives 1). So to work out n , we can divide the cost of one lampshade A by the cost of one lampshade B (as both sides of the ratio need to be divided by the same amount).

The cost of fabric is per square metre so all the measurements in centimetres should be converted into metres (there are 100 centimetres in a metre). This ensures the areas are worked out in square metres rather than square centimetres.

The curved surface area of a cylinder = πdh , where d is the diameter and h is the height
Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$

Answer _____ : _____

5

Turn over ►



- 16** In a running club there are 50 females and 80 males.
 If a female is chosen at random, the probability she has blue eyes is 0.38
 If a male is chosen at random, the probability he has blue eyes is 0.6
 One person is chosen at random.
 Show that the probability the person has blue eyes is **more than** 0.5 **[4 marks]**

Express the number of people with blue eyes as a fraction of the number of people then convert the fraction into a decimal, which should be more than 0.5.

Multiplying the probability of a female having blue eyes by the number of females gives the number of females with blue eyes.

17 $w = \frac{3}{5\sqrt{x}}$

Circle the expression for w^2

[1 mark]

$$\frac{6}{10x^2}$$

$$\frac{9}{25x^2}$$

$$\frac{6}{10x}$$

$$\frac{9}{25x}$$

Squaring w also squares the right side of the equation. To square a fraction, square the numerator and the denominator



18 Here is some information about the ages of people at a concert.

Age, x (years)	Frequency
$10 \leq x < 15$	8
$15 \leq x < 25$	24
$25 \leq x < 40$	30
$40 \leq x < 70$	39

$C F d$
 Frequency density = frequency/class width

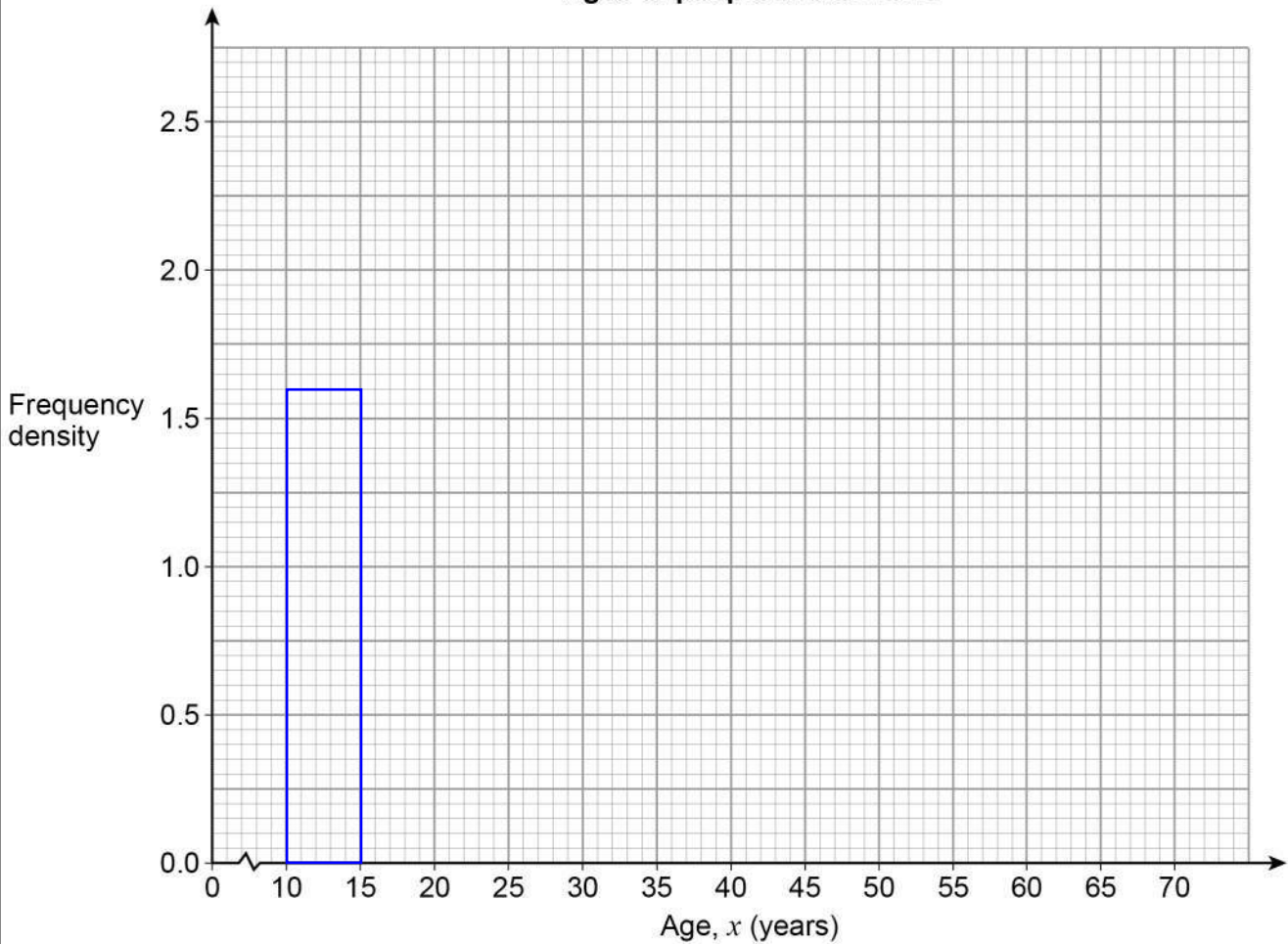
$8 / (15 - 10) = 1.6$

Working out the frequency densities for each category. The class width is the range of the values of each category

Draw a histogram to represent the information.

[3 marks]

Ages of people at a concert



8

Turn over ►



19

The length of a roll of ribbon is 30 metres, correct to the nearest half-metre.
A piece of length 5.8 metres, correct to the nearest 10 centimetres, is cut from the roll.
Work out the maximum possible length of ribbon left on the roll.

[3 marks]

The maximum possible length is left when the amount started with is as great as possible and the amount cut from the roll is as small as possible.

To find the upper and lower bounds of the lengths, half the resolution (how much it goes up in, or what it has been rounded to the nearest) then add or subtract it from the quoted value

Answer _____ metres



20

Curve P has equation $y = 2(x - 1)^2 - 5$ Curve Q is a reflection in the y -axis of curve P.

Work out the equation of curve Q.

Give your answer in the form $y = ax^2 + bx + c$ where a , b and c are integers.**[3 marks]**

$$y = 2(-x - 1)^2 - 5$$

It is a reflection in the y -axis so all the x become negative

Expanding out the square bracket and
simplify until it is in the desired form

Answer _____

Turn over for the next question

Turn over ►



21

Priya and Joe travel the same 16.8 km route.

Priya starts at 9.00 am and walks at a constant speed of 6 km/h

Joe starts at 9.30 am and runs at a constant speed.

Joe overtakes Priya at 10.20 am

At what time does Joe finish the route?

[5 marks]

 $S^D T$

From the formula triangle, time = distance/speed

Adding the time taken for Joe to finish the route to 9:30am gives the time he finished. To get the time taken for Joe to finish the route, the total distance of the route needs to be divided by Joe's speed.

To get Joe's speed, we need to divide the distance he has done by 10:20am by the amount of time taken between 9:30am and 10:20am. The distance he has done by 10:20am is the same distance as Priya has done by 10:20am (as Joe overtakes Priya at this time).

The distance Priya has done is found by multiplying her speed by the amount of time taken

To put time into the calculator, enter the hours, press the button on the left, enter the minutes then press the button on the left again. For example, 10:20 should be entered as 10°20° into the calculator.



To convert the result the calculator gives into time, press the button on the left

Answer _____



22 An approximate solution to an equation is found using the iterative formula

$$x_{n+1} = \frac{(x_n)^3 - 2}{10} \quad \text{with } x_1 = -1$$

22 (a) Work out the values of x_2 and x_3

[2 marks]

Enter -1 then press =. Enter (Ans³ - 2)/10
and press = to get x_2 . Press = again to get x_3

$x_2 =$ _____

$x_3 =$ _____

22 (b) Work out the solution to 5 decimal places.

[1 mark]

Following on from what was done in part (a), keep
pressing = until all the decimal places do not change

Round the result to 5 decimal places

$x =$ _____

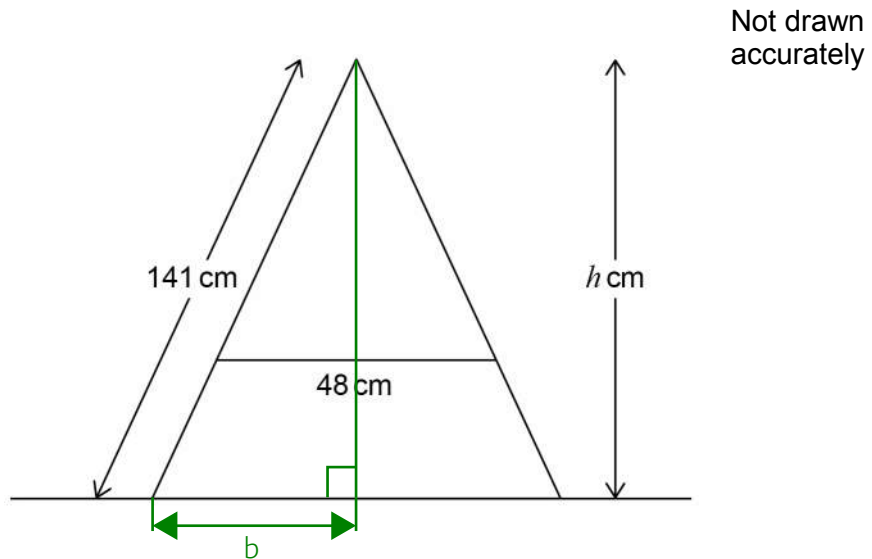


23

The diagram shows the side view of a step ladder with a horizontal strut of length 48 cm

The strut is one third of the way up the ladder.

The symmetrical cross section of the ladder shows two similar triangles.



Work out the vertical height, h cm, of the ladder.

[5 marks]

Drawing a line down the line of symmetry divides the shape in two and gives a right angled triangle. The missing side is h and this can be found using Pythagoras' Theorem.

$a^2 + b^2 = c^2$, where c is the longest side and a and b are the shorter sides. Rearrange to make a (which is representing h) the subject

b is found by using the fact the triangles are similar. The strut is $1/3$ of the way up the ladder, so is $2/3$ of the way down. $2/3$ of the base of the ladder is 48cm

Answer _____ cm



24

Volume of a sphere = $\frac{4}{3}\pi r^3$ where r is the radius

Volume of a cone = $\frac{1}{3}\pi r^2 h$ where r is the radius and h is the perpendicular height

A sphere has radius $2x$ cm

A cone has

radius $3x$ cm

perpendicular height h cm

The sphere and the cone have the same volume.

Work out radius of cone : perpendicular height of cone

Give your answer in the form $a : b$ where a and b are integers.

[4 marks]

Set the volume of the sphere equal to the volume of the cone as they have the same volume. Substitute $2x$ for r in the volume of the sphere and $3x$ for r in the volume of the cone. This should give an equation which can be rearranged and simplified to express the perpendicular height of the cone, h , in terms of x . Write the ratio of the radius of cone : perpendicular height of cone and simplify it to get rid of x and any fractions

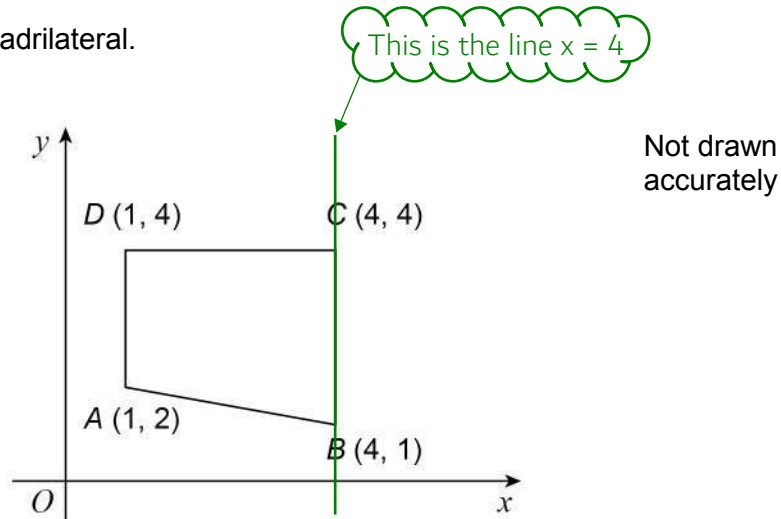
Answer _____ : _____

9

Turn over ►



25

 $ABCD$ is a quadrilateral.The quadrilateral is reflected in the line $x = 4$

Which vertices are invariant?

Which corners do not move?

Circle your answer.

[1 mark]

A and D

C and D

B and C

B and D



26

$$f(x) = \frac{2x+3}{x-4}$$

Work out $f^{-1}(x)$

$$x = \frac{2y+3}{y-4}$$

$f(x)$ is basically y . The inverse function is when x and y are swapped so doing this then rearranging to make y the subject finds the inverse function

[4 marks]

Answer _____

Turn over for the next question**Turn over ►**

27 The line $y = 3x + p$ and the circle $x^2 + y^2 = 53$ intersect at points A and B .
 p is a positive integer.

27 (a) Show that the x -coordinates of points A and B satisfy the equation

$$10x^2 + 6px + p^2 - 53 = 0$$

[3 marks]

Substitute $3x + p$ for y in the second equation. Expand out the square bracket using 'square the first term, double the product of the two terms, square the last term'. Subtract 53 from both sides. Collect the like terms



27 (b) The coordinates of A are $(2, 7)$

Work out the coordinates of B .

You **must** show your working.

[5 marks]

A satisfies the equation $y = 3x + p$ so substituting in its x and y -coordinates into the equation allows us to rearrange and find p .

Substitute in the value of p in $10x^2 + 6px + p^2 - 53 = 0$ to get a quadratic in terms of x which can be solved using the quadratic formula. This finds the x -coordinates of A and B .

Substitute the value of x (which isn't 2) and the value of p into the equation $y = 3x + p$ to find the y -coordinate of point B

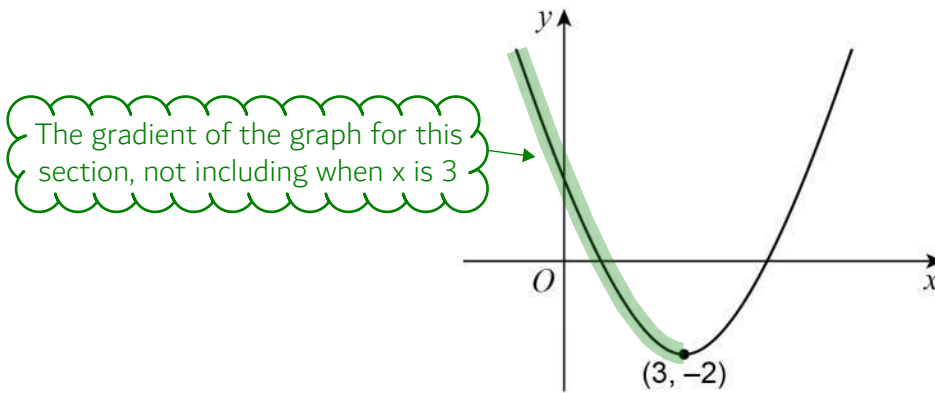
Answer (_____ , _____)

Turn over for the next question



- 28 Here is a sketch of a quadratic curve.
The turning point is $(3, -2)$

Not drawn
accurately



Circle the correct statement about the gradient of the curve for $x < 3$

[1 mark]

gradient is positive

gradient is negative

gradient is zero

gradient could be any value

END OF QUESTIONS

