

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

GCSE MATHEMATICS

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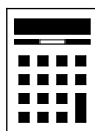
Higher Tier Paper 3 Calculator

Wednesday 8 November 2017 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.
- 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.

Advice

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

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	



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.

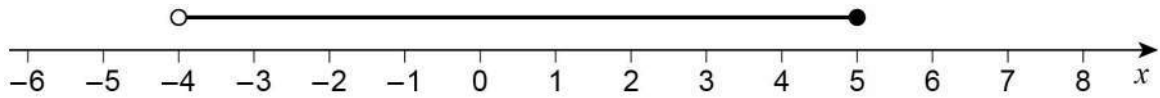
Anything written in green in a cloud doesn't have to be written in the exam.

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 Circle the inequality shown by the diagram.



[1 mark]

$-4 \leq x < 5$ $-4 \leq x \leq 5$ $-4 < x < 5$ $-4 < x \leq 5$

The closed dot means it can be equal to the value it is above.
The open dot means it cannot be equal to the value it is above

- 2 y is 100% **more** than x .

Circle the ratio $x : y$

[1 mark]

1 : 100 100 : 1 1 : 2 2 : 1

Increasing by 100% makes it 200%. So the ratio would be 100 : 200, which simplifies to ...

- 3 The first four terms of a sequence are -10 -8 -6 -4

Circle the expression for the n th term of the sequence.

[1 mark]

$-12 - 2n$ $-8 - 2n$ $n + 2$ $2n - 12$

The sequence increases by 2 between each term so it must involve $2n$



- 4 Circle the equation of the line that is parallel to the x -axis.

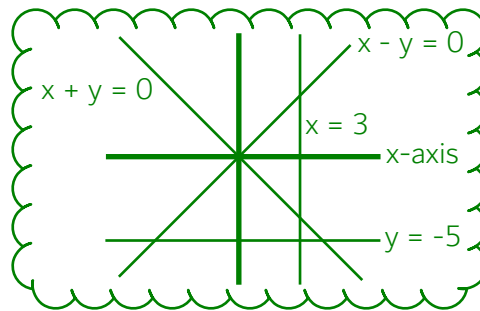
[1 mark]

$y = -5$

$x - y = 0$

$x = 3$

$x + y = 0$



- 5 Multiply out and simplify $(x - 8)^2$

[2 marks]

$$(x - 8)(x - 8)$$

Answer _____

Turn over for the next question

Turn over ►



- 6 Show that 268 can be written as the sum of a power of 3 and a square number.

[2 marks]

Enter table mode by pressing MENU then 3. $f(x) = 268 - 3^x$. Ignore $g(x)$. Start: 1. End: 30. Step: 1

Subtracting the powers of 3 from 268 until the result is a square number

Answer _____

- 7 Here is some information about the times taken by 40 people to fill in a form.

Time, t minutes	Number of people
$0 < t \leq 5$	3
$5 < t \leq 10$	9
$10 < t \leq 15$	11
$15 < t \leq 20$	17

In which class interval is the median?

Circle your answer.

[1 mark]

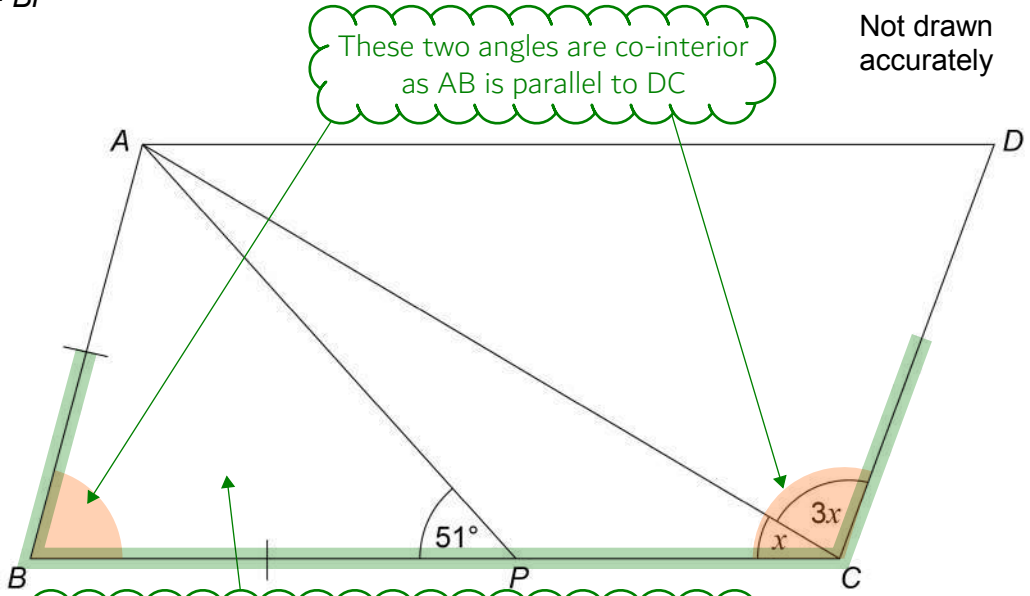
$0 < t \leq 5$ $5 < t \leq 10$ $10 < t \leq 15$ $15 < t \leq 20$

The formula $(n + 1)/2$, where n is the number of people, works out which value is the median. Listing a cumulative frequency until it goes over this. The median is in the category where it first goes over



8 $ABCD$ is a parallelogram.

$AB = BP$



Work out the size of angle x .

[4 marks]

Base angles of an isosceles triangle are equal. The angles in a triangle add up to 180. Co-interior angles add up to 180

Answer _____ degrees

Turn over for the next question



9 (a) Rearrange $v = u + at$ to make t the subject of the formula.

[2 marks]

Follow the order of operations, BIDMAS, backwards and do the opposite operations to both sides to eliminate everything apart from t on the right side

Answer _____

9 (b) Complete this table with consistent metric units.

[2 marks]

Distance	Time	Speed	Acceleration
m	s		

Speed = distance/time. Dividing the metres by seconds give the unit of speed.

Acceleration = (change in speed)/(change in time). Dividing the unit of speed by seconds gives the unit of acceleration



10

Construct a locus of points that are the same distance from points A and B .

[2 marks]

•
 A •
 B Create a perpendicular bisector of line AB

Scribe an arc from A which is at least halfway between A and B .
Scribe an arc from B which is at least halfway between A and B .
Draw a straight line through the points the two arcs cross

Turn over for the next question

6

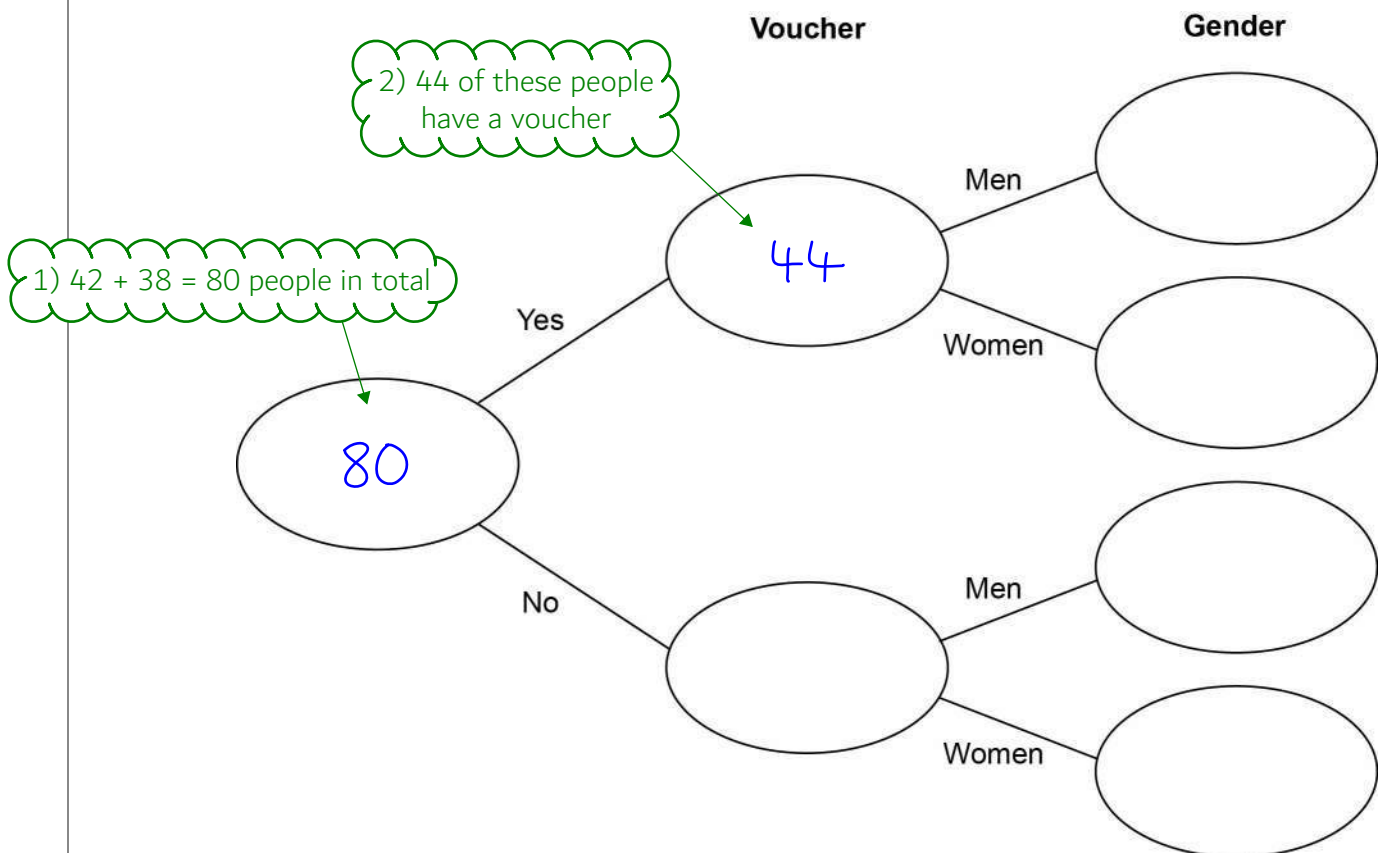
Turn over ►



- 11 42 men and 38 women visit a restaurant.
44 of these people have a voucher.
Three times as many men as women do **not** have a voucher.

11 (a) Complete the frequency tree.

[4 marks]



The ratio of men who do not have a voucher to women who do not have a voucher is 3 : 1. Divide the the number who do not have a voucher into this ratio to work out how many men and women do not have a voucher



- 11 (b)** A voucher takes **15% off** the bill.
After using the voucher, the bill for a meal is £27.20
How much was the bill before using the voucher?

[3 marks]

100 - 15 works out the percentage of the price of the meal it has reduced to. Dividing by this percentage works out 1%. Multiplying by 100 works out 100%, which is the price before the voucher was used

Answer £ _____

Turn over for the next question

Turn over ►



12 The distance by road from Newport to London is 140 miles.

Tom travels by coach from Newport to London.
The coach leaves Newport at 1.30 pm

12 (a) He assumes the coach will travel at an average speed of 50 mph

Use his assumption to work out the arrival time in London.

[3 marks]

$s^d t$

This is a speed, distance, time problem so writing the formula triangle

Working out the time taken in hours for the journey then adding this to the original time works out the arrival time

FACT B



Enter 1:30 by pressing 1, then the button on the left, then 30, then the button on the left again. It should appear as 1°30'. This button can also be pressed to convert the answer in hours into time

Answer _____

12 (b) In fact, the coach has a lower average speed.

How does this affect the arrival time?

[1 mark]

Consider how the time was calculated and what effect reducing the speed will have. If the time is increased, the arrival time will be later



13 Here is some information about the length of time cars stayed in a car park.

Shortest time 30 minutes

Lower quartile 2 hours

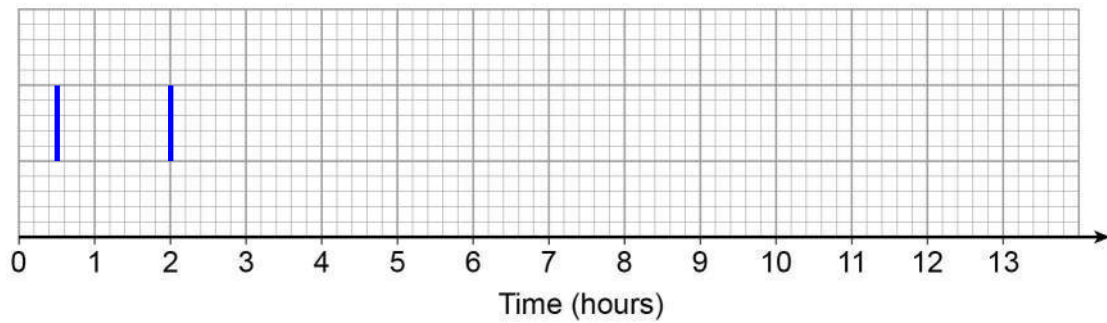
Longest time 12 hours

Interquartile range 3 hours

Median time 4 hours

Draw a box plot to show this information.

[3 marks]



Turn over for the next question

Draw vertical lines for the lowest, lower quartile, median, upper quartile and highest.

Connect the lowest value to the lower quartile and the upper quartile to the highest value using horizontal lines. Draw a box around the quartiles and median.

The upper quartile is found by adding the interquartile range to the lower quartile



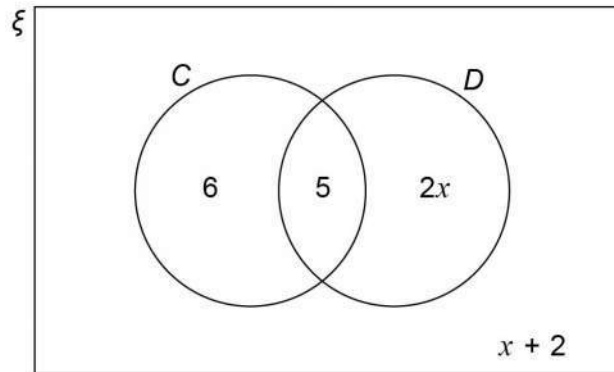
14

In the Venn diagram

 ξ represents 31 students in a class

C is students who have a cat

D is students who have a dog



14 (a) One student from the class is picked at random.

Work out the probability that the student has a dog.

[3 marks]

Express the total number of students in the class in terms of x . Simplify the expression by collecting like terms then set it equal to the 31.
Rearrange to find x . Then express the number of students who have a dog as a fraction of the total number of students; this is the probability

Answer _____

14 (b) One of the students who has a cat is picked at random.

Work out the probability that this student has a dog.

[1 mark]

11 have a cat as $6 + 5 = 11$. Out of these, ... also have a dog

Answer _____



15

Circle the highest common factor (HCF) of $6xy^2$ and $4x^3y$

[1 mark]

$2xy^2$

$2xy$

~~$12x^3y^2$~~

~~$24x^4y^3$~~

2 is the highest common factor of 6 and 4

16

$f(x) = x^2 - x^3$

Circle the value of $f(-3)$

[1 mark]

18

-18

36

-36

Negatives must go into brackets when raised to a power.
 $f(-3)$ basically means to substitute -3 for x in $f(x)$

Turn over for the next question

Turn over ►



17

At a football game

number of men : number of women : number of children = 13 : 5 : 7

There are 4152 **more** men than women.

Work out the number of children at the game.

[3 marks]

Work out how many more parts there are for men than women in the ratio. This many parts represent the 4152. Dividing by this many parts works out what 1 part of the ratio is worth. Multiplying by 7 works out what the 7 parts which represent the children are worth

Answer _____

18

Expand and simplify $(3x^2 + 2)(2x + 5) - 6x(x^2 - 3)$ **[4 marks]**

Answer _____

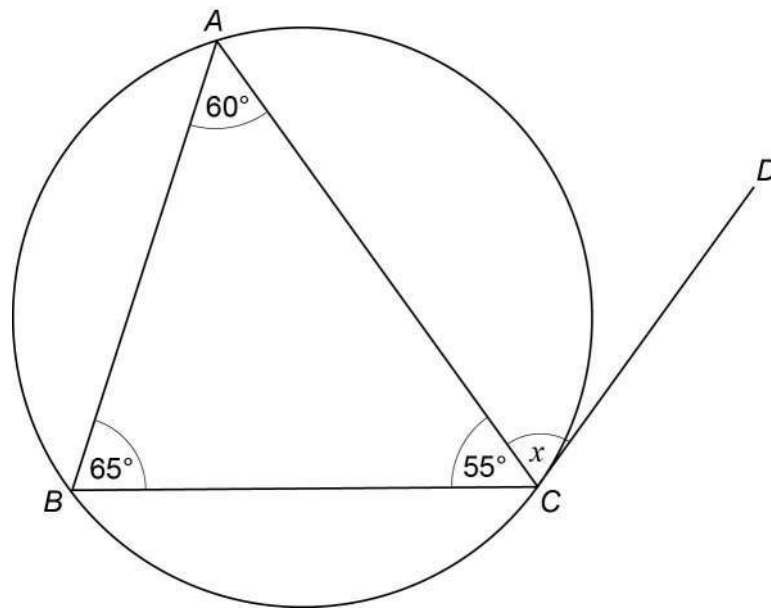


19

A , B and C are points on a circle.

CD is a tangent to the circle.

Not drawn
accurately



Write down the size of angle x .

Give a reason for your answer.

[2 marks]

Answer _____ degrees

Reason Alternate segment theorem

Turn over for the next question



20

 w is a positive number. x is 10% more than w . y is 10% less than x .Let $w = 100$. Work out what x and y would be

Which statement is true?

Tick **one** box.**[1 mark]** $w < x$ and $w < y$ $w < x$ and $w = y$ $x > y$ and $w > y$ $x > y$ and $w = y$

21

 N is a number.As a product of prime factors in index form $N = 2 \times 3^4 \times y^3$ Work out $3N^2$ as a product of prime factors in index form.Give your answer in terms of y .**[3 marks]**

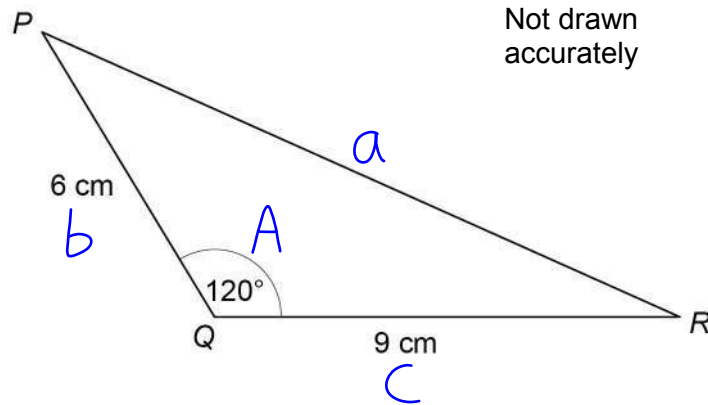
$3N^2 = 3(2 \times 3^4 \times y^3)^2$. Everything in the bracket is raised to the power of 2 first. $(a^x)^y = a^{xy}$. $a^x \times a^y = a^{x+y}$

Answer _____



22

Here is a triangle.

Work out the length PR .**[3 marks]**

$$a^2 = b^2 + c^2 - 2bc \cos A$$

The sine rule can't be used as there are not opposite pairs of sides and angles. So the cosine rule could be used

Answer _____ cm

Turn over for the next question

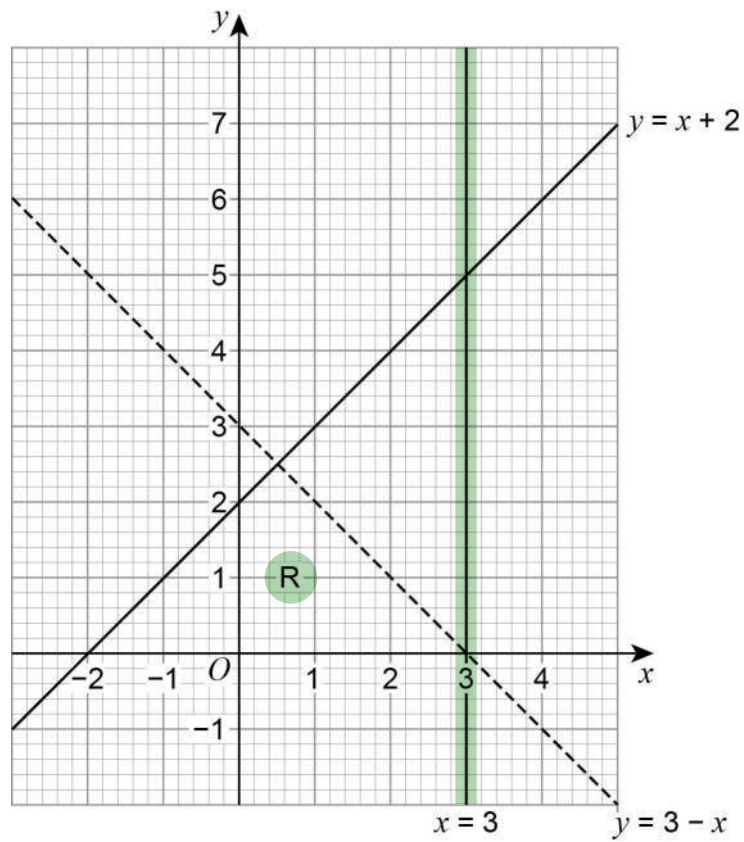
Turn over ►



23

Joe draws this graph to identify the region R represented by

$$y \leq x + 2 \quad \text{and} \quad y > 3 - x \quad \text{and} \quad x < 3$$

Make **two** criticisms of his graph.**[2 marks]**

Criticism 1

Criticism 2



24 $a : b = 9 : 4$ and $10b = 7c$

Work out $a : c$ in its simplest form.

[3 marks]

a	b	c
9	4	

In the equation $10b = 7c$, b could be 7 and c could be ... Write the ratio $b : c$ using these values. Combine both ratios by making the number of parts for b the same while making equivalent ratios. A ratio is equivalent if all sides are multiplied or divided by the same amount. Once the ratio $a : b : c$ is found, b can be ignored

Answer _____ :

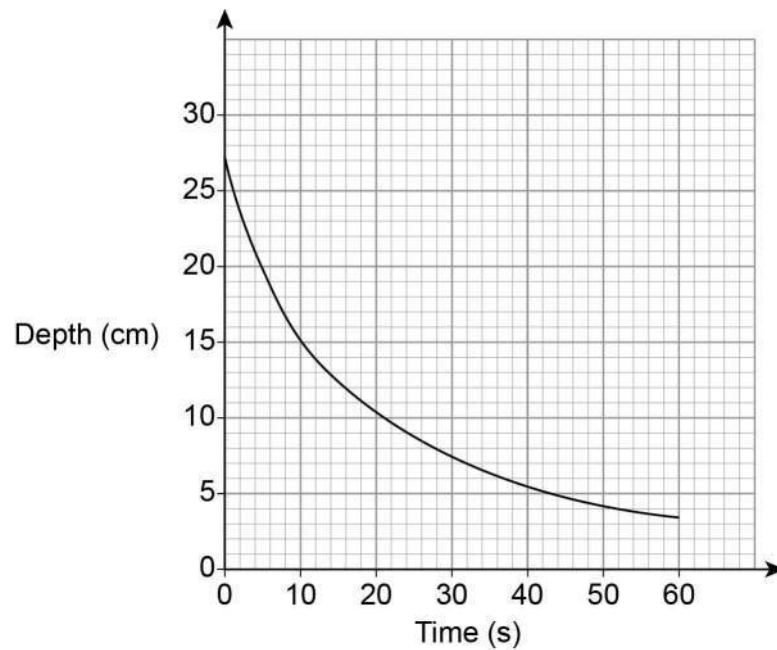
Turn over for the next question



25

Liquid is leaking out of a container.

The graph shows the depth of the liquid for 60 seconds.



Use the graph to work out an estimate of the rate of decrease of depth at 10 seconds.

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

Draw a tangent to the curve at the point where the time is 10 seconds.
 The rate of change of depth is the gradient, which can be found using
 (change in y)/(change in x). The rate of change of depth is negative
 but as it asks for the rate of decrease the negative is ignored

Answer _____ cm/s



26

$$a^2 - b^2 \equiv (a + b)(a - b)$$

a and b are positive whole numbers with $a > b$

$a^2 - b^2$ is a **prime** number.

Why are a and b consecutive numbers?

[2 marks]

$(a + b)(a - b)$ is the factorised form and prime numbers only have two factors: themselves and 1. $(a + b)$ and $(a - b)$ are factors of $a^2 - b^2$. Subtracting b from a works out the difference

Turn over for the next question

Turn over ►



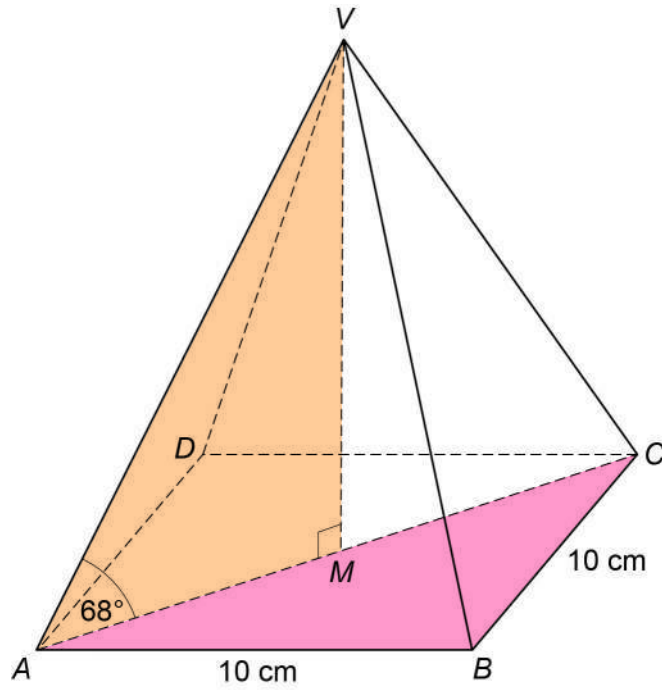
27

$VABCD$ is a square-based pyramid.

The horizontal base $ABCD$ has side length 10 cm and centre M .

Angle VMA is 90°

Angle VAM is 68°



$$\text{Volume of pyramid} = \frac{1}{3} \times \text{area of base} \times \text{perpendicular height}$$



Work out the volume of the pyramid.

[6 marks]

$$\begin{array}{c} \text{S}^{\circ} \text{H} \text{C}^{\wedge} \text{H} \text{T}^{\circ} \text{A} \\ \hline \\ \hline \\ \hline \end{array}$$

The perpendicular height, VM, can be found using right angled trigonometry in the orange triangle. Tick what we have (or can find) and tick what we are trying to find. Two ticks on one of the formula triangles means that that one can be used. Covering over what we are trying to find and it tells us how to calculate it

$$\begin{array}{c} a^2 + b^2 = c^2 \\ \hline \\ \hline \end{array}$$

AM is half of AC, which is the hypotenuse of the pink triangle. This can be found using Pythagoras' Theorem

The base is a square and area of a square = length x width

Answer _____ cm³

Turn over for the next question

Turn over ►



28

$$y = p \times q^{x-1} \quad \text{where } p \text{ and } q \text{ are numbers.}$$

$$y = 10 \text{ when } x = 1$$

$$y = 0.3125 \text{ when } x = 6$$

Work out the value of y when $x = 3$

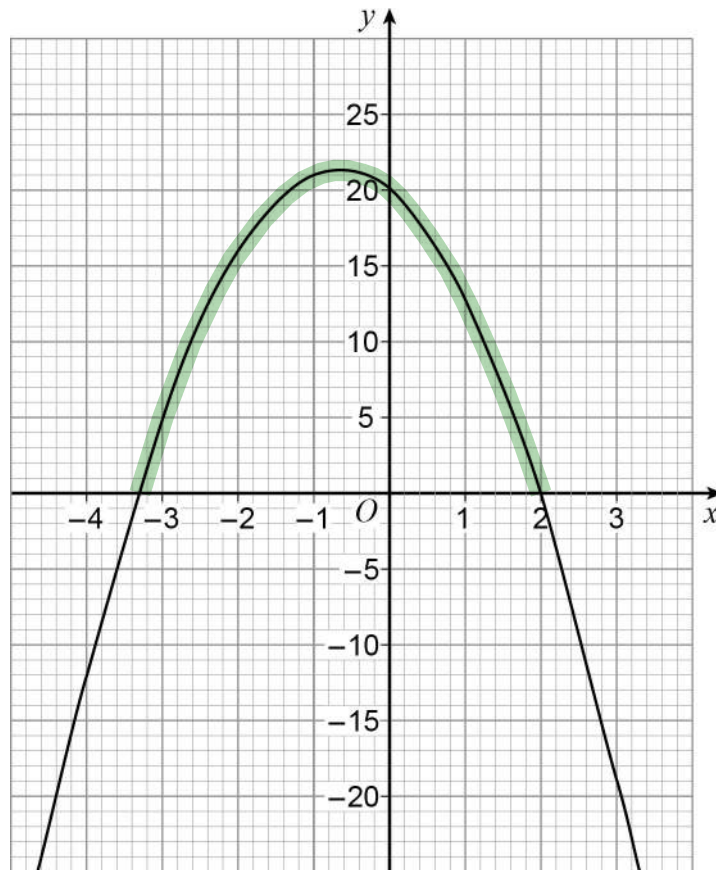
[5 marks]

Substitute 10 for y and 1 for x in the equation. Anything to the power of 0 is 1. Find the value of p . Substitute 0.3125 for y , 6 for x and the value of p . Rearrange to find q . Now we have the values of p and q in the equation substitute in 3 for x to find y

Answer _____



29 Here is the graph of $y = f(x)$ where $f(x)$ is a quadratic function.



Write down all the **integer** solutions of $f(x) \geq 0$

[2 marks]

The highlighted region of the line is where $f(x) \geq 0$. It is basically asking what the integer values of x are when the line is above or on the x axis

Answer _____

Turn over for the next question



30 $f(x) = \frac{x}{3} + 4$ for all values of x .

$g(x) = 6x^2 + 3$ for all values of x .

Work out $fg(x)$.

Give your answer in the form $ax^2 + b$ where a and b are integers.

[2 marks]

Substitute $g(x)$ for x in $f(x)$

Answer _____

END OF QUESTIONS

