



model answers

Please write clearly in block capitals.

Centre number       Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

# GCSE MATHEMATICS

# H

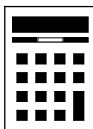
Higher Tier Paper 3 Calculator

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.

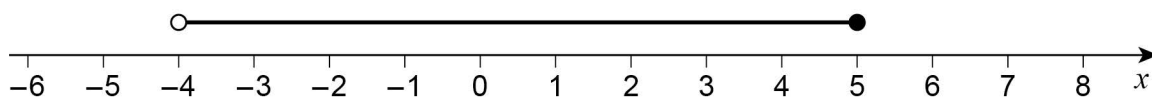
For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26	
<b>TOTAL</b>	



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

Answer **all** questions in the spaces provided

- 1 Circle the inequality shown by the diagram.



[1 mark]

$-4 \leq x < 5$

$-4 \leq x \leq 5$

$-4 < x < 5$

$-4 < x \leq 5$

○ = greater than  
● = less than or equal to

- 2  $y$  is 100% more than  $x$ . so  $y$  is double  $x$

Circle the ratio  $x : y$

$x : y$   
 $1 : 2$

[1 mark]

$1 : 100$

$100 : 1$

$1 : 2$

$2 : 1$

- 3 The first four terms of a sequence are  $-12, -10, -8, -6, -4$   $\Rightarrow -12n + 2n$

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

[1 mark]

$-12 - 2n$

$-8 - 2n$

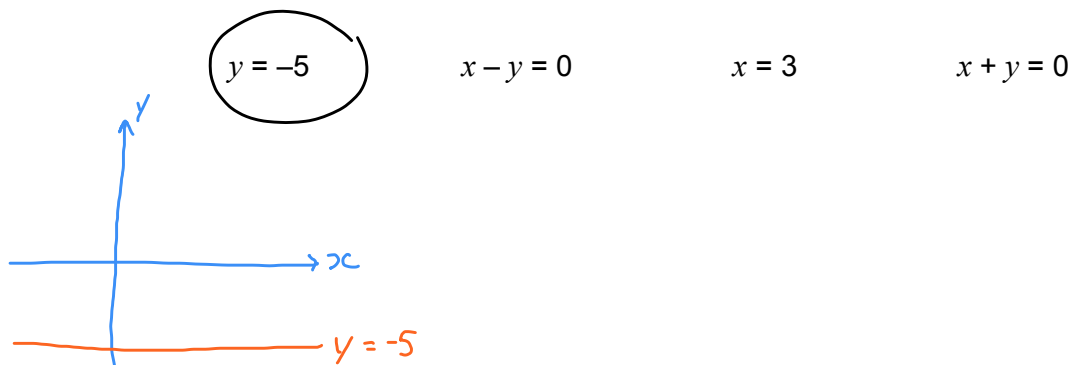
$n + 2$

$2n - 12$



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

[1 mark]



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

[2 marks]

$$\begin{aligned} & (x - 8)(x - 8) \\ &= x^2 - 8x - 8x + 64 \\ &= x^2 - 16x + 64 \end{aligned}$$

Answer  $x^2 - 16x + 64$

Turn over for the next question



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

[2 marks]

powers of 3:  $3^1 = 3$   
 $3^2 = 9$

square numbers: 1, 4, 9, 16, 25, 36

$3^3 = 27$

$243 + 25 = 268$

$3^4 = 81$

$3^5 = 243$

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

median is  
20.5th value

$(\frac{40+1}{2}) = 20.5$

↑  
cumulative frequency

In which class interval is the median?

Circle your answer.

[1 mark]

$0 < t \leq 5$

$5 < t \leq 10$

$10 < t \leq 15$

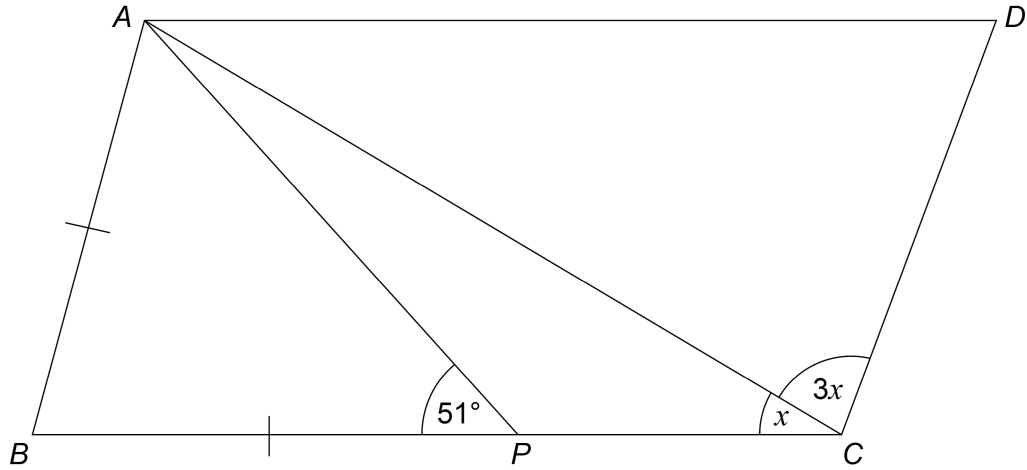
$15 < t \leq 20$



8  $ABCD$  is a parallelogram.

$AB = BP$

Not drawn  
accurately



Work out the size of angle  $x$ .

[4 marks]

$\angle PAB = 51^\circ$  base angles in an isosceles are equal  
 $\angle ABP = 180 - 51 - 51 = 78^\circ$  angles in a triangle sum  $180^\circ$   
 $\angle BCD = 180 - 78 = 102^\circ$  co-interior angles sum  $180^\circ$

---


$$x + 3x = 102$$


---


$$4x = 102$$


---


$$x = 25.5$$


---

Answer 25.5 degrees

Turn over for the next question



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

[2 marks]

$$v = u + at$$
$$v - u = at$$

$$\frac{v - u}{a} = t$$

Answer  $\frac{v - u}{a} = t$

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

[2 marks]

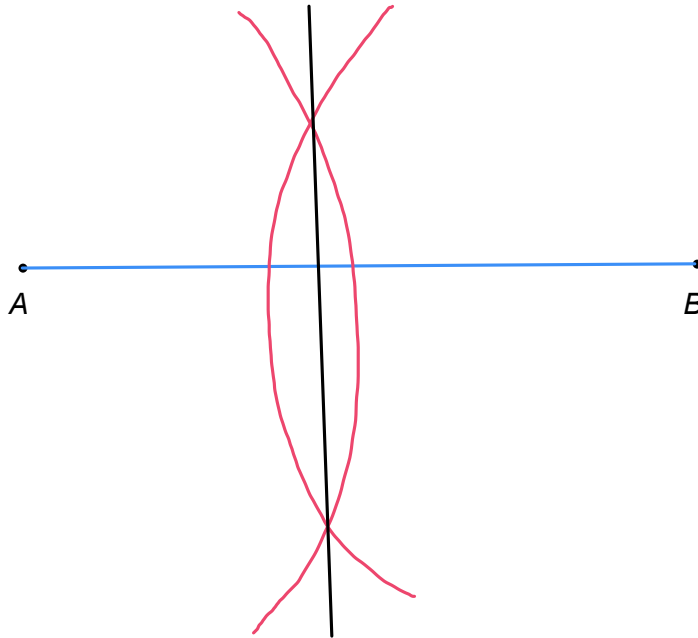
Distance	Time	Speed	Acceleration
m	s	m/s	m/s <sup>2</sup>



10

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

[2 marks]



draw arc with radius more than  $\frac{1}{2}AB$ , from A and B.

draw line between points where arcs meet

Turn over for the next question

6

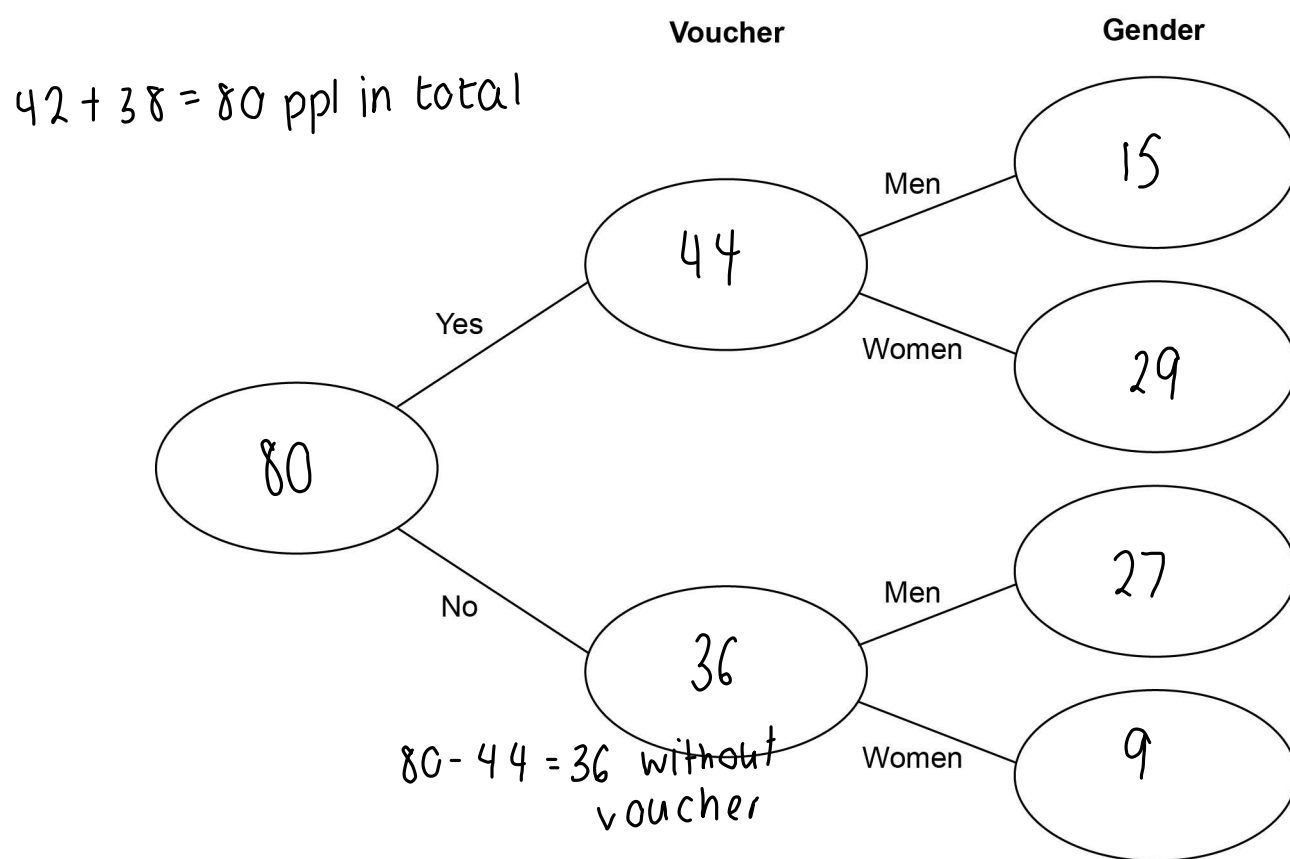
Turn over ►



- 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]



out of ppl without voucher

men : women

3 : 1

27 : 9 = 36







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]

$$\text{Speed} = \frac{\text{distance}}{\text{time}}, \quad t = \frac{d}{s}$$

$$t = \frac{140}{50} = 2.8 \text{ hrs}$$

$$= 2 \text{ hr } 48 \text{ mins}$$

+2hr

1:30 → 3:30 +48min → 4:18

Answer 4:18 pm

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

How does this affect the arrival time?

[1 mark]

lower speed, so takes longer to get there  
hence, later arrival time



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

Shortest time 30 minutes

Lower quartile 2 hours

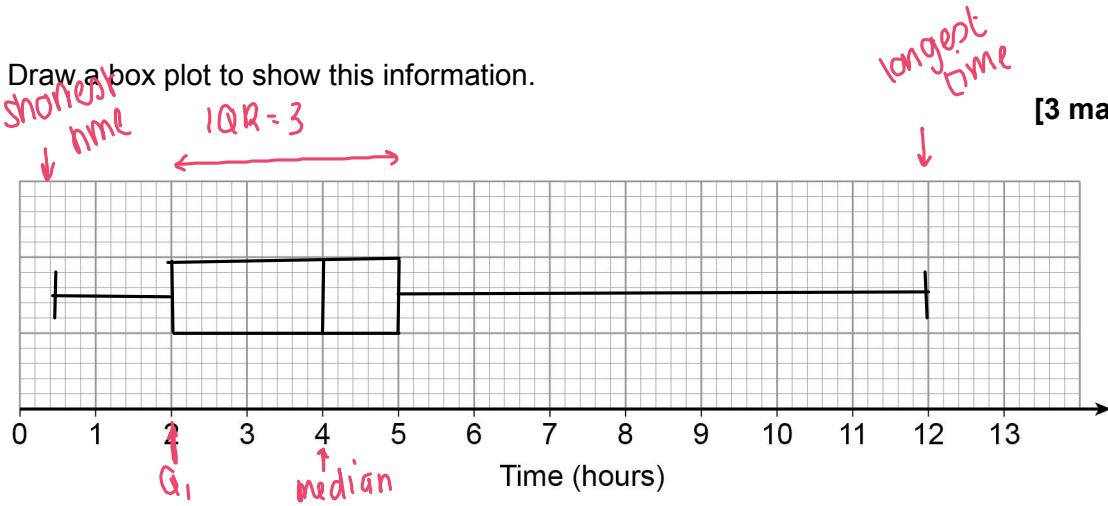
Longest time 12 hours

Interquartile range 3 hours

Median time 4 hours

Draw a box plot to show this information.

[3 marks]



Turn over for the next question



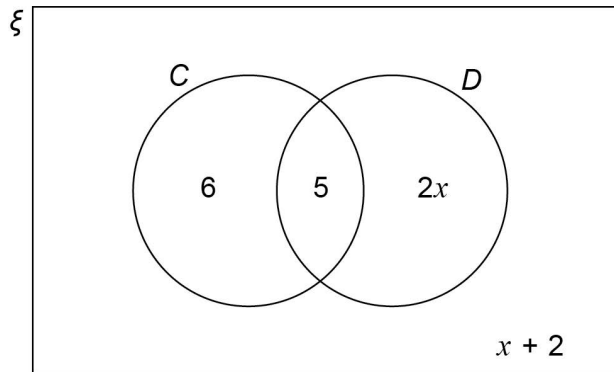
14

In the Venn diagram

 $\xi$  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]

$$\begin{aligned}
 6 + 5 + 2x + x + 2 &= 31 & P(\text{dog}) &= \frac{5+2x}{31} \\
 3x + 13 &= 31 \\
 3x &= 18 & &= \frac{5+2(6)}{31} \\
 x &= 6 & &= \frac{17}{31}
 \end{aligned}$$

Answer     ,  $\frac{17}{31}$     

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]

$$\begin{aligned}
 6 + 5 &= 11 \text{ have a cat} \\
 5 &\text{ have dog too} \rightarrow \frac{5}{11}
 \end{aligned}$$

Answer      $\frac{5}{11}$     



15

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

[1 mark]

$2xy^2$

$2xy$

$12x^3y^2$

$24x^4y^3$

$6xy^2 = 2xy(3y)$

$4x^3y = 2xy(2x^2)$

$3y$  and  $2x^2$   
have no  
common  
factors

16

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

Circle the value of  $f(-3)$ 

$$f(-3) = (-3)^2 - (-3)^3$$
$$= 9 - (-27) = 36$$

[1 mark]

18

-18

36

-36

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.

↪ 8 parts difference

[3 marks]

$$8 \text{ parts} = 4152$$

$$1 \text{ part} = 519$$

children represent 7 parts, so

$$\text{no. children} = 519 \times 7 = 3633$$

Answer 3633

18

Expand and simplify  $(3x^2 + 2)(2x + 5) - 6x(x^2 - 3)$ 

[4 marks]

$$(3x^2 + 2)(2x + 5) = 6x^3 + 15x^2 + 4x + 10$$

$$-6x(x^2 - 3) = -6x^3 + 18x$$

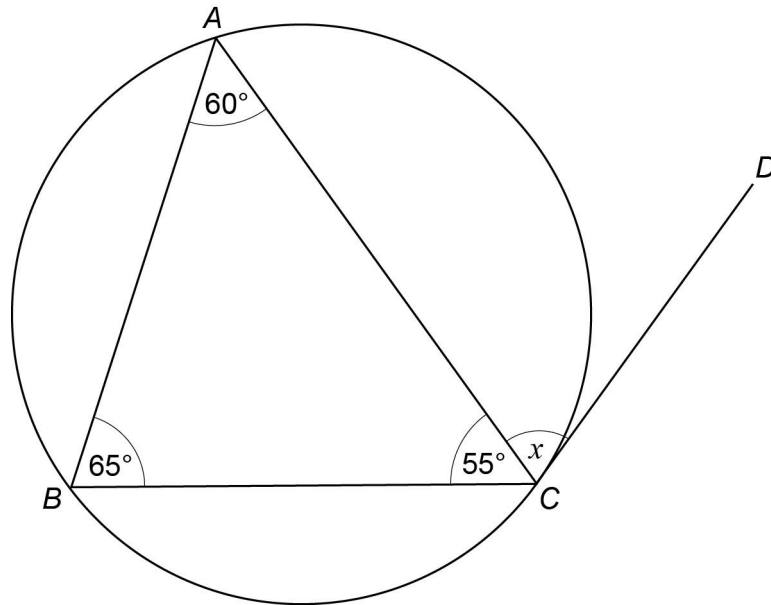
$$\# \quad \cancel{6x^3} + 15x^2 + 4x + 10 - \cancel{6x^3} + 18x$$

$$= 15x^2 + 22x + 10$$

Answer  $15x^2 + 22x + 10$ 

- 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 65 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  $x$ .

Which statement is true?

Tick **one** box.

$$x = 1.1w$$

$$y = 0.9x \rightarrow y = 0.9(1.1w)$$

$$y = 0.99w$$

[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]

$$N^2 = 2^2 \times 3^8 \times y^6$$

→ add indices

$$3N^2 = 2^2 \times (3^1 \times 3^8) \times y^6$$

$$= 2^2 \times 3^9 \times y^6$$

Answer  $2^2 \times 3^9 \times y^6$



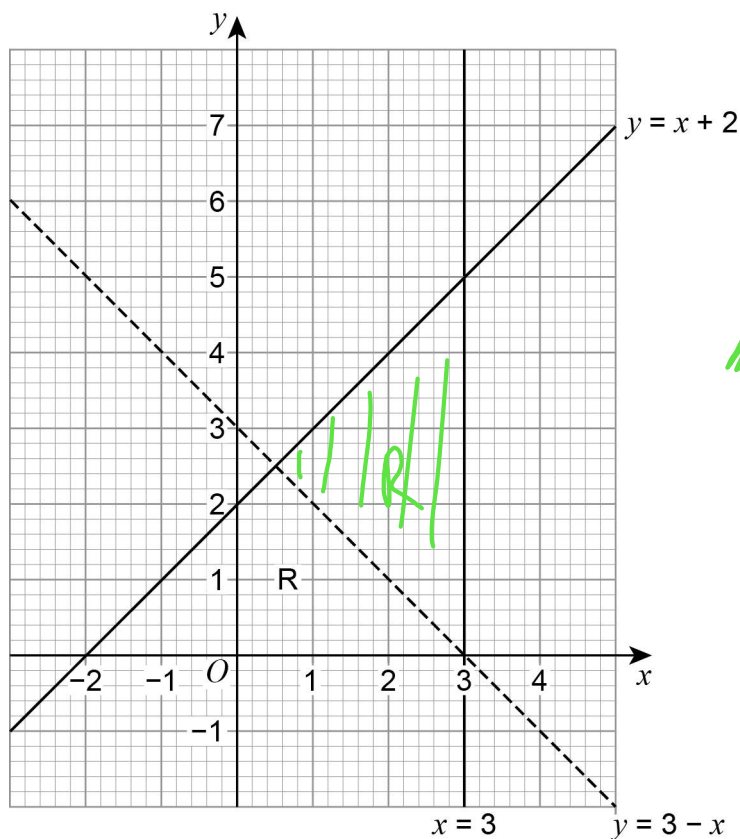




23

Joe draws this graph to identify the region R represented by

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



*where R  
should be*

Make **two** criticisms of his graph.

[2 marks]

Criticism 1 the line  $x = 3$  should be dashed

Criticism 2 the region R is in the wrong place



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

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

[3 marks]

$$a : b = 9 : 4, \text{ so } 4a = 9b$$

from  $10b = 7c$   
 $b = \frac{7}{10}(c)$

*sub into  
 $4a = 9b$*

$$4a = 9\left(\frac{7}{10}c\right)$$
$$40a = 63c$$

so,  $a : c$   
 $63 : 40$

Answer 63 : 40

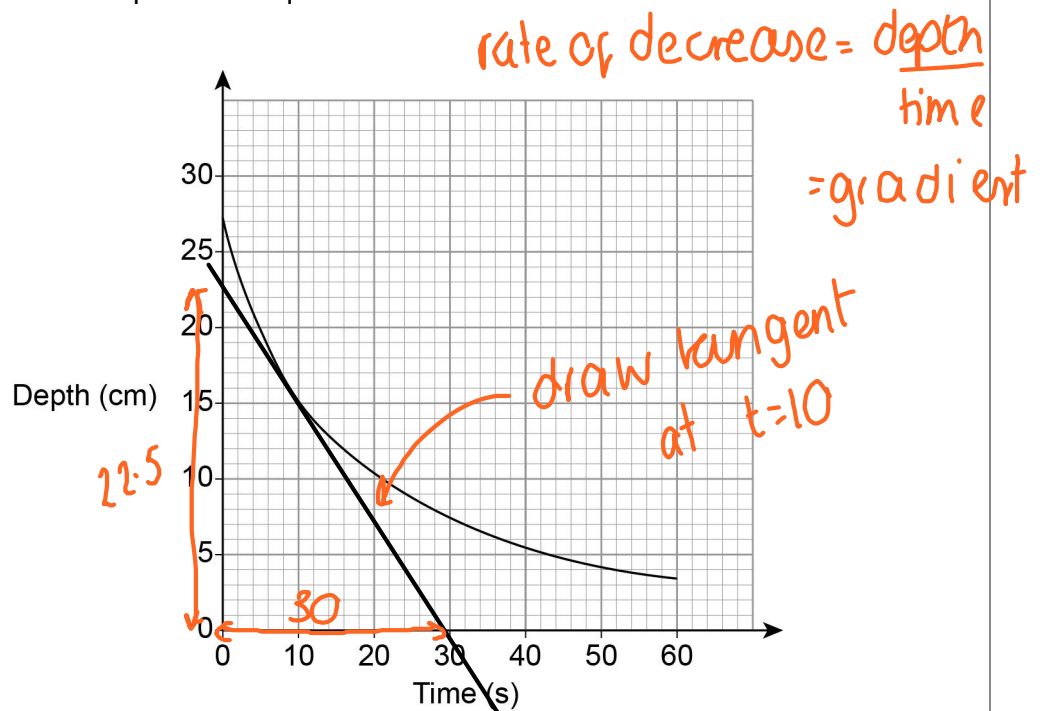
Turn over for the next question



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]

$$\text{gradient} = \frac{22.5}{30} = 0.75$$

Answer 0.75 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]

If  $a^2 - b^2$  is prime,  $a+b$  or  $a-b$  must be prime  
then the other must be 1

• prime numbers are only divisible by themselves and 1

$a+b$  cannot be 1 (as they are +ve whole numbers)

so  $a-b$  must equal 1  $\rightarrow a-b=1$

$a=b+1$ , so are  
consecutive

Turn over for the next question



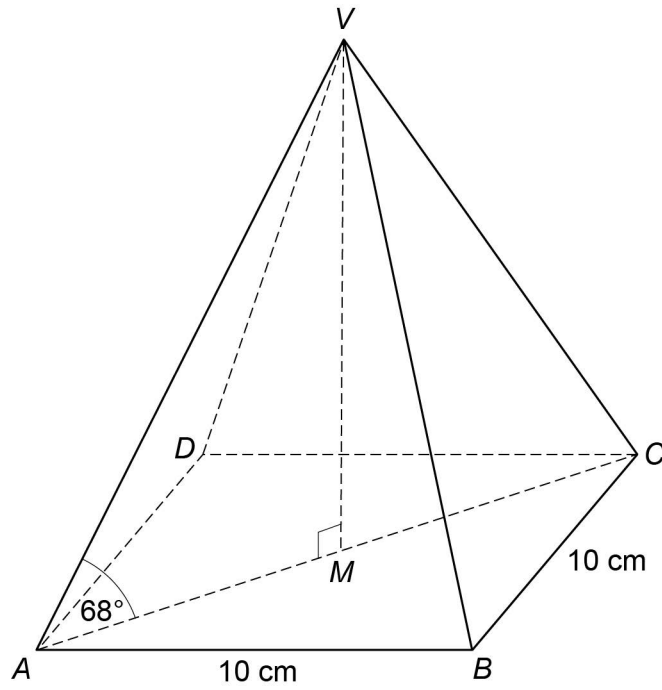
27

$VABCD$  is a square-based pyramid.

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

Angle  $VMA$  is  $90^\circ$

Angle  $VAM$  is  $68^\circ$



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

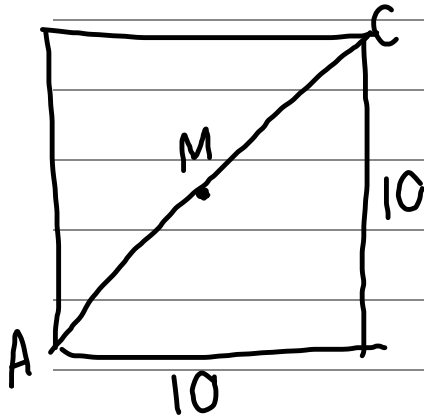


Work out the volume of the pyramid.

[6 marks]

area of base =  $10 \times 10 = 100 \text{ cm}^2$

Pythagoras  
Theorem



$$AC^2 = 10^2 + 10^2$$

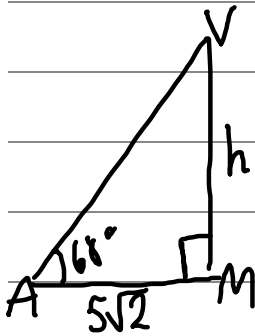
$$AC = \sqrt{200} = 10\sqrt{2}$$

$$AM = \frac{1}{2} AC$$

$$= 5\sqrt{2}$$

1

SOH CAH TOA



vertical height,  $h$

$$\tan x = \frac{\text{opp}}{\text{adj}}$$

$$\tan 68 = \frac{h}{5\sqrt{2}}$$

$$h = \tan 68 \times 5\sqrt{2} = 17.5 \text{ cm}$$

$$\text{volume} = \frac{1}{3} \times 100 \times 17.5 = 583.4 \text{ cm}^3$$

Answer 583.4  $\text{cm}^3$

Turn over for the next question



28

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

$y = 10$  when  $x = 1$

$y = 0.3125$  when  $x = 6$

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

$y = 10, x = 1$

$10 = p \times q^{1-1}$

$10 = p \times q^0$

$10 = p \times 1$

$p = 10$

[5 marks]

$y = 0.3125, x = 6$

$0.3125 = 10 \times q^{6-1}$

$0.03125 = q^5$

$q = 0.5$



$y = 10 \times 0.5^{x-1}$

$y = 10 \times 0.5^{3-1}$

$y = 10 \times 0.5^2 = 2.5$

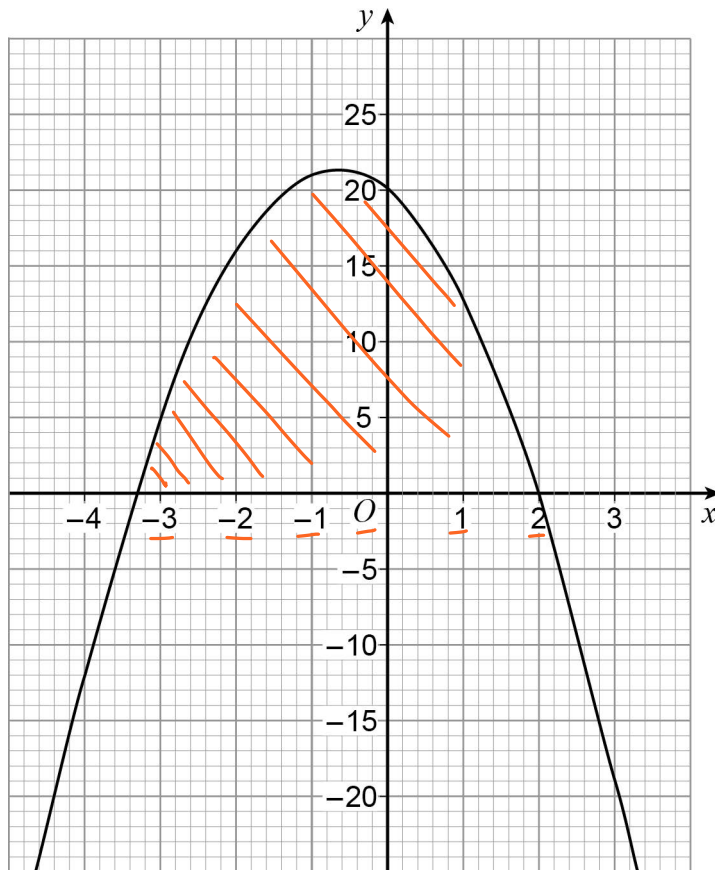
Answer 2.5





29

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



Whole numbers  $\rightarrow$   
Write down all the integer solutions of  $f(x) \geq 0 \rightarrow$  above the  $x$ -axis

[2 marks]

---



---



---

Answer -3, -2, -1, 0, 1, 2

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]

$$fg(x) = f(6x^2 + 3)$$

$$= \frac{6x^2 + 3}{3} + 4$$

$$= 2x^2 + 1 + 4$$

$$= 2x^2 + 5 \quad a = 2$$

$$b = 5$$

Answer  $2x^2 + 5$

END OF QUESTIONS



**There are no questions printed on this page**

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**



**There are no questions printed on this page**

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**

**Copyright Information**

For confidentiality purposes, from the November 2015 examination series, acknowledgements of third party copyright material will be published in a separate booklet rather than including them on the examination paper or support materials. This booklet is published after each examination series and is available for free download from [www.aqa.org.uk](http://www.aqa.org.uk) after the live examination series.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team, AQA, Stag Hill House, Guildford, GU2 7XJ.

Copyright © 2017 AQA and its licensors. All rights reserved.

