

Please write clearly in block capitals.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 3 Calculator

Tuesday 12 June 2018

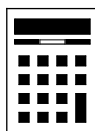
Morning

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.

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	
TOTAL	



J U N 1 8 8 3 0 0 3 H 0 1

Answer **all** questions in the spaces provided

Do not write
outside the
box

- 1** Circle the decimal that is closest in value to $\frac{11}{20}$ **[1 mark]**

0.56

0.6

0.525

0.5

- 2** Circle the list of **all** the integers that satisfy $-2 < x \leq 4$ **[1 mark]**

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

-1, 0, 1, 2, 3

-2, -1, 0, 1, 2, 3, 4

-1, 0, 1, 2, 3, 4

- 3** Circle the largest number. **[1 mark]**

 $3.\dot{2}7$

3.27

3.277

 $3.20\dot{7}$ 

- 4 What is the size of an exterior angle of a regular decagon?
Circle your answer.

[1 mark] 18° 36° 144° 162°

- 5 a is a common factor of 72 and 120
 b is a common multiple of 6 and 9

Work out the highest possible value of $\frac{a}{b}$

[4 marks]

Answer _____

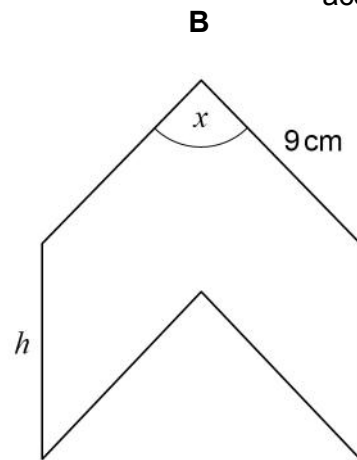
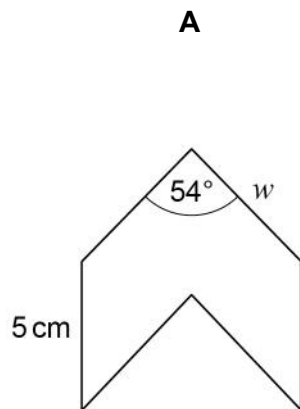
Turn over for the next question



6

A and B are similar shapes.

B is an enlargement of A with scale factor 1.5

Not drawn
accuratelyWork out the values of x , h and w .**[3 marks]**

 $x =$ _____ degrees $h =$ _____ cm $w =$ _____ cm

7 Investment A Save £150 per month for 2 years.
2.5% interest is added to the total amount saved.

Investment B Invest £3500
Compound interest is added at 3% per year.

After 2 years, how much **more** is investment B worth than investment A?

[4 marks]

Answer £ _____

Turn over for the next question



- 8 (a) Show that the lines $y = 3x + 7$ and $2y - 6x = 8$ are parallel.

Do **not** use a graphical method.

[3 marks]

- 8 (b) Is the point $(-5, -6)$ above, below or on the line $y = 3x + 7$?

Tick **one** box.

☐

Above

☐

Below

☐

On the line

You **must** show your working.

Do **not** use a graphical method.

[2 marks]



- 9** The cost of a ticket increases by 10% to £19.25

Work out the original cost.

[3 marks]

Answer £ _____

- 10** The n th term of a sequence is $12n - 5$

Work out the numbers in the sequence that

have two digits

and

are **not** prime.

[3 marks]

Answer _____



11 $\mathbf{a} = \begin{pmatrix} 6 \\ -10 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ $\mathbf{c} = \begin{pmatrix} -4 \\ 7 \end{pmatrix}$

11 (a) Work out $\mathbf{a} + \mathbf{b} + \mathbf{c}$

[2 marks]

Answer

$$\left(\right)$$

11 (b) Show that $\mathbf{a} + 2\mathbf{c}$ is parallel to \mathbf{b}

[2 marks]



12

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

A force of 40 Newtons is applied to an area of 3.2 square metres.

Work out the pressure.

Give the units of your answer.

[2 marks]

Answer _____

13

Tick **all** the statements that are true for any rhombus.

[1 mark]

☐

The diagonals are lines of symmetry

☐

The diagonals bisect each other

☐

The diagonals are perpendicular

☐

The diagonals are equal in length

Turn over for the next question

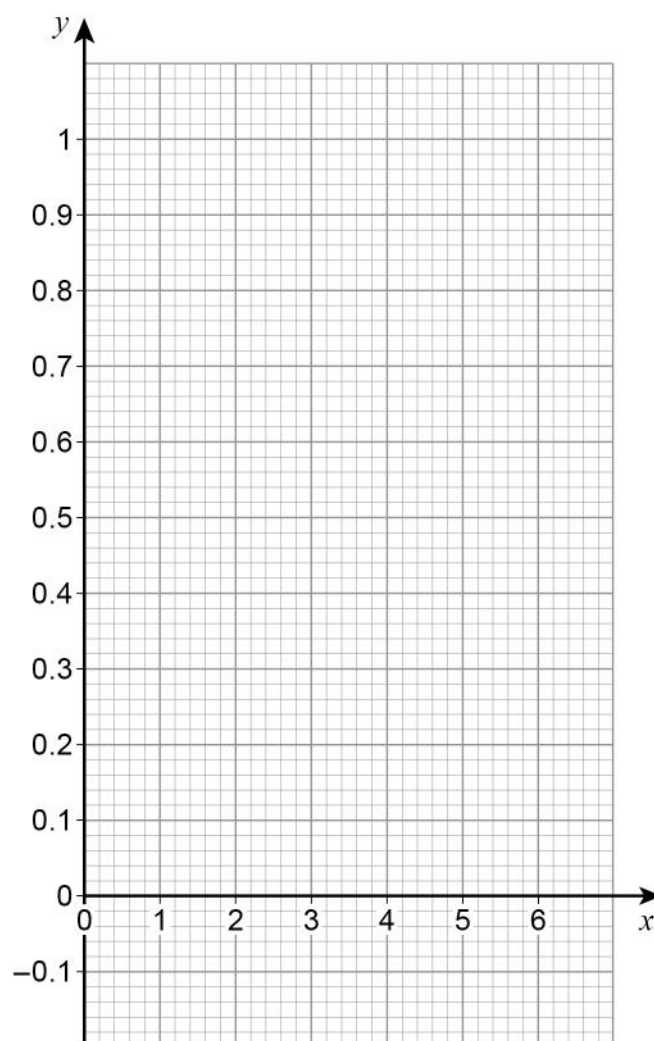
Turn over ►



14

Draw the graph of $y = 0.8^x$ for values of x from 0 to 6**[3 marks]**

x	0	1	2	3	4	5	6
y							



15

Amy has x beads.

Billy has three more beads than Amy.

Carly has four times as many beads as Billy.

Circle the expression for the number of beads that Carly has.

[1 mark]

$4x + 3$

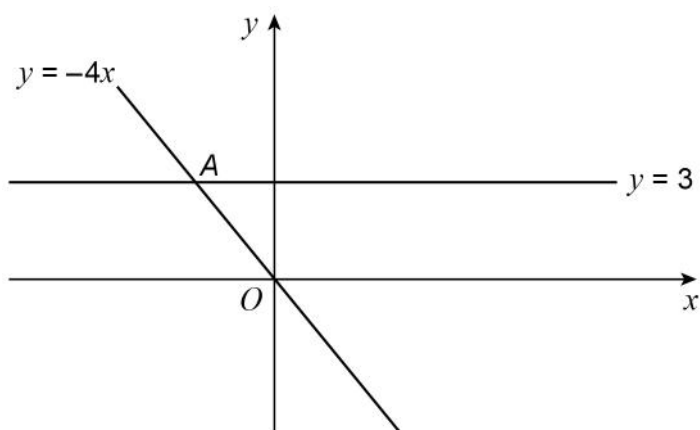
$3x + 4$

$4(x + 3)$

$x + 12$

16

Two straight lines intersect at point A.



Not drawn
accurately

Circle the coordinates of A.

[1 mark]

$(-\frac{3}{4}, 3)$

$(-4, 3)$

$(-12, 3)$

$(-\frac{4}{3}, 3)$



17

Here are two methods to make a 4-digit code.
Codes can have repeated digits.

Method A

For the first two digits use an odd number between 30 and 100
For the last two digits use a multiple of 11

Method B

Use four digits in the order even odd even odd
Do **not** use the digit zero

Which method gives the **greater** number of possible codes?
You **must** show your working.

[3 marks]

Answer _____



18 Show that, for $x \neq 0$

$$\frac{x+4}{3x} - \frac{5}{2x}$$

can be written in the form $\frac{ax+b}{cx}$ where a , b and c are integers.

[3 marks]

Answer _____

19 The equation of a straight line is $3x + 2y = 24$

Circle the point where the line crosses the x -axis.

[1 mark]

(0, 8)

(12, 0)

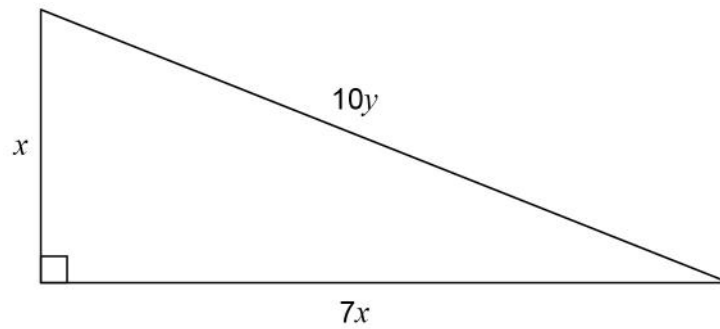
(0, 12)

(8, 0)



20

All dimensions are in centimetres.

Not drawn
accuratelyUse Pythagoras' theorem to work out the exact value of $\frac{x}{y}$ **[3 marks]**

Answer _____



- 21** The mass of an ornament is m grams.
The height of the ornament is h centimetres.
 m is directly proportional to the cube of h .
 $m = 1600$ when $h = 8$

- 21 (a)** Work out an equation connecting m and h .

[3 marks]

Answer _____

- 21 (b)** Work out the mass of an ornament of height 12 centimetres.

[2 marks]

Answer _____ grams

Turn over for the next question

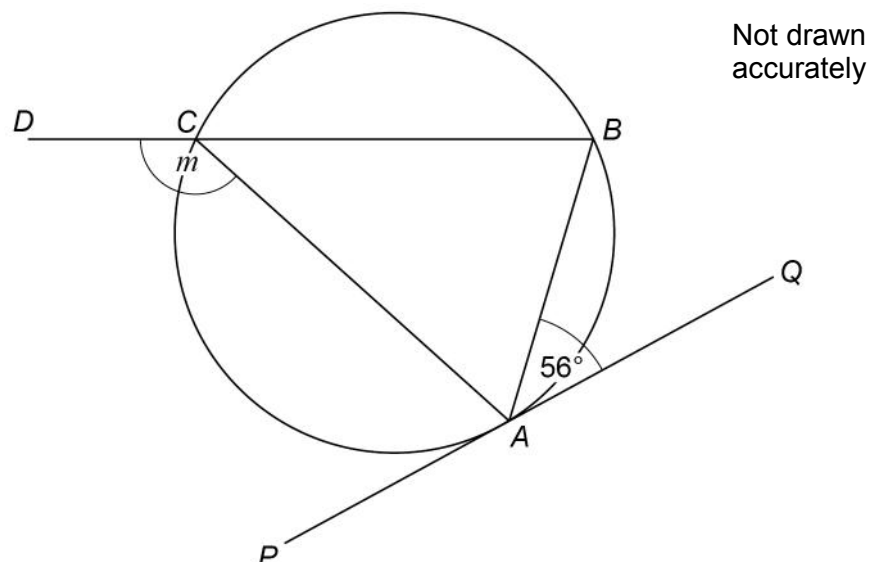


22

A , B and C are points on a circle.

DCB is a straight line.

PAQ is a tangent to the circle.



Sam is trying to work out the size of angle m .

Here is his working.

$$\text{angle } ACB = 56^\circ$$

angles in the same segment are equal

$$m = 180^\circ - 56^\circ$$

angles at a point on a straight line add up to 180°

$$m = 124^\circ$$

Make a criticism of his working.

[1 mark]



23

A sequence of numbers is formed by the iterative process

$$u_{n+1} = \frac{3}{u_n + 1}, \quad u_1 = 4$$

Work out the values of u_2 and u_3

[2 marks]

$$u_2 = \underline{\hspace{10cm}}$$

$$u_3 = \underline{\hspace{10cm}}$$

Turn over for the next question

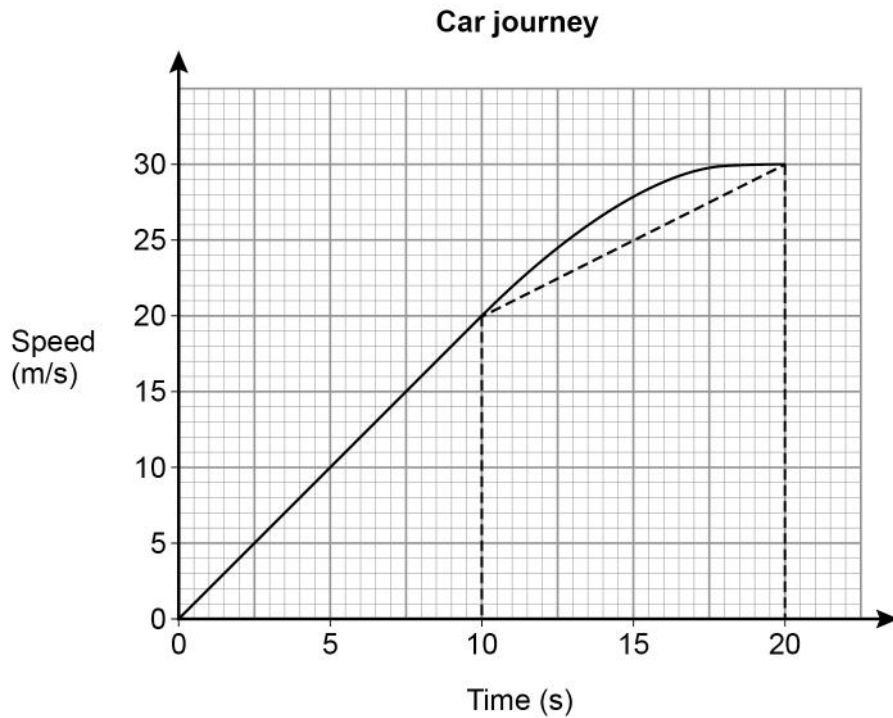


24

The speed-time graph shows 20 seconds of a car journey.

Harry wants to estimate the distance the car travels in this time.

He uses a triangle and a trapezium, as shown, to estimate the area under the graph.



24 (a) Complete Harry's method to estimate the distance the car travels.

[3 marks]

Answer _____ m



24 (b) For this journey, which of these is true for Harry's method?

Tick **one** box.

[1 mark]

☐

It works out an overestimate of the distance

☐

It works out an underestimate of the distance

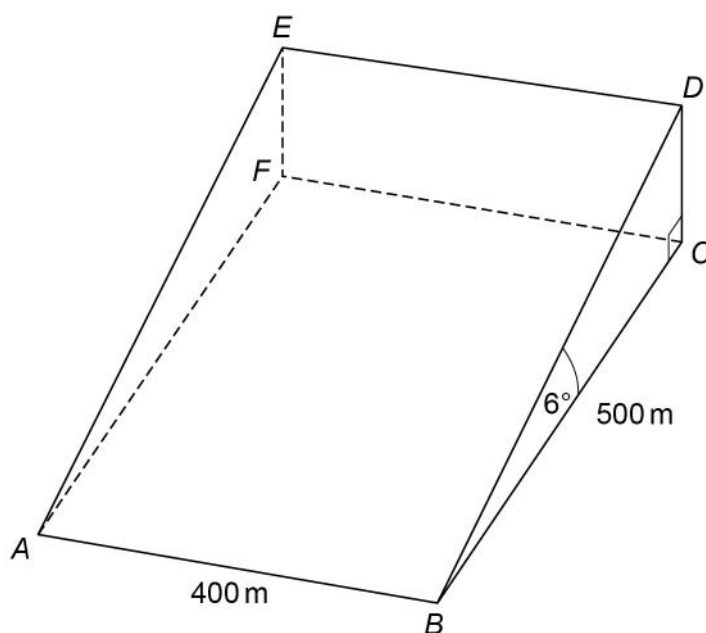
☐

It could work out an overestimate or an underestimate of the distance

Turn over for the next question



- 25** $ABCDEF$ is a triangular prism which represents part of a hill.
 $ABCF$ is the horizontal rectangular base.
 D is vertically above C .



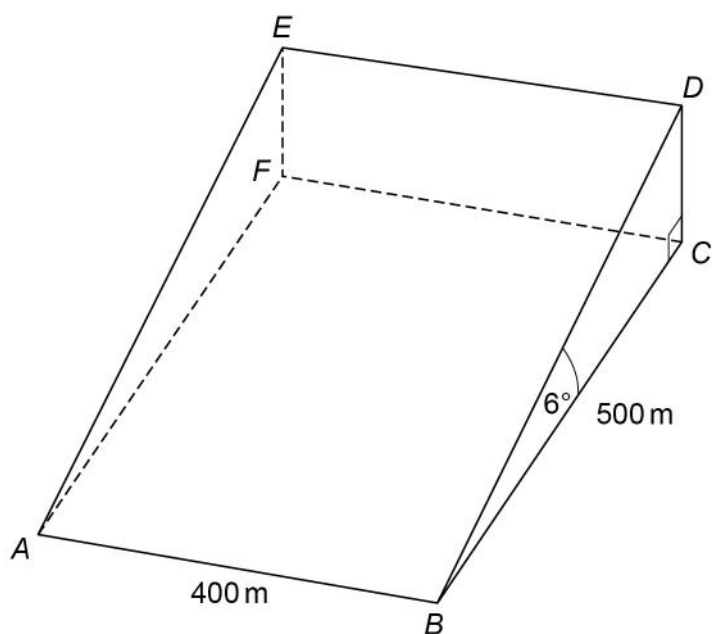
- 25 (a)** Work out the height CD .

[2 marks]

Answer _____ m



- 25 (b) Jamil walks in a straight line from A to D .



Work out the size of angle DAC .

You **must** show your working.

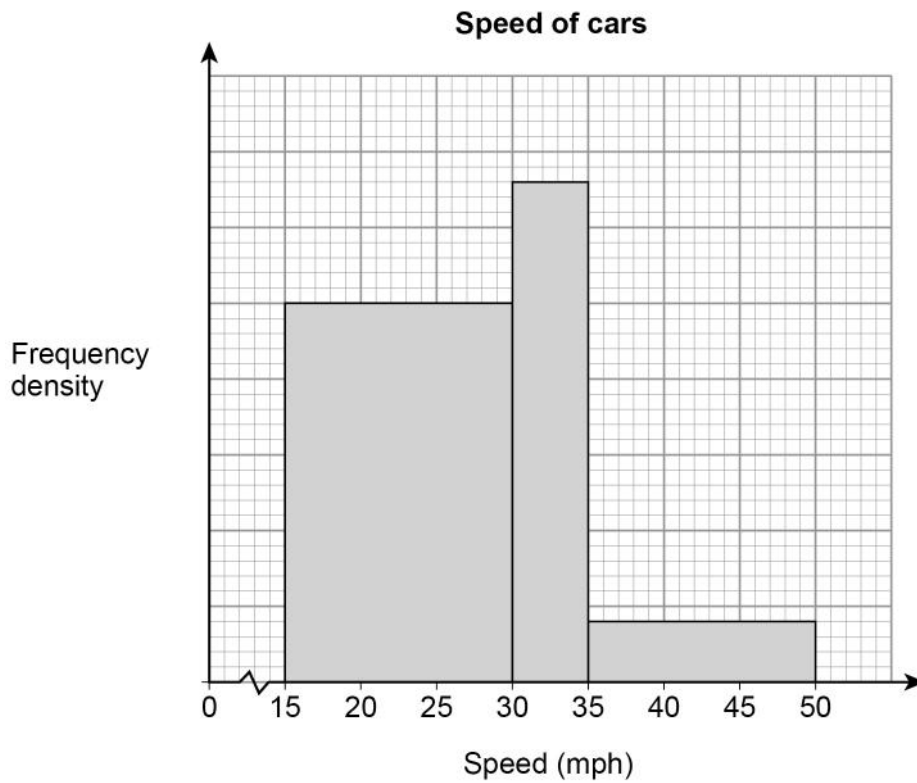
[4 marks]

Answer _____ degrees



26

The histogram shows information about the speed of cars as they pass a checkpoint.
The scale on the frequency density axis is missing.



The histogram shows information about 480 cars.

26 (a) How many cars does the first bar represent?

[4 marks]

Answer _____



26 (b) Cars with a speed greater than 40 mph are over the speed limit.

Use the histogram to estimate the number of cars that are over the speed limit.

[2 marks]

Answer _____

Turn over for the next question



27

A bag contains 30 discs.

10 are red and 20 are blue.

One disc is taken out at random and replaced by **two** of the other colour.

Another disc is then taken out at random and replaced by **two** of the other colour.

Another disc is then taken out at random.

Work out the probability that all three discs taken out are **red**.

[3 marks]

Answer _____

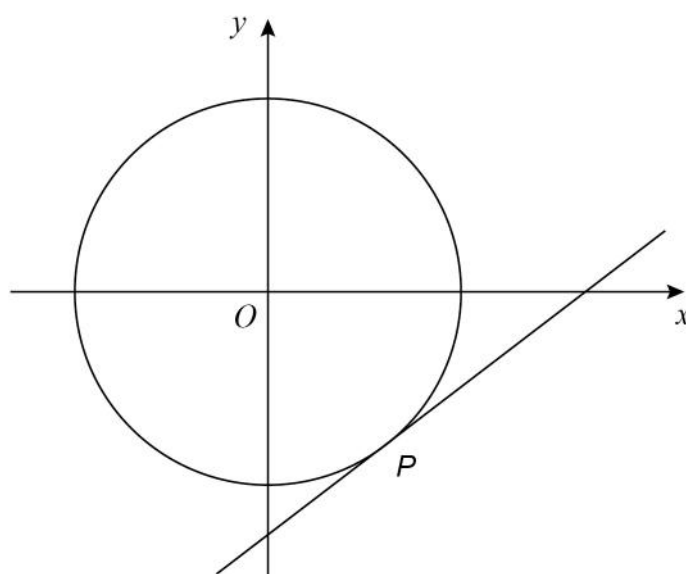


28

P is a point on the circle with equation $x^2 + y^2 = 80$

P has x -coordinate 4 and is below the x -axis.

Not drawn
accurately



Work out the equation of the tangent to the circle at P .

[5 marks]

Answer _____

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

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



There are no questions printed on this page

*Do not write
outside the
box*

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



There are no questions printed on this page

*Do not write
outside the
box*

**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 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 © 2018 AQA and its licensors. All rights reserved.



GCSE Mathematics

8300/3H – Paper 3 Higher Tier
Mark scheme

June 2018

Version/Stage: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq \text{value} < b$
3.14 ...	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Question	Answer	Mark	Comments
1	0.56	B1	
	Additional Guidance		
2	-1, 0, 1, 2, 3, 4	B1	
	Additional Guidance		
3	$3.2\dot{7}$	B1	
	Additional Guidance		
4	36°	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
5	At least two common factors of 72 and 120 from 2, 3, 4, 6, 8, 12, 24 or $72 = 2 \times 2 \times 2 \times 3 \times 3$ or $120 = 2 \times 2 \times 2 \times 3 \times 5$	M1	May be seen on a diagram, eg factor tree
	At least two common multiples of 6 and 9 from 18, 36, 54...	M1	
	(HCF =) 24 selected from factors or $a = 24$ or (LCM =) 18 selected from multiples or $b = 18$	M1	oe eg HCF = $2 \times 2 \times 2 \times 3$ 24 can be implied from their numerator oe eg LCM = $2 \times 3 \times 3$ 18 can be implied from their denominator oe eg $\frac{2 \times 2 \times 2 \times 3}{2 \times 3 \times 3}$
	$1\frac{1}{3}$ or $\frac{4}{3}$ or 1.33...	A1	oe Accept $\frac{24}{18}$ Ignore further incorrect cancelling
	Additional Guidance		
	HCF = 24 and LCM = 18	M1M1M1	
	HCF = 24	M1M0M1	
	LCM = 18	M0M1M1	

Question	Answer	Mark	Comments
6	54	B1	May be on diagram
	7.5 6	B2	May be on diagram B1 for 1 correct or for answers transposed
	Additional Guidance		
	If answers are in wrong position on answer lines, check working and diagram for clear indication of possible transcription errors eg $w = 9 \div 1.5 = 6$ in working, 9 on answer line $9 \div 1.5 = 6$ in working, 9 on answer line		B1 B0
	Answer line takes precedence over diagram eg $x = 54$ on diagram and $x = 81$ on answer line		B0

Question	Answer	Mark	Comments
7	$2 \times 12 \times 150 \times 1.025$ or $24 \times 150 \times 1.025$ or 3690 or $2 \times 12 \times 150 \times 0.025$ or $24 \times 150 \times 0.025$ or 90	M1	Investment A oe
	1.03×3500 or 3605	M1	Investment B oe eg $0.03 \times 3500 + 3500$ or $105 + 3500$ May be implied from $1.03^2 \times 3500$
	$1.03^2 \times 3500$ or $1.03 \times \text{their } 3605$ or 1.0609×3500 or 3713(.15) or $0.03 \times \text{their } 3605$ or 108(.15)	M1dep	oe Dependent on 2nd M1
	23.15	A1	Condone £23.15p
	Additional Guidance		
	If build up methods are used they must be complete		
	$1\% = 35$ $3\% = 95$ (error without showing method) $95 + 3500$ or 3595		M0
	$1\% = 35$ $3\% = 35 \times 3 = 95$ (error but correct method shown) $95 + 3500$ or 3595		M1
	$1.03^3 \times 3500$ (full method incorrect but implies 1.03×3500)		M0M1M0

Question	Answer	Mark	Comments
8(a)	Alternative method 1 – Using gradients		
	Gradient of $y = 3x + 7$ is 3 and $y = 3x + 4$ and gradient of $2y - 6x = 8$ is 3 or $6 \div 2$	B3	May come from using points on line eg using (0, 7) and (1, 10) and $\frac{10 - 7}{1 - 0} = 3$ or correct calculation for gradient from points on line $2y - 6x = 8$ eg using (0, 4) and (1, 7) and $\frac{7 - 4}{1 - 0} = 3$ B2 for $y = 3x + 4$ and lines have same gradient or $y = 3x + 4$ and gradient of $2y - 6x = 8$ is 3 or $6 \div 2$ or gradient of $y = 3x + 7$ is 3 and $y = 3x + 4$ B1 for gradient of $y = 3x + 7$ is 3 or $y = 3x + 4$ or gradient of $2y - 6x = 8$ is 3 or $6 \div 2$
	Alternative method 2 – Using coordinates and distances		
	Chooses a value for x and correctly evaluates the y value for both lines	M1	eg (0, 7) and (0, 4)
	Chooses a different value for x and correctly evaluates the y value for both lines	M1dep	eg (1, 10) and (1, 7)
	States that y values are a constant distance apart so parallel	A1	oe

Continues on next page

8(a) cont	Alternative method 3 – Using simultaneous equations		
	$y = 3x + 4$ or $y - 3x = 4$ or $2y = 6x + 14$ or $2y - 6x = 14$	M1	oe Equates coefficients in any form
	Any attempt to eliminate both variables from their equations	M1dep	
	States simultaneous equations have no (real) solution and concludes parallel	A1	
	Additional Guidance		
	To award A mark on Alternative method 2, the working must be seen		
	$y = 3x + 4$ and lines have gradient of $3x$		B2
	$y = 3x + 4$ and $3x$ identified in both equations		B2
	Both lines have gradient $3x$		B1
	$y = 3x + 7$, gradient 3 and $y = 3x + 8$, gradient 3 (error in rearrangement)		B1
	$y = 3x + 8$, gradient 3 (error in rearrangement)		B0
	Parallel as both have same gradient		B0
	$2(3x + 7) - 6x = 8$ $6x + 14 - 6x = 8$ $14 = 8$	M1 M1	
	$y = 3x + 7$ and $y = \frac{8 + 6x}{2}$ are equated coefficients, Alternative method 3		M1

Question	Answer	Mark	Comments
8(b)	$3 \times -5 + 7$ or $-15 + 7$ or -8 or $(-5, -8)$ or $(-6 - 7) \div 3$ or $-4.33\dots$ or $y = 3x + 9$	M1	Use a point on $y = 3x + 7$ with $(-5, -6)$ to compare gradient to 3 eg Gradient from $(-5, -6)$ to $(0, 7)$ is 2.6
	Above and -8 or Above and -4.33 or Above and $y = 3x + 9$	A1	oe Above and eg Gradient from $(-5, -6)$ to $(0, 7)$ is 2.6
	Additional Guidance		
	Do not ignore incorrect statements eg -6 is less than -8 so above		M1A0
	$(0, 7)$, $(-1, 4)$, $(-2, 1)$, $(-3, -2)$, $(-4, -5)$, $(-5, -8)$ and ticks below		M1A0
9	1.1 seen or $110\% = 19.25$ seen or $19.25 \div 110$	M1	oe eg $10\% = 1.75$ $1\% = 0.175$
	$19.25 \div 1.1$ or 0.175×100 or 17.5	M1dep	oe
	17.50	A1	correct money notation
	Additional Guidance		
	Condone £17.50p		M1M1A1
	Answer £17.5		M1M1A0

Question	Answer	Mark	Comments
10	55 and 91	B3	B2 for (7), 19, 31, 43, 55, 67, 79, 91 or 55 identified with 0 or 1 incorrect answer or 91 identified with 0 or 1 incorrect answer or 55 and 91 identified with 1 incorrect answer B1 at least 2 correct two-digit numbers from the sequence seen
	Additional Guidance		
	The correct sequence is (7), 19, 31, 43, 55, 67, 79, 91 Ignore continuation of sequence beyond 91		
	Ignore further working unless contradictory		
	55 and 91 identified and 5 th and 8 th terms stated (ignore fw)		B3
	55 and 91 identified and answer 2 (or there are 2) (ignore fw)		B3
	55 identified and 5 th stated (ignore fw)		B2
	Condone 5 or 5 th as final answer provided there is a clear link to 55 eg 12 × 5 = 60 – 5 = 55 55 ÷ 11 = 5 5 on answer line		B2
	Condone 8 or 8 th as final answer provided there is a clear link to 91 eg 12 × 8 = 96 – 5 = 91 8 on answer line		B2

11(a)	$\begin{pmatrix} 1 \\ -1 \end{pmatrix}$	B2	B1 for 1 correct value in correct position Condone a divisor line
	Additional Guidance		

Question	Answer	Mark	Comments
11(b)	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen	M1	
	Valid reason	A1	eg $\begin{pmatrix} -2 \\ 4 \end{pmatrix} = 2 \times \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ $\begin{pmatrix} -2 \\ 4 \end{pmatrix} = 2\mathbf{b}$ $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ is a multiple of $\begin{pmatrix} -1 \\ 2 \end{pmatrix}$ $\mathbf{a} + 2\mathbf{c}$ is a multiple of \mathbf{b} $2\mathbf{b} = \mathbf{a} + 2\mathbf{c}$
	Additional Guidance		
	Condone vectors written as coordinates, eg $(-1, 2)$ is half of $(-2, 4)$		
	Must see $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ or $(-2, 4)$ to award the A mark		
	Condone missing brackets and / or divisor lines		
	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen and both gradient -2		M1A1
	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen and double so parallel		M1A1
	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen and half so parallel		M1A1
	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen and $\mathbf{a} + 2\mathbf{c}$ is $2\mathbf{b}$		M1A1
	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen and $\mathbf{b} = \frac{1}{2}\mathbf{a} + 2\mathbf{c}$		M1A0
	$\begin{pmatrix} -2 \\ 4 \end{pmatrix}$ seen and both have same ratio		M1A0
	$\frac{-2}{4}$ and $\frac{-1}{2}$ both equal -0.5		M1A0

Question	Answer	Mark	Comments
12	12.5 or $12\frac{1}{2}$ or $\frac{25}{2}$	B1	
	N/m ² or newtons per square metre or Nm ⁻² or pascals or Pa	B1	oe
	Additional Guidance		
	m ² /N or P		B0
13	<div> <div>The diagonals are lines of symmetry</div> <div><input checked="" type="checkbox"/></div> </div> <div> <div>The diagonals bisect each other</div> <div><input checked="" type="checkbox"/></div> </div> <div> <div>The diagonals are perpendicular</div> <div><input checked="" type="checkbox"/></div> </div> <div> <div>The diagonals are equal in length</div> <div><input type="checkbox"/></div> </div>	B1	
	Additional Guidance		

Question	Answer	Mark	Comments
14	At least 4 of $(x = 0) \ y = 1$ $(x = 1) \ y = 0.8 \text{ or } \frac{4}{5}$ $(x = 2) \ y = 0.64 \text{ or } \frac{16}{25}$ $(x = 3) \ y = [0.51, 0.512] \text{ or } \frac{64}{125}$ $(x = 4) \ y = [0.40, 0.41] \text{ or } \frac{256}{625}$ $(x = 5) \ y = [0.32, 0.33] \text{ or } \frac{1024}{3125}$ $(x = 6) \ y = [0.26, 0.262144] \text{ or } \frac{4096}{15625}$	M1	oe May be seen in the table or a list or implied from their graph
	6 or 7 correct points plotted	A1	tolerance of $\pm \frac{1}{2}$ small square
	Fully correct smooth curve through all seven correct points	A1	tolerance of $\pm \frac{1}{2}$ small square
	Additional Guidance		
	Ignore extra points plotted		
	Ignore any curve drawn for $x < 0$ or $x > 6$		
	Curve passing through all correct points within tolerance		M1A1A1
	Ruled straight lines		A0

Question	Answer	Mark	Comments
15	$4(x + 3)$	B1	
	Additional Guidance		
16	$(-\frac{3}{4}, 3)$	B1	
	Additional Guidance		
17	$7 \times 5 (\times 9)$ or $(100 - 30) \div 2 (\times 9)$ or $35 (\times 9)$ or $99 \div 11$ or 9 or $4 \times 5 \times 4 \times 5$	M1	First two digits of Method A Last two digits of Method A Complete for Method B
	315 or 400	A1	
	315 and 400 with Method B identified	A1	Method B can be implied by choosing 400
	Additional Guidance		
	315 and 400 and B with no working		M1A1A1
	315 and 400 with 400 circled		M1A1A1
	Beware $40 \times 10 = 400$ (for Method A) is incorrect working		

Question	Answer	Mark	Comments
18	Alternative method 1		
	$\frac{2(x+4)}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x+8}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x(x+4)}{6x^2}$ or $(-)\frac{15x}{6x^2}$ or $\frac{2x^2+8x}{6x^2}$ or $(-)\frac{15x}{6x^2}$	M1	oe A correct fraction using a common denominator for one of the given fractions Accept for this mark only eg $2(3x)$ for $6x$ $3(5)$ for 15 $(2x)(3x)$ for $6x^2$ First fraction can be written as separate fractions eg $\frac{2x}{2(3x)} + \frac{8}{2(3x)}$
	$\frac{2(x+4)}{6x}$ and $(-)\frac{15}{6x}$ or $\frac{2x+8}{6x}$ and $(-)\frac{15}{6x}$ or $\frac{2x(x+4)}{6x^2}$ and $(-)\frac{15x}{6x^2}$ or $\frac{2x^2+8x}{6x^2}$ and $(-)\frac{15x}{6x^2}$	A1	oe A correct fraction using a common denominator for both of the given fractions First fraction can be written as separate fractions eg $\frac{2x}{6x} + \frac{8}{6x}$
	$\frac{2x-7}{6x}$ or $\frac{2kx-7k}{6kx}$, where k is a constant value	A1	Accept eg $\frac{2x + -7}{6x}$ Do not ignore further working

Continues on next page

18 cont	Alternative method 2		
	$\frac{2(x+4)}{6x}$ or $(-)\frac{15}{6x}$ or $\frac{2x+8}{6x}$ or $(-)\frac{15}{6x}$ $\text{or } \frac{2x(x+4)}{6x^2}$ or $(-)\frac{15x}{6x^2}$ $\text{or } \frac{2x^2+8x}{6x^2}$ or $(-)\frac{15x}{6x^2}$	M1	oe A correct fraction using a common denominator for one of the given fractions Accept for this mark only eg $2(3x)$ for $6x$ $3(5)$ for 15 $(2x)(3x)$ for $6x^2$ First fraction can be written as separate fractions eg $\frac{2x}{2(3x)} + \frac{8}{2(3x)}$
	$\frac{2x+8-15}{6x}$ or $\frac{2x-7}{6x}$ or $\frac{2kx-7k}{6kx}$, where k is a constant value	A1	Allow one error in numerator Accept eg $\frac{2x+-7}{6x}$ Must be $6x$ or a multiple of $6x$
	$\frac{2x-7}{6x}$ or $\frac{2kx-7k}{6kx}$, where k is a constant value	A1	Accept eg $\frac{2x+-7}{6x}$ Do not ignore further working
	Additional Guidance		
	Use the method that gives the greater mark		
	$\frac{2x^2-7x}{6x^2}$		M1A1
	$\frac{2x-7}{6x} = \frac{-5}{6x}$		M1A1A0
	$\frac{15x}{6x^2} - \frac{2x^2+8x}{6x^2}$ (order of fractions reversed)		M1A0A0

Question	Answer	Mark	Comments
19	(8, 0)	B1	
	Additional Guidance		
20	$x^2 + (7x)^2 = (10y)^2$ or $x^2 + 49x^2 = 100y^2$	M1	oe
	$50x^2 = 100y^2$ or 1.41(...)	A1	oe equation with terms collected eg $\frac{x^2}{y^2} = \frac{100}{50}$ or $x^2 = 2y^2$ or $x = 1.41y$
	$\sqrt{2}$ or $\frac{2}{\sqrt{2}}$	A1	Do not accept further working
	Additional Guidance		
	$x^2 + 7x^2 = 10y^2$		M0
	$\sqrt{2} = 1.41$		M1A1A0
	$x^2 + (7x)^2 = (10y)^2$ $x^2 + 14x^2 = 20y^2$		M1 A0

Question	Answer	Mark	Comments
21(a)	$m \propto h^3$ or $m = k \times h^3$ or $1600 = k \times 8^3$ or $c \times m = h^3$ or $c \times 1600 = 8^3$	M1	oe eg $h = km^{1/3}$
	(k =) $1600 \div 8^3$ or 3.125 or (c =) $8^3 \div 1600$ or 0.32	M1dep	oe eg $\frac{1600}{512}$ or $\frac{25}{8}$ $\frac{512}{1600}$ or $\frac{8}{25}$
	$m = 3.125 \times h^3$ or $0.32 \times m = h^3$	A1	oe equation
	Additional Guidance		
	$m \propto 3.125 \times h^3$ or $0.32m \propto h^3$		M1M1A0
	(k =) 3.125 or (c =) 0.32		M1M1
	$3.125h^3$ or $0.32h^3$		M1M1

Question	Answer	Mark	Comments
21(b)	their 3.125×12^3 their 3.125×1728 or $1600 \times \left(\frac{12}{8}\right)^3$ or $12^3 \div \text{their } 0.32$ or $1728 \div 0.32$ or $1600 \div \left(\frac{8}{12}\right)^3$	M1	oe
	5400	A1ft	oe ft their 3.125 provided using $m = \text{their } 3.125 \times h^3$
	Additional Guidance		
	Must use $\times 12^3$ or $\times 1728$ or $\times \left(\frac{12}{8}\right)^3$ for M1		
	If in part (a) $m = k \times h$ $1600 = k \times 8$ $m = 200h$ and in part (b) $m = 200 \times 12, m = 2400$		M0 part (a) M0 part (b)
	If in part (a) $m = k \times h$ $1600 = k \times 8$ $m = 200h$ and in part (b) $m = 200 \times 12^3, m = 345\,600$		M0 part (a) M1A1ft part (b)

Question	Answer	Mark	Comments
22	Alternate segment or Reason on first line of working is incorrect	B1	oe Any incorrect statement B0
	Additional Guidance		
	Incorrect theorem stated in first line		B1
	First line is incorrect. It should say alt segment		B1
	Angles not in same segment		B1
	Angles in same segment are not equal		B0
	Opposite segments (are not equal)		B0
	First line is incorrect. It should say opposite segment		B0
	The angle between the chord and the tangent is equal to the angle in the opposite segment		B0
	Angle ACB is not in the same segment, it is alternate		B0
	Angles are not in the same segment, they are alternate		B0
23	$u_2 = 0.6$ or $\frac{3}{5}$ $u_3 = 1.875$ or $\frac{15}{8}$	B2	oe B1 for 1 correct or for u_2 incorrect but their value of u_3 correctly follows through rounded or truncated to 4 dp
	Additional Guidance		
	$u_1 = 0.6$, $u_2 = 1.875$, $u_3 = 1.0434\dots$ or $u_3 = 1.0435$		B1

Question	Answer	Mark	Comments
24(a)	Alternative method 1		
	$\frac{1}{2} \times 10 \times 20$ or 100	M1	oe Area of triangle on left
	$\frac{1}{2} \times (20 + 30) \times 10$ or 250 or 20 × 10 or 200 and $\frac{1}{2} \times 10 \times 10$ or 50	M1	oe Area of trapezium on right
	350	A1	
	Alternative method 2		
	$\frac{1}{2} \times 10 \times 10$ or 50	M1	oe Area of triangle on top right
	$\frac{1}{2} \times (20 + 10) \times 20$ or 300 or 10 × 20 or 200 and $\frac{1}{2} \times 10 \times 20$ or 100	M1	oe Area of trapezium across bottom
	350	A1	
	Additional Guidance		
	$\frac{1}{2} \times (0 + 2 \times 20 + 30) \times 10$ (using Trapezium rule)	M1M1	
	Beware of 300 from incorrect working		
	Beware $(30 - 20) \times (20 - 10) = 100$ is incorrect working		

Question	Answer	Mark	Comments
24(b)	<input type="checkbox"/> It works out an overestimate of the distance	B1	
	<input checked="" type="checkbox"/> It works out an underestimate of the distance		
	<input type="checkbox"/> It could be an overestimate or an underestimate of the distance		
	Additional Guidance		
25(a)	$\tan 6 = \frac{CD}{500}$ or $500 \times \tan 6$	M1	oe any letter $\frac{CD}{\sin 6} = \frac{500}{\sin 84}$
	[52.5, 52.6] or 53	A1	May be on diagram
	Additional Guidance		
	Check diagram for angle		

Question	Answer	Mark	Comments
25(b)	Alternative method 1		
	$500^2 + 400^2$ or $250\,000 + 160\,000$ or $410\,000$	M1	oe
	$\sqrt{\text{their } 410\,000}$ or $\sqrt{500^2 + 400^2}$ or $640.(3\dots)$	M1dep	AC
	$\tan x = \frac{[52.5, 52.6] \text{ or } 53}{\text{their } 640.(3\dots)}$	M1dep	oe any letter
	[4.6, 4.75] from correct working	A1	accept 5 with correct working seen
	Alternative method 2		
	$\frac{500}{\cos 6}$ or [502.7, 502.8]	M1	oe BD
	$\sqrt{\left(\frac{500}{\cos 6}\right)^2 + 400^2}$ or [642.4, 642.5]	M1dep	AD
	$\sin x = \frac{[52.5, 52.6] \text{ or } 53}{\text{their } [642.4, 642.5]}$	M1dep	oe any letter
	[4.6, 4.75] from correct working	A1	accept 5 with correct working seen

Continues on next page

25(b) cont	Alternative method 3		
	$500^2 + 400^2$ or $250\,000 + 160\,000$ or $410\,000$ or $\frac{500}{\cos 6}$ or $[502.7, 502.8]$	M1	oe <i>BD</i>
	$\sqrt{\text{their } 410\,000}$ or $\sqrt{500^2 + 400^2}$ or $640.(3\dots)$ or $\sqrt{\left(\frac{500}{\cos 6}\right)^2 + 400^2}$ or $[642.4, 642.5]$	M1dep	AC <i>AD</i>
	$\cos x = \frac{\text{their } 640.(3\dots)}{\text{their } [642.4, 642.5]}$	M1dep	oe any letter
	$[4.6, 4.75]$ from correct working	A1	accept 5 with correct working seen
	Additional Guidance		
	Check diagram for lengths		
	Beware $\sin x = \frac{52.6}{640.(3\dots)}$ leads to $[4.6, 4.75]$		M1M1M0A0

Question	Answer	Mark	Comments
26(a)	Alternative method 1 – Counting squares		
	15 or 6.6 or 2.4 (cm squares)	M1	375 or 165 or 60 (small squares)
	their 15 + their 6.6 + their 2.4 or 24 (total cm squares)	M1dep	allow one error their 375 + their 165 + their 60 or 600 (total small squares)
	$\frac{\text{their 15}}{\text{their 24}}$ or $\frac{\text{their 375}}{\text{their 600}}$ or 0.625 or $\frac{480}{\text{their 600}}$ or 0.8 (cars per small square) or $\frac{480}{\text{their 24}}$ or 20 (cars per cm square)	M1dep	oe $\frac{\text{their 600}}{480}$ or 1.25 (small squares per car) $\frac{\text{their 24}}{480}$ or 0.05 (cm square per car)
	300	A1	
	Alternative method 2 – Using f.d. scale of x per unit		
	$5x \times 15$ or $75x$ or $6.6x \times 5$ or $33x$ or $0.8x \times 15$ or $12x$ (x per cm)	M1	$25x \times 15$ or $375x$ or $33x \times 5$ or $165x$ or $4x \times 15$ or $60x$ (x per small square)
	$5x \times 15 + 6.6x \times 5 + 0.8x \times 15$ or $75x + 33x + 12x$ or $120x$ (x per cm)	M1dep	allow one error $25x \times 15 + 33x \times 5 + 4x \times 15$ or $375x + 165x + 60x$ or $600x$ (x per small square)
	their $120x = 480$ or $x = 4$	M1dep	oe $\frac{480}{\text{their 120}}$ or 4
	300	A1	

Continues on next page

26(a) cont	Alternative method 3 – Using a number scale of f.d. axis		
	5×15 or 75 or 6.6×5 or 33 or 0.8×15 or 12	M1	25×15 or 375 or 33×5 or 165 or 4×15 or 60
	$5 \times 15 + 6.6 \times 5 + 0.8 \times 15$ or $75 + 33 + 12$ or 120 (1 per cm)	M1dep	allow one error $25 \times 15 + 33 \times 5 + 4 \times 15$ or $375 + 165 + 60$ or 600 (1 per small square)
	$\frac{\text{their } 15}{\text{their } 24}$ or $\frac{\text{their } 375}{\text{their } 600}$ or 0.625 or $\frac{480}{\text{their } 600}$ or 0.8 (cars per small square) or $\frac{480}{\text{their } 24}$ or 20 (cars per cm square)	M1dep	oe $\frac{\text{their } 600}{480}$ or 1.25 (small squares per car) $\frac{\text{their } 24}{480}$ or 0.05 (cm square per car)
	300	A1	
	Additional Guidance		
	Check diagram for working		
	Alternative method 1 Total squares must be the sum of three numbers		
	Alternative method 2 Must be the sum of three expressions		
	The correct f.d. labels for the heights of the bars are 20, 26.4 and 3.2		
	A correct frequency density scale using 1 cm = 4 units eg 4 seen on vertical scale at 1 cm 20 seen on vertical scale at 5 cm		M1M1M1 M1M1M1

Question	Answer	Mark	Comments
26(b)	$\frac{2}{3} \times 2.4$ or 1.6 or $\frac{2}{3} \times 60$ or 40 or $\frac{2}{3} \times 48$ or $10 \times 0.8 \times 4$	M1	oe
	32	A1	
	Additional Guidance		
27	$\frac{10}{30}$ and $\frac{9}{31}$ seen or $\frac{1}{3}$ and $\frac{9}{31}$ seen	M1	oe accept 0.33... and 0.29...
	$\frac{10}{30} \times \frac{9}{31} \times \frac{8}{32}$ or $\frac{1}{3} \times \frac{9}{31} \times \frac{1}{4}$	M1dep	oe accept 0.33... and 0.29... and 0.25
	$\frac{3}{124}$ or [0.0239, 0.0242]	A1	oe eg $\frac{720}{29\,760}$
	Additional Guidance		
	Fractions do not have to be in simplest form		
	$\frac{10}{30} \times \frac{9}{31} \times \frac{8}{32} \times \frac{7}{33}$		M1M0
	$\frac{10}{30} + \frac{9}{31} + \frac{8}{32}$		M1M0

Question	Answer	Mark	Comments
28	$4^2 + y^2 = 80$ or $y = \sqrt{64}$	M1	oe May be implied from 8 on diagram
	$y = -8$	A1	Accept (4, -8)
	$\frac{\text{their } -8}{4}$ or -2	M1	oe gradient of radius OP
	$-1 \div \text{their } -2$ or $\frac{1}{2}$ or $-1 \div \text{their gradient}$	M1	gradient of tangent at P
	$y = \frac{1}{2}x - 10$ or $y + 8 = \frac{1}{2}(x - 4)$	A1	oe Ignore further working
	Additional Guidance		
	$y + 8 = \frac{1}{2}(x - 4)$ followed by error expanding and/or collecting terms	M1A1M1M1A1	
	$y = \frac{1}{2}x - 10$ in working and $\frac{1}{2}x - 10$ only on answer	M1A1M1M1A1	
	$\frac{1}{2}x - 10$	M1A1M1M1A0	
	$(y = \sqrt{64})$ $y = 8$ Gradient $OP = 2$ Perpendicular gradient $= -\frac{1}{2}$	M1 A0 M1 M1 A0	