AQA

GCSE
Mathematics

Paper 2 43652H

Mark scheme

43652H
June 2016

Version: 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. e.g. 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 e.g. 3.14, 3.142, 3.1416
Q	Marks awarded for quality of written communication
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 candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

Questions which ask candidates to show working

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

Questions which do not ask candidates to show working

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

Misread or miscopy

Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate 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 candidate intended it to be a decimal point.

Paper 2 Higher Tier

Q	Answer	Mark	Comments
1	$\frac{20}{8}$ or 2.5 seen or implied or $\frac{8}{20}$ or 0.4 seen or implied or 75 + 75 + 37.5 or 187.5 or 50 + 50 + 25 or 125 or 40 + 40 + 20 or 100 or 2 + 2 + 1 or 5	M1	oe
	Two from 187.5 or 125 or 100 or 5	A1	For 187.5 allow [187, 188] or 190
	187.5 and 125 and 100 and 5	A1	For 187.5 allow [187, 188] or 190 SC1 for [112, 113] and 75 and 60 and 3
	Additional Guidance		

Q	Answer	Mark	Comments
2(a)	720 + 430 or 1150 or 0.15 × 720 or 108 or 0.15 × 430 or 64.5(0)	M1	oe 1 – 0.15 or 0.85
	0.15 × their 1150 or their 108 + their 64.5(0) or their 1150 – 1000 or 1000 – their 1150 or 150 or –150	M1dep	oe their 0.85 and their 1150 or their 0.85 × 720 or 720 – their 108 or 612 or their 0.85 × 430 or 430 – their 64.5(0) or 365.5(0) or 1000 ÷ their 0.85 or [1176, 1177]
	172.5 or 0.15 × their 1150 and (–)150 or their 108 + their 64.5(0) and (–)150 or their 1150 – their 172.5(0)	M1dep	oe their 0.85 × their 1150 or their 612 + their 365.5(0) or 1000 ÷ their 0.85 and their 1150
	977.5 or 977 or 978 or 172.5(0) and (–)150 or 22.5(0) or –22.5(0)	A1	[1176, 1177] and 1150
	Yes	Q1ft	Strand (iii) decision to match their answer provided all method marks are correct.
	Additional Guidance on next page		

	Additional Guidance	
2(a) **AG**	Allow rounding or truncation to £ for 64.5, 365.5, 172.5, 22.5 and 977.5	
	Ignore fw after 977.5 eg 1000 – 977.5 = 32.5 so Yes	5 marks
	15% of 1000 = 150, so 15% of 1150 > 150 so when you subtract the final cost will be < 1000	5 marks
	0.15 × 1150 = 172.5, 172.5 without (–) 150 cannot score the Q mark as they have nothing to compare the 172.5 with	M1M1M1
	Beware: 0.15 × 1000 = 150 with no correct working	M0

Q	Answer	Mark	Comments
2(b)	800 × 1.25 or 1000	M1	oe
	their 1000 – 895 or 105	M1dep	
	their 105 ÷ 1.4(0)	M1dep	oe
	75	A1	SC2 for 84 or 160.(71…) or 161 SC1 for 639.(28…) or 639.29 or 640
	Additional Guidance		
	84 implies 105 ÷ 1.25 or 895 Euros to pounds and subtracting from £800		
	160.(71…) implies 800 × 1.4		
	895 ÷ 1.25 = 716 800 – 716 = 84 84 × 1.25 ÷ 1.4 = 75		4 marks
	895 ÷ 1.25 = 716 800 – 716 = 84 84 ÷ 1.4 = 60		SC2

Q	Answer	Mark	Comments
3	$\frac{9}{5}$ × 28 or 50.4	M1	oe
	82.4 or $82\frac{2}{5}$ or 82 remainder 2	A1	oe
	82	B1ft	ft their answer provided not an integer
	Additional Guidance		
	82 on its own		M1A1B1
	$\frac{9}{5}$ × 28 + 32 on its own		M1
	$\frac{9}{5}$ of 28 + 32 on its own		M0
	$\frac{9}{5}$ × 28 + 32 = $\frac{9}{5}$ × 60 (incorrect order of operations) = 108 (no ft as not from a decimal answer)		M0A0B0
4(a)	4, 2 and 0	B2	B1 for 4, 2, x or 4, x, x – 2 or 4, x, 0 or x, x – 2, x – 4 or x, 2, 0 or 0, 2, 4 eg 4, 2, 1 4, 3, 1 4, 3, 0 6, 4, 2 6, 2, 0

Q	Answer	Mark	Comments
4(b) Alt 1 of 3 Alt 2 of 3	**Alternative method 1**		
	(31 + 3) ÷ 2 or 17	M1	oe 2 × 17 – 3 (= 31)
	(their 17 + 3) ÷ 2	M1dep	oe 2 × 10 – 3 (= 17)
	10	A1	Ignore fw continuing the sequence SC1 for 12.25
	Alternative method 2		
	Inputs a number for first term and evaluates third term correctly.	M1	eg First term = 1 implies third term = –5 First term = 2 implies third term = –1 First term = 3 implies third term = 3 First term = 4 implies third term = 7 First term = 5 implies third term = 11 First term = 6 implies third term = 15 First term = 7 implies third term = 19 First term = 8 implies third term = 23 First term = 9 implies third term = 27 First term = 9.5 implies third term = 29
	Inputs another number for first term and evaluates third term correctly.	M1dep	
	10	A1	Ignore fw continuing the sequence SC1 for 12.25

Q	Answer	Mark	Comments

4(b) Alt 3 of 3	**Alternative method 3**			
	$2(2x - 3) - 3 = 31$	$2x - 3 = 31$ or $2x = 34$ or $x = 17$	M1	oe with any variable
	$4x - 6 - 3 = 31$ or $4x - 9 = 31$ or $4x = 40$	$2x - 3 =$ their 17 or $2x = 20$	M1dep	oe with any variable
	10		A1	Ignore fw continuing the sequence SC1 for 12.25
	Additional Guidance			
	10 + 3 = 13, answer 13	(allow as fw continuing the sequence)		M1M1A1
	10 + 3 = 13, answer 6.5	(allow as fw continuing the sequence)		M1M1A1
	10 – 3 = 7, answer 7	(do not allow A mark as not continuing the sequence)		M1M1A0
	$((31 + 3) \div 2 + 3) \div 2$ or $\frac{31 + 3 + 6}{4}$			M1M1

5(a)	$15 < x \leq 25$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
5(b)	Mid values seen	B1	10, 20, 30, 40 and 50 or 10.005, 20.005, 30.005, 40.005, 50.005 or 10.01, 20.01, 30.01, 40.01, 50.01
	10 × 14 (+) 20 × 12 (+) 30 × 11 (+) 40 × 2 (+) 50 (× 1) or 140 (+) 240 (+) 330 (+) 80 (+) 50 or 840	M1	Accept use of mid values 10.005, 20.005 etc or 10.01, 20.01 etc Allow one error eg one mid value incorrect or one calculation incorrect
	their 840 ÷ 40	M1dep	
	21 or 21.01	A1	Accept 21.005 SC2 for 16 or 16.005 or 16.01 or 21.5(0) or 21.505 or 21.51 or 26 or 26.005 or 26.01 or 791.25
	Additional Guidance		
	21 and then states answer is in $15 < x \leq 25$ class is fw and can be ignored		4 marks
	140 + 240 + 330 + 80 + 50 ÷ 40 = 21 (recovered)		4 marks
	$\frac{140 + 240 + 330 + 80 + 50}{40} = 791.25$		B1M1M1A0
	140 + 240 + 330 + 80 + 50 ÷ 40 = 791.25		B1M1
	Answer 791.25 implies at least B1M1		
	840		B1M1
	840 ÷ 5 = 168		B1M1M0
	140, 240, 330, 80, 50		B1M1
	168 with no working		M0
	Note: Two or more midpoints incorrect		B0M0

Q	Answer	Mark	Comments
6	**Alternative method 1**		
	6 : 3 : 1 or 10 seen or implied	M1	oe Any order
	130 ÷ 10 × 6 or 78 or 130 ÷ 10 × 3 or 39 or 130 ÷ 10 or 13	M1dep	
	White 78 Brown 39 Granary 13	A1	
	Alternative method 2		
	$6x + 3x + x = 130$ or $10x = 130$	M1	oe eg $y + \frac{y}{2} + \frac{y}{6} = 130$ or $\frac{5y}{3} = 130$
	130 ÷ 10 or 13	M1dep	oe eg 3 × 130 ÷ 5 or 78
	White 78 Brown 39 Granary 13	A1	
	Alternative method 3		
	A correctly evaluated trial where white : brown : granary = 6 : 3 : 1	M1	eg (white =) 6, (brown =) 3, (granary =) 1, total 10
	A different correctly evaluated trial where white : brown : granary = 6 : 3 : 1	M1dep	eg (white =) 12, (brown =) 6, (granary =) 2, total 20
	White 78 Brown 39 Granary 13	A1	

	Additional Guidance on next page

Q	Answer	Mark	Comments

6 AG	**Additional Guidance**	
	Allow decimals in a correctly evaluated trial, eg 75, 37.5, 12.5, total 125	
	6 : 3 : 1	M1
	6, 3, 1 Total = 10	M1
	6, 3, 1	M0
	7 : 2 : 1 = 10, 130 ÷ 10 = 13	M0

7(a)	$\pi \times 6^2$ or 3.14×6^2 or [113, 113.2]	M1	May be embedded oe
	$\pi \times 6^2 \times 15$ or $3.14 \times 6^2 \times 15$ or [113, 113.2] × 15	M1dep	oe
	[1695, 1698] or 1700 or 540π	A1	Ignore fw after 540π
	Additional Guidance		
	$\pi \times 6^2 = \pi \times 12 \times 15$		M1M1
	$\pi \times 6^2 \times 15 = \pi \times 12 \times 15$		M1M1
	$\pi \times 6^2 \times 30$		M1M0
	$2 \times \pi \times 6^2 \times 15$		M1M0
	$\pi \times 6^2 = \pi \times 12$		M1M0
	$\pi 6^2$		M1
	$\pi \times 12$		M0
	$\pi \times 12 \times 15$		M0

Q	Answer	Mark	Comments
7(b)	**Alternative method 1**		
	45 000 ÷ 1000 or 45	M1	
	45 ÷ 0.75 or 45 × 1.33… or their 45 ÷ 0.75	M1	oe eg 45 ÷ 3 × 4
	60	A1	
	60 minutes or 60 min(s) or 1 hour or 1h(r)	Q1	Strand (i) Correct notation
	Alternative method 2		
	0.75 × 1000 or 750	M1	
	45 000 ÷ 750 or 45 000 ÷ their 750	M1	oe
	60	A1	
	60 minutes or 60 min(s) or 1 hour or 1h(r)	Q1	Strand (i) Correct notation
	Additional Guidance		
	For the Q mark 60 minutes or 1 hour must not come from incorrect working		
	Ignore fw after 60 minutes or 1 hour		
	Digit 6 implies M0M1 eg 60 000, 6000, 600, 6 or 0.6		M0M1
	750 ÷ 45 000 = 0.016… (units would be minutes^{-1})		M1M0A0Q0
	750 ÷ 45 000 = 0.016… and 0.016… × 60 = 1 hour (method is incorrect)		M1M0A0Q0
	Do not accept 60 m for the Q mark		M1M1A1Q0

Q	Answer	Mark	Comments
8 Alt 1 of 3 Alt 2 of 3	**Alternative method 1**		
	$5x - x$ or $4x$ or $5x + 5x - x - x$ or $8x$	M1	oe $5x + 5x$ or $10x$ or $5x + x + x$ or $7x$
	$8x \times 5x$ or $40x^2$ or $x \times 5x$ or $5x^2$	M1	oe $10x \times 7x$ or $70x^2$ or $6 \times x \times 5x$ or $30x^2$
	$8x \times 5x = 1440$ or their $40x^2 = 1440$ or $x^2 = 36$	M1dep	oe $10x \times 7x - 6 \times x \times 5x = 1440$ or their $70x^2$ – their $30x^2 = 1440$
	$(x =)$ 6 or 5×36 or $(5x^2 =)$ 1440 ÷ 8	M1dep	oe Must be correct
	180	A1	
	Alternative method 2		
	$5x - x$ or $4x$ or $5x + 5x - x - x$ or $8x$	M1	oe
	4 small rectangles fit in half white rectangle	M1	May be implied from diagram
	8 small rectangles fit in white rectangle	M1dep	May be implied from diagram
	1440 ÷ 8	M1dep	oe Must be correct
	180	A1	

Q	Answer	Mark	Comments

8 Alt 3 of 3	**Alternative method 3**		
	5 – 1 or 4 or 5 + 5 – 1 – 1 or 8	M1	5 + 5 or 10 or 5 + 1 + 1 or 7 May be on diagram
	8 × 5 or 40	M1	oe 10 × 7 or 70 or 6 × 1 × 5 or 30
	1440 ÷ their 40 or 36 or $\sqrt{\text{their } 36}$	M1dep	oe
	6	M1dep	Must be correct
	180	A1	
	Additional Guidance		
	$x = 6$ with no clearly incorrect working		M1M1M1M1
	Answer 180^2 scores A0		M1M1M1M1
	4 small rectangles fit in half white rectangle implies $4x$		M1M1
	Just $5x^2$		M0M1

Q	Answer	Mark	Comments
9	75% = 14 625	M1	oe 14 625 ÷ 3 or 4875
	$\frac{14\ 625 \times 100}{75}$ or 14 625 ÷ 0.75 or 14 625 ÷ 75 or 195	M1dep	oe 14 625 + their 4875 or 4 × their 4875
	19 500	A1	
	Additional Guidance		
	14 625 × 75 ÷ 100		M0

Q	Answer	Mark	Comments
10(a)	Median at 18	B1	tolerance ± ½ square
	LQ at 14	B1	tolerance ± ½ square
	UQ at 26	B1	tolerance ± ½ square
	Min at 5 and max at 30 and correct shape box including 3 lines for LQ, median and UQ	Q1	tolerance ± ½ square Strand (ii) End vertical lines are not required if end points are clear SC1 for (median =) 18 or (LQ =) 14 or (UQ =) 26
	Additional Guidance		
	Note, for the SC1 (median =) 18, need to see 18, 8 circled on diagram is not enough, this also applies for the LQ and UQ values		
	Condone whisker line drawn horizontally through the box, but not along the top or along the bottom of the box		

Q	Answer	Mark	Comments
10(b)	More points on average or median is higher.	B1	
	More consistent or IQR is less.	B1	
	Additional Guidance – continues on the next page		
	Median		
	Jack scored more points on average because 21 is bigger than 18		B1
	His median score is higher than Rob's		B1
	Jack's median is located on a higher score		B1
	Jack's average score (median) is higher		B1
	He has a higher average amount of points		B1
	Jack's average score is higher		B1
	On average Jack scored higher points		B1
	Jack's average score is higher by 3 points		B1
	Jack's median score is higher by 3 points		B1
	Higher median score		B1
	The median is larger		B1
	On average Jack scores 21 points a game and Rob scores 18		B1
	Jack has all round better scores		B0
	He had a higher midpoint so scored more often than Rob		B0
	Jack was better		B0
	Jack is higher		B0
	Jack's score is higher		B0
	Jack scores 21 points a game and Rob scores 18		B0

10b AG cont.	**Additional Guidance – continued from previous page**	
	IQR	
	Jack scored more consistently because 12 is more than 8	B1
	Jack's IQR is smaller so Jack is more CONCISE	B1
	Jack has a smaller IQR (… than Rob)	B1
	Jack has a lower IQR	B1
	Jack's IQR is less spread out than Rob's	B1
	The spread is less (Assume referring to Jack)	B1
	Jack's box is smaller so he is more consistent	B1
	Jack is more consistent	B1
	His scores are closer together	B1
	Jack's IQR is higher	B0
	Jack has a consistent score	B0
	Jack's range is more consistent	B0
	Jack's UQ is higher than Rob's	B0
	Jack's LQ is higher than Rob's	B0
	Jack's LQ is 18 whilst Rob's is 12	B0
	Median and IQR in one statement	
	Jack is higher on average and is more consistent	B1B1
	Additional Guidance	
	If not explicitly stated assume referring to Jack	
	Numbers quoted must be correct	
	Jack's IQR is less spread out and higher than Rob's	Allow B1
	Jack has a more consistent higher score	Allow B1
	Use of mean or mode for average	B0
	Use of range for IQR	B0

Q	Answer	Mark	Comments
11	4 or 5 points plotted correctly	M1	± ½ square tolerance
	Fully correct with a smooth curve	A1	± ½ square tolerance
	Additional Guidance		

12 Alt 1 of 2	**Alternative method 1**		
	20 × 2.5 or 50 or 30 × 2.5 or 75	M1	oe May be on a diagram
	(their 50)^2 + (their 75)^2 or 8125	M1dep	$\cos 56 = \frac{50}{h}$ or $\cos 34 = \frac{75}{h}$ or $\sin 56 = \frac{75}{h}$ or $\sin 34 = \frac{50}{h}$
	$\sqrt{(\text{their } 50)^2 + (\text{their } 75)^2}$ or $\sqrt{8125}$	M1dep	$(h =) \frac{50}{\cos 56}$ or $(h =) \frac{75}{\cos 34}$ or $(h =) \frac{75}{\sin 56}$ or $(h =) \frac{50}{\sin 34}$
	90.1(…)	A1	
	90	B1ft	ft rounding their 3sf or more answer to 2sf SC3 for 14 SC2 for 14.4(…)

Q	Answer	Mark	Comments
12 Alt 2 of 2	**Alternative method 2**		
	$20^2 + 30^2$ or 1300	M1	$\cos 56 = \frac{20}{h}$ or $\cos 34 = \frac{30}{h}$ or $\sin 56 = \frac{30}{h}$ or $\sin 34 = \frac{20}{h}$
	$\sqrt{20^2 + 30^2}$ or $\sqrt{1300}$ or 36.0(5…)	M1dep	$(h =) \frac{20}{\cos 56}$ or $(h =) \frac{30}{\cos 34}$ or $(h =) \frac{30}{\sin 56}$ or $(h =) \frac{20}{\sin 34}$
	their 36.0(5…) × 2.5	M1dep	oe
	90.1(…)	A1	
	90	B1ft	ft rounding their 3sf or more answer to 2sf SC3 for 14 SC2 for 14.4(…)
	Additional Guidance		
	Scale drawing with answer 90		5 marks
	$\sqrt{8125} = 90$		5 marks
	Allow more accurate values for 56 and 34 eg 56.3… or 33.6… or 33.7		

Q	Answer	Mark	Comments
13 Alt 1 of 6	**Alternative method 1**		
	$2x + y + 128 = 180$ or $x + 5y + 100 = 180$	M1	oe
	$2x + y = 52$ and $x + 5y = 80$	M1dep	oe Collecting terms
	$2x + y = 52$ $2x + 10y = 160$ $10x + 5y = 260$ $x + 5y = 80$	M1dep	oe Equating coefficients
	$x = 20$ or $y = 12$	A1	
	$x = 20$ and $y = 12$	A1	SC3 for $x = 41\frac{1}{3}$ or 41 or 41.3… and $y = 17\frac{1}{3}$ or 17 or 17.3… or $x = 60$ and $y = 8$ or $x = 38\frac{2}{3}$ or 39 or 38.6… or 38.7 and $y = 2\frac{2}{3}$ or 3 or 2.6… or 2.7

<table>
<tr><td rowspan="6">13
Alt
2 of 6</td><td colspan="3">Alternative method 2</td></tr>
<tr><td colspan="2">$2x + y + 128 = 180$
or $2x + y + x + 5y + 128 + 100 = 360$</td><td>M1</td><td>oe</td></tr>
<tr><td colspan="2">$2x + y = 52$
and $3x + 6y = 132$</td><td>M1dep</td><td>oe
Collecting terms</td></tr>
<tr><td>$6x + 3y = 156$
$6x + 12y = 264$</td><td>$12x + 6y = 312$
$3x + 6y = 132$</td><td>M1dep</td><td>oe
Equating coefficients</td></tr>
<tr><td colspan="2">$x = 20$ or $y = 12$</td><td>A1</td><td></td></tr>
<tr><td colspan="2">$x = 20$ and $y = 12$</td><td>A1</td><td>SC3 for $x = 41\frac{1}{3}$ or 41 or 41.3…
and $y = 17\frac{1}{3}$ or 17 or 17.3…
or $x = 60$
and $y = 8$
or $x = 38\frac{2}{3}$ or 39 or 38.6… or 38.7
and $y = 2\frac{2}{3}$ or 3 or 2.6… or 2.7</td></tr>
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<tr><td rowspan="6">13
Alt
3 of 6</td><td colspan="3">Alternative method 3</td></tr>
<tr><td colspan="2">$x + 5y + 100 = 180$
or $2x + y + x + 5y + 128 + 100 = 360$</td><td>M1</td><td>oe</td></tr>
<tr><td colspan="2">$x + 5y = 80$
and $3x + 6y = 132$</td><td>M1dep</td><td>oe
Collecting terms</td></tr>
<tr><td>$3x + 15y = 240$
$3x + 6y = 132$</td><td>$6x + 30y = 480$
$15x + 30y = 660$</td><td>M1dep</td><td>oe
Equating coefficients</td></tr>
<tr><td colspan="2">$x = 20$ or $y = 12$</td><td>A1</td><td></td></tr>
<tr><td colspan="2">$x = 20$ and $y = 12$</td><td>A1</td><td>SC3 for $x = 41\frac{1}{3}$ or 41 or 41.3…
and $y = 17\frac{1}{3}$ or 17 or 17.3…
or $x = 60$
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or $x = 38\frac{2}{3}$ or 39 or 38.6… or 38.7
and $y = 2\frac{2}{3}$ or 3 or 2.6… or 2.7</td></tr>
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<tr><td rowspan="7">13
Alt
4 of 6</td><td colspan="3">Alternative method 4</td></tr>
<tr><td colspan="2">$2x + y + 128 = x + 5y + 100$
or $2x + y + 128 = 180$
or $x + 5y + 100 = 180$</td><td>M1</td><td>oe</td></tr>
<tr><td colspan="2">$-x + 4y = 28$
and
$2x + y = 52$ or $x + 5y = 80$</td><td>M1dep</td><td>oe
Collecting terms</td></tr>
<tr><td>$-2x + 8y = 56$
$2x + y = 52$</td><td>$-x + 4y = 28$
$x + 5y = 80$</td><td rowspan="2">M1dep</td><td rowspan="2">oe
Equating coefficients</td></tr>
<tr><td>$-x + 4y = 28$
$8x + 4y = 208$</td><td>$-5x + 20y = 140$
$4x + 20y = 320$</td></tr>
<tr><td colspan="2">$x = 20$ or $y = 12$</td><td>A1</td><td></td></tr>
<tr><td colspan="2">$x = 20$ and $y = 12$</td><td>A1</td><td>SC3 for $x = 41\frac{1}{3}$ or 41 or 41.3…
and $y = 17\frac{1}{3}$ or 17 or 17.3…
or $x = 60$
and $y = 8$
or $x = 38\frac{2}{3}$ or 39 or 38.6… or 38.7
and $y = 2\frac{2}{3}$ or 3 or 2.6… or 2.7</td></tr>
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<tr><td rowspan="6">13
Alt
5 of 6</td><td colspan="3">Alternative method 5</td></tr>
<tr><td colspan="2">$2x + y + 128 = x + 5y + 100$
or $2x + y + x + 5y + 128 + 100 = 360$</td><td>M1</td><td></td></tr>
<tr><td colspan="2">$-x + 4y = 28$
and $3x + 6y = 132$</td><td>M1dep</td><td>oe
Collecting terms</td></tr>
<tr><td>$-3x + 12y = 84$
$3x + 6y = 132$</td><td>$-3x + 12y = 84$
$6x + 12y = 264$</td><td>M1dep</td><td>oe
Equating coefficients</td></tr>
<tr><td colspan="2">$x = 20$ or $y = 12$</td><td>A1</td><td></td></tr>
<tr><td colspan="2">$x = 20$ and $y = 12$</td><td>A1</td><td>SC3 for $x = 41\frac{1}{3}$ or 41 or 41.3…
and $y = 17\frac{1}{3}$ or 17 or 17.3…
or $x = 60$
and $y = 8$
or $x = 38\frac{2}{3}$ or 39 or 38.6… or 38.7
and $y = 2\frac{2}{3}$ or 3 or 2.6… or 2.7</td></tr>
</table>

13 Alt 6 of 6	**Alternative method 6** Substitution			
	$2x + y + 128 = 180$ or $x + 5y + 100 = 180$		M1	oe
	$y = 52 - 2x$ or $y = \frac{80 - x}{5}$	$x = \frac{52 - y}{2}$ or $x = 80 - 5y$	M1dep	oe Making one variable the subject
	$52 - 2x = \frac{80 - x}{5}$	$\frac{52 - y}{2} = 80 - 5y$	M1dep	oe Eliminating a variable
	$x = 20$ or $y = 12$		A1	
	$x = 20$ and $y = 12$		A1	SC3 for $x = 41\frac{1}{3}$ or 41 or 41.3… and $y = 17\frac{1}{3}$ or 17 or 17.3… or $x = 60$ and $y = 8$ or $x = 38\frac{2}{3}$ or 39 or 38.6… or 38.7 and $y = 2\frac{2}{3}$ or 3 or 2.6… or 2.7
	Additional Guidance			
	Note $x = 20$ and $y = 12$ using trial and improvement or without working			5 marks
	$x + 2y = 44$ may be used for $3x + 6y = 132$ when equating coefficients			
	For SC3 accept fractions written as decimals to 1dp or better			
	Alternative method 6 is one example of the principles of marking for the			

	substitution method	

Q	Answer	Mark	Comments
14	$y = 5x + 4$	B2	oe B1 for $y = mx + 4$ or $y = 5x + c$, $c \neq 3$ or $5x + 4$
	Additional Guidance		
	$y = 5x$		B1
	$y = 4$		B1
	$y = 5x – 3$		B1
	$y = 5x + 3$		B0
	$5x + 1$		B0

Q	Answer	Mark	Comments
15	**Alternative Method 1**		
	One correctly evaluated calculation within range for nails and one correctly evaluated calculation within range for screws	M1	eg 4 × 200 = 800 and 6 × 140 = 840 The bags do not have to all weigh the same eg 3 × 195 + 200 = 785 and 6 × 140 = 840
	One more correctly evaluated calculation within range for nails and one more correctly evaluated calculation within range for screws	M1dep	eg 4 × 202 = 808 and 6 × 137 = 822
	Any correctly evaluated calculation giving same answer in range 810 to 820 for both nails and screws	Q1	Strand (ii) SC1 for implying a single value [810, 820] works, eg (it works for) 815
	Alternative Method 2		
	195 or 205 or 135 or 145	M1	800 ± 20 or 780 or 820 or 840 ± 30 or 810 or 870
	4 × 195 = 780 and 4 × 205 = 820 or 6 × 135 = 810 and 6 × 145 = 870	M1dep	Writes 800 ± 20 and writes 840 ± 30
	(Overlap) 810 to 820	Q1	Strand (ii) SC1 for implying a single value [810, 820] works, eg (it works for) 815
	Additional Guidance on next page		

15 AG	**Additional Guidance**	
	Condone use of upper bounds	
	Mark best scheme	
	Beware: The bags do not have to all weigh the same, eg 3 × 204 + 200 = 812 and 4 × 135 + 2 × 136 = 812	M1M1Q1
	4 × 204 = 816 and 6 × 136 = 816	M1M1Q1
	4 × 202.5 = 810 and 6 × 135 = 810	M1M1Q1
	4 x 205 = 820 and 820 ÷ 6 = 136.6… or 136.7	M1M1Q1

Q	Answer	Mark	Comments
16	Angle $ABC = 74$ or angle $PAB = 35$	M1	May be on diagram in the correct place 180 – 74 – 35
	71	A1	
	Additional Guidance		
17	$\frac{270}{360} \times 2 \times \pi \times 7$ or 10.5π or [32.97, 33] or $\frac{90}{360} \times 2 \times \pi \times 7$ or 3.5π or [10.99, 11]	M1	oe
	$7 + 7 + \frac{270}{360} \times 2 \times \pi \times 7$ or 46.9…	M1dep	oe
	[46.97, 47] or $10.5\pi + 14$ as final answer or $\frac{21\pi}{2} + 14$	A1	oe
	Additional Guidance		
	46.97 with 46.9 on answer line is fw and can be ignored		M1M1A1
	$10.5\pi + 14 = \frac{49\pi}{2}$		M1M1A0
	$10.5\pi + 14 = 77$		M1M1A0

Q	Answer	Mark	Comments
18(a)	$\frac{50}{400}$ or $\frac{1}{8}$ or 400 ÷ 50 or 8 seen or implied	M1	
	12.5 or 12 or 13 and 18.75 or 18 or 19 and 11.25 or 11 or 12 and 7.5 or 7 or 8	A1	Allow one error
	One row from 12 18 12 8 12 19 11 8 12 19 12 7 13 18 11 8 13 18 12 7 13 19 11 7	A1	Rounded or truncated and total = 50
	Additional Guidance		

18(b)	100 ÷ 20 or 5 or 150 ÷ 15 or 10 or 90 ÷ 10 or 9 or 60 ÷ 25 or 2.4	M1	oe May be implied from the diagram
	5 and 10 and 9 and 2.4	A1	Allow one error May be implied from the diagram
	At least one fully correct bar	B1	tolerance ± ½ square
	Fully correct histogram with correct bar heights	B1	tolerance ± ½ square
	Additional Guidance		

Q	Answer	Mark	Comments
19	$36^2 = 14^2 + 25^2 - 2 \times 14 \times 25 \times \cos x$	M1	oe
	$\frac{14^2 + 25^2 - 36^2}{2 \times 14 \times 25}$ or $\frac{-475}{700}$ or $\frac{-19}{28}$ or $-0.67\ldots$ or -0.68	M1dep	oe
	[132.7, 133]	A1	SC1 for [47, 47.3]
	Additional Guidance		

Q	Answer	Mark	Comments
20	15 ÷ 12 or 1.25 or 12 ÷ 15 or 0.8	M1	oe
	(their 1.25)^3 or $\frac{125}{64}$ or 1.95(3125) or (their 0.8)^3 or $\frac{64}{125}$ or 0.512	M1dep	oe
	2734.375 or 2734.(…) or 2730	A1	SC1 for 1750 or 2187.5 or 2188 with no working
	Additional Guidance		
	Treats as a particular shape eg cylinder $r^2 \times \pi \times 12 = 1400 \rightarrow r = 6.0939\ldots$ $r \times 1.25$ (1.25 seen) $= 6.0939\ldots \times 1.25$ $= 7.617$ $12 \times 1.25 = 15$ $7.617^2 \times \pi \times 15$ (1.25^3 implied) 2734.375 or 2734.(…) or 2730		M1 M1dep A1

Q	Answer	Mark	Comments
21	**Alternative method 1**		
	$\frac{4}{10}$ (black)	M1	oe May be on diagram
	$\frac{4}{10} \times \frac{3}{9}$	M1dep	oe 0.4 × 0.33… May be on diagram
	$\frac{12}{90}$ or $\frac{2}{15}$	A1	oe 0.13… or 13.(…)%
	Alternative method 2		
	4 × 3 or 12 or 10 × 9 or 90	M1	
	4 × 3 or 12 and 10 × 9 or 90	M1dep	
	$\frac{12}{90}$ or $\frac{2}{15}$	A1	oe 0.13… or 13.(…)%
	Additional Guidance		
	$\frac{12}{90} = \frac{1}{9}$, ignore fw		M1M1A1

Q	Answer	Mark	Comments
22(a)	$(7c - d)(7c + d)$	B2	oe Any order B1 for $(ac - d)(bc + d)$ where $ab = 49$ or $(7c - d)(7c - d)$ or $(7c - d)^2$ or $(7c + d)(7c + d)$ or $(7c + d)^2$ or $(7 - d)(7 + d)$
	Additional Guidance		
	Condone missing end bracket		
	$(-7c - d)(-7c + d)$		B2
	$(d - 7c)(d + 7c)$		B0
	$7c - d(7c + d)$		B0

Q	Answer	Mark	Comments
22(b)	$x(x - 6)$	B1	
	$(x - 6)(2x + 5)$ or $(x + a)(2x + b)$	M1	where $ab = \pm 30$ or $2a + b = -7$
	$\frac{x}{2x+5}$	A1	Do not ignore fw
	Additional Guidance		
	$\frac{x\cancel{(x-6)}}{(2x+5)\cancel{(x-6)}}$		B1M1A1
	$\frac{(x-0)(x-6)}{(2x+5)(x-6)} = \frac{(x-0)}{(2x+5)}$		B1M1A0

Q	Answer	Mark	Comments
23	$x^2 + ax + ax + a^2$ (– 7) or $x^2 + 2ax + a^2$ (– 7) or $2ax = 10x$ or $2a = 10$ or $a = 5$ or $a^2 – 7 = b$ or $(x + 5)^2$	M1	oe
	$a = 5$ and $b = 18$	A1	
	Additional Guidance		
	$(x + 5)^2 – 7 = x^2 + 10x + 18$		M1A1
	$a = 7$ and $b = 18$		M0

Q	Answer	Mark	Comments
24	$6(2x + 5) + 1(x + 3)$ or $3(x + 3)(2x + 5)$	M1	oe May be seen as part of a fraction or fractions with denominator $(x + 3)(2x + 5)$
	$6(2x + 5) + 1(x + 3) = 3(x + 3)(2x + 5)$	M1dep	oe
	$6x^2 + 20x + 12$ (= 0) or $3x^2 + 10x + 6$ (= 0)	A1	Simplifying the expression to three terms
	$\frac{-20 \pm \sqrt{20^2 - 4 \times 6 \times 12}}{2 \times 6}$ or $\frac{-10 \pm \sqrt{10^2 - 4 \times 3 \times 6}}{2 \times 3}$	M1	oe Allow one error –2.548… or –0.784… Strictly ft their quadratic
	$\frac{-20 \pm \sqrt{20^2 - 4 \times 6 \times 12}}{2 \times 6}$ or $\frac{-10 \pm \sqrt{10^2 - 4 \times 3 \times 6}}{2 \times 3}$	A1ft	oe fully correct
	–0.78 and –2.55	A1	
	Additional Guidance		
	One correct solution to 2 or more dp implies 4 marks Two correct solutions to more than 2 dp implies 5 marks		
	$3x^2 + 10x = -6$		M1M1A1
	ft their quadratic for the 4th and 5th marks If no real roots M1A1ft can still be awarded If quadratic factorises, must see correct factors for M1 and correct solutions for A1ft If quadratic does not factorise, attempt to factorise scores M0 "Their quadratic" must be in the form $ax^2 + bx + c$ (= 0) or equivalent, no credit for solving a quadratic embedded within fractions etc		

Q	Answer	Mark	Comments
25 Alt 1 of 4	**Alternative method 1**		
	$8 \div 4$ or 2	B1	$4 \times 2 = 8$ or implies volume = 4 × area of triangle
	(Area of triangle =) $\frac{1}{2} \times x \times x \times \sin 60$ or $\frac{1}{2} \times x \times x \times \frac{\sqrt{3}}{2}$	B1	oe
	$\frac{1}{2} \times x \times x \times \sin 60 = 2$ or $\frac{1}{2} \times x \times x \times \frac{\sqrt{3}}{2} = 2$ or $(x^2 =) \frac{4}{\sin 60}$ or 4.59… or 4.6… or $(x^2 =) \frac{8}{\sqrt{3}}$ $\cos 30 = \frac{h}{2.149}$ or $\sin 60 = \frac{h}{2.149}$ or $2 = \frac{1}{2} \times 2.149 \times h$ or $h^2 = \frac{6}{\sqrt{3}}$ or $2\sqrt{3}$	M1	oe
	$(h =)$ [1.81, 1.87] or $(x =)$ [2.1, 2.15] or $(x^2 =)$ [4.59, 4.66]	A1	oe
	[1.81, 1.87] and No	A1	

25 Alt 2 of 4 3 of 4	**Alternative method 2**		
	8 ÷ 4 or 2	B1	4 × 2 = 8 or implies volume = 4 × area of triangle
	(half the base =) h tan 30	B1	oe
	h tan 30 × h = 2	M1	
	(h^2 =) [3.46, 3.47] or (h =) [1.81, 1.87]	A1	
	[1.81, 1.87] and No	A1	
	Alternative method 3		
	8 ÷ 4 or 2	B1	4 × 2 = 8 or implies volume = 4 × area of triangle
	tan 60 = $\frac{1.95}{\text{half the base}}$ or tan 30 = $\frac{\text{half the base}}{1.95}$ or (half the base =) $\frac{1.95}{\tan 60}$ or (half the base) = 1.95 × tan 30 or 1.125… or 1.13 or $\frac{13\sqrt{3}}{20}$	B1	
	their 1.125… × 1.95 or their 1.125… × 1.95 × 4	M1	oe
	(Area of triangle =) [2.19, 2.2] or (Volume of prism =) [8.7, 8.8]	A1	oe
	[2.19, 2.2] and No or [8.7, 8.8] and No	A1	

Q	Answer	Mark	Comments
25 Alt 4 of 4	**Alternative method 4**		
	8 ÷ 4 or 2	B1	4 × 2 = 8 or implies volume = 4 × area of triangle
	$x^2 = h^2 + \left(\frac{x}{2}\right)^2$ or $h^2 = x^2 - \left(\frac{x}{2}\right)^2$ or $h^2 = \frac{3}{4}x^2$ or $h = \frac{\sqrt{3}}{2}x$ or $\frac{1}{2}xh = 2$	B1	oe
	$\frac{1}{2} x \times \frac{\sqrt{3}}{2} x = 2$ or $\frac{1}{2} \times \frac{2}{\sqrt{3}} h \times h = 2$ or $h^2 = \frac{8}{\sqrt{3}} - \frac{2}{\sqrt{3}}$ or $\frac{6}{\sqrt{3}}$ or $2\sqrt{3}$ or $h^2 = 2.149^2 - \left(\frac{2.149}{2}\right)^2$	M1	oe
	(h^2 =) [3.46, 3.47] or (h =) [1.81, 1.87]	A1	
	[1.81, 1.87] and No	A1	
	Additional Guidance on next page		

	Additional Guidance	
25 **AG**	Throughout mark scheme: x represents the length of one side of the triangle h represents the perpendicular height of the triangle The principle of this mark scheme is as follows Fact Different correct fact Any correct equation set up involving only one variable (need not be simplified) Any answer in range An answer in range giving the full solution with the correct conclusion	 B1 B1 M1 A1 A1
	$\frac{1}{2}\ ab \sin C = 2$ (given on the formula sheet)	B1B0