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# GCSE MATHEMATICS 8300/2H

Higher Tier

Paper 2 Calculator

Shadow paper based on November 2022 paper

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**Mark scheme**

November 2022

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Version: 1.0

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 Examiner.

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.

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## 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.

<b>M</b>	Method marks are awarded for a correct method which could lead to a correct answer.
<b>A</b>	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>B</b>	Marks awarded independent of method.
<b>ft</b>	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
<b>SC</b>	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
<b>M dep</b>	A method mark dependent on a previous method mark being awarded.
<b>B dep</b>	A mark that can only be awarded if a previous independent mark has been awarded.
<b>oe</b>	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
<b>[a, b]</b>	Accept values between a and b inclusive.
<b>[a, b)</b>	Accept values $a \leq \text{value} < b$
<b>3.14 ...</b>	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
<b>Use of brackets</b>	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.

<b>Q</b>	<b>Answer</b>	<b>Mark</b>	<b>Comment</b>
<b>1</b>	-2	B1	

<b>Q</b>	<b>Answer</b>	<b>Mark</b>	<b>Comment</b>
<b>2</b>	$9.261 \times 10^{15}$	B1	

<b>Q</b>	<b>Answer</b>	<b>Mark</b>	<b>Comment</b>
<b>3</b>	(0, -7)	B1	

<b>Q</b>	<b>Answer</b>	<b>Mark</b>	<b>Comment</b>
<b>4</b>	$\frac{p}{n^3}$	B1	

Q	Answer	Mark	Comments
5	At least two of $2^3$ , $3^3$ , 7 selected eg $2^3 \times 3^3 \times 7$ or 2 2 2 3 3 3 7 7 or $2^2 + 3^3 + 7$ or $2^3 \times 3^3$ or $2^3 + 7$ or $3^3 \cdot 7$	M1	allow $2^3$ to be $2 \times 2 \times 2$ or 8 allow $3^3$ to be $3 \times 3 \times 3$ or 27 allow 7 to be $7^1$ selection is implied by inclusion in intersection of overlapping circles
	1512	A1	
	<b>Additional Guidance</b>		
	$8 \times 27 \times 7$		M1
	8, 27, 49		M1
	$4 + 27 + 7$		M1
	Intersecting circles with eg only 27 and 7 in the intersection		M1
	Allow inclusion of 1 for up to M1 eg $1 \times 2^3 \times 3^3 \times 7$		M1
	Answer 1512		M1A1
M1 seen with answer the LCM		M1A0	

Q	Answer	Mark	Comments	
6(a)	$\frac{90 - 42}{100} \times 36\,000$ or $\frac{50}{100} \times 36\,000 \text{ or } 18\,000$ or $\frac{36}{100} \times 36\,000 \text{ or } 12\,960$ or $\frac{50 - 36}{100} \times 36\,000$ or 14 and 50 and 36 seen	M1	oe	
	5040			A1
	<b>Additional Guidance</b>			
	Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts			
	Build-up to 50% or 36% must be correct or full method must be shown			
	eg only $50\% \times 36\,000$ with no or incorrect evaluation			M0

Q	Answer	Mark	Comments
<b>6(b)</b>	Ticks Cannot tell and valid reason	B1	eg ticks Cannot tell and We don't know the number sold (in 2007)
	<b>Additional Guidance</b>		
	Ignore calculations using percentages from the bar chart		
	Allow any unambiguous indication of Cannot tell with a valid reason		
	Ticks Cannot tell and They might have sold fewer drinks (in 2007)		B1
	Ticks Cannot tell and It (only) gives percentages		B1
	Ticks Cannot tell and It doesn't tell you how many teas were sold		B1
	Ticks Cannot tell and Don't have enough information		B1
	Ticks Cannot tell and Both bars the same height		B0
	Ticks Yes or ticks No		B0

Q	Answer	Mark	Comments		
7(a)	Correct evaluation of the square root of an integer [10, 20] or correct evaluation of the square of a decimal or fraction [3.5, 4.5)	M1	eg $\sqrt{10} = 3.16$ or $10 \rightarrow 3.16$ eg $3.5^2 = 12.25$ or $3.5 \rightarrow 12.25$		
	13	A1	SC1 answer given as $\sqrt{13}$		
	<b>Additional Guidance</b>				
	Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts				
	Condone eg $10 = 3.16$				
	Answer only 13			M1A1	
	Must select 13 as final answer for M1A1 ie 13 as the last in a list with a blank answer line is not enough for A1 unless 13 selected				
	If $\sqrt{13}$ or $3.5^2$ is evaluated then it must be correct to award the A1 for 13				
	Acceptable values for square roots of integers in range				
	10	3.1(62...) or 3.2		16	4
11	3.3(16...) or 3.317 or 3.32		17	4.1(23...)	
12	3.4(64...) or 3.5		18	4.2(42...) or 4.243	
13	3.6(05...) or 3.606 or 3.61		19	4.3(58...) or 4.359 or 4.36 or 4.4	
14	3.7(41...) or 3.742		20	4.4(72...) or 4.5	
15	3.8(72...) or 3.873 or 3.9				
Examples of squares of numbers in range with their acceptable values					
3.5	12.25		4.0	16	
3.6	12.96 or 13		4.1	16.8(1) or 17	
3.7	13.69 or 13.7 or 14		4.2	17.6(4) or 18	
3.8	14(.44)		4.3	18.49 or 18.5 or 18	
3.9	15(.21)		4.4	19(.36)	

Q	Answer	Mark	Comments
7(b)	Valid response that indicates there is one (negative) answer missing	B1	eg $-11$ (is also an answer) or there is a negative value as well or square roots have two answers or answer is 11 and $-11$
	<b>Additional Guidance</b>		
	$-11 \times -11 (= 121)$		B1
	Another number can square to make 121 (implies exactly two)		B1
	He has forgotten the other value (implies exactly two)		B1
	There is another value it could be (implies exactly two)		B1
	It could be a different number (implies exactly two)		B1
	It could be negative (bod means 11 could be $-11$ )		B1
	$-11^2 (= 121)$ (condone missing brackets around $-11$ )		B1
	$\pm \sqrt{121}$		B1
	Indication that there might be <b>more</b> than two possible values for $x$ eg There are other possible numbers eg There could be other values eg Other numbers square to make 121 eg He hasn't included negatives		B0 B0 B0 B0
	Repeating the question eg There is more than 1 possible value eg 11 is not the only possible value eg More than 1 number works		B0 B0 B0
	A partially correct statement eg $x$ could be negative or decimal eg $-11 \times -11 = -121$ eg $x^2 = -11$		B0 B0 B0

Q	Answer	Mark	Comments	
8(a)	4 5 6	B2	any order B1 answer of three positive numbers in any order with sum 15 eg 12 2 1 or $5\frac{1}{2}$ $7\frac{1}{2}$ 2 or 5 5 5 or $3\frac{2}{3}$ $4\frac{2}{3}$ $6\frac{2}{3}$ or correct equation in $w$ , $x$ and $y$ eg $4w + 4x + 4y = 60$ or $w + x + y = 15$	
	<b>Additional Guidance</b>			
	Ignore attempts to work out the volume or surface area eg 5 5 5 volume calculated as 250			B1
	Negative numbers and/or zero used			B0
	$wxy > 110$ or $wxy = 110$			B0

Q	Answer	Mark	Comments
8(b)	$27a^3$	B1	

Q	Answer	Mark	Comment
9	1378	B1	

Q	Answer	Mark	Comment
<b>10</b>	<b>Alternative method 1</b> Works out $n$ th term of new sequence		
	Common difference of 3 identified	M1	implied by $3n \dots$
	$3n + 6$	A1	oe eg $9 + 3(n - 1)$
	their $(3n + 6) - (n + 2)$	M1	oe their $(3n + 6)$ must be a linear expression condone missing brackets
	$2n + 4$	A1ft	oe eg $6 + 2(n - 1)$ ft their $3n + 6$ which must be a linear expression missing brackets must be recovered
	<b>Alternative method 2</b> Works out terms of sequence A and sequence B		
	3, 4, 5, 6	M1	sequence A
	6, 8, 10, 12	A1	sequence B
	Common difference of 2 identified	M1	ft their 6, 8, 10, 12 which must be a linear sequence for B
	$2n + 4$	A1ft	oe eg $6 + 2(n - 1)$ ft their 6, 8, 10, 12 which must be a linear sequence for B
	<b>Additional Guidance</b>		
	Choose the scheme that favours the student		

Q	Answer	Mark	Comments
11(a)	$1.4 \times 15 = 21$ and $50 - 21 = 29$	B1	oe eg $1.4 \times 15 = 21$ and $21 + 29 = 50$ or $50 - 29 = 21$ and $21 \div 15 = 1.4$ or $21 + 29 = 50$ and $21 \div 1.4 = 15$ may be seen as one calculation eg $50 - 1.4 \times 15 = 29$ or $29 + 1.4 \times 15 = 50$ or $50 - 29 = 1.4 \times 15$
	<b>Additional Guidance</b>		
	$50 - 21 = 29$ and $50 - 29 = 21$ and $21 + 29 = 50$ are equivalent		
	$1.4 \times 15 = 21$ and $21 \div 1.4 = 15$ and $21 \div 15 = 1.4$ are equivalent		
	$50 - 21 = 29$ or $29 + 21 = 50$ or $50 - 29 = 21$	B0	
	(15 minutes =) 21 litres leak out $50 - 21 = 29$	B0	
	$1.4 \times 15 = 21$ 29 litres left	B0	
	Allow unambiguous working in ml and/or seconds		
	For eg $50 - 21 = 29$ condone $21 - 50 = 29$ or $21 - 50 = -29$		
	Condone incorrect use of equals sign eg $1.4 \times 15 = 21 + 29 = 50$ or $1.4 \times 15 = 21 - 50 = 29$	B1	
	Correct response with irrelevant work	B1	
29 from two different ways with one way incorrect is choice eg $1.4 \times 15 = 21$ and $50 - 21 = 29$ and $21 \times 1.4 = 29$	B0		

Q	Answer	Mark	Comments
11(b)	8	B1	
	Correct method for gradient eg $\frac{50-29}{15-\text{their } 8}$ or $\frac{21}{7}$	M1	oe eg $\frac{50-35}{15-10}$ or $\frac{15}{5}$ or $50-47$
	3	A1ft	correct or ft their 8
	<b>Additional Guidance</b>		
	Note that their 8 can be used to work out the rate but does not have to be		
	Values seen on graph must be used correctly eg 12 and 4 seen on the graph is M0 unless subsequently used correctly in attempt to work out the gradient		
	A1ft answers must be to 1 dp or better eg 8.5 $\frac{50-29}{15-8.5}$ 3.2 (accept 3.23...)		B0 M1 A1ft
	After B0 the method may be implied (use $\frac{50-29}{15-\text{their } 8}$ to check) eg 7 2.625 (accept 2.63)		B0 M1A1ft
	If the report is blank, 8 and 3 must be unambiguously identified in working to be acceptable		
	Allow 3 to be written as $\frac{3}{1}$		

Q	Answer	Mark	Comments
<b>12</b>	<b>Alternative method 1</b>		
	$5x + x + 4x + 5x + x + 5x + x$ or $22x$ or $5 + 1 + 4 + 5 + 1 + 5 + 1$ or 22	M1	oe eg $6x + 5x - x + 5x + x + 5x + x$ $22x$ or 22 is implied by 4.2 oe if addition not seen
	their $22x = 92.4$ or $92.4 \div \text{their } 22$ or $4.2$ or $\frac{21}{5}$	M1	oe equation must have terms collected if 1st M1 <b>not</b> awarded their $22x$ must be $20x$ or $21x$ or $23x$ if 1st M1 <b>not</b> awarded their 26 must be 20 or 21 or 23
	their $4.2 \times 12$	M1dep	dep on 2nd M1 oe eg $42 + 8.4$
	50.4	A1ft	oe ft their 4.2 if M0M2 awarded

**Mark scheme and Additional Guidance continue on the next page**

<b>12 cont</b>	<b>Alternative method 2</b>		
	$5x + x + 5x$ or $11x$ or $5 + 1 + 5$ or $11$	M1	oe eg $5x + x + 4x + x$ $11x$ or $11$ is implied by 4.2 oe if addition not seen
	their $11x = 92.4 \div 2$ or $46.2 \div$ their 11 or $4.2$ or $\frac{21}{5}$	M1	oe equation must have terms collected if 1st M1 <b>not</b> awarded their $11x$ must be $10x$ if 1st M1 <b>not</b> awarded their 11 must be 10
	their $4.2 \times 12$	M1dep	dep on 2nd M1 oe eg $42 + 8.4$
	50.4	A1ft	oe ft their 4.2 if MOM2 awarded
	<b>Additional Guidance</b>		
	Up to M3 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts		
	Follow through must be to at least 1 dp and their 22 or their 11 must be seen		MOM1M1A1ft
	Both 2nd and 3rd method marks may be implied by their answer. If not using 20, 21, 22, 23, 10 or 11 you must have seen the first M1.		
	$23x = 92.4$ (1st M0, no addition seen, but $23x$ allowed) $\frac{92.4}{23} \times 14$ , answer 56.2	MOM1 M1A1ft	
$6x + 4x + 5x + x + 5x + x = 20x$ (correct terms added with incorrect total) $92.4 \div 20 = 4.62$ 64.68 (multiplication by 14 implied)	M1 M1 M1A0		
$92.4 \div 20 = 4.62$ (1st M0, no addition seen, and 20 not allowed) $4.62 \times 14$ , answer 64.68	MOM0 MOA0		
$5x + x + 4x + 5x + x + 5x + x = 22x^7$	M1MOM0A0		

Q	Answer	Mark	Comment
<b>13</b>	<b>Alternative method 1</b> Works out $BC$ using Pythagoras then works out $EH$		
	$8^2$ or 64 and $4.8^2$ or 23.04	M1	oe
	$\sqrt{8^2 - 4.8^2}$ or $\sqrt{64 - 23.04}$ or $\sqrt{40.96}$ or 6.4	M1dep	oe implied by 15.36 as the area of the smaller triangle may be on diagram
	$9 \div 4.8 \times$ their 6.4 or 12	M1dep	oe full method to work out $EH$ may be on diagram as $EH$ or $FG$ implied by 54 as the area of the larger triangle or 126 as the area of the rectangle
	0.5 $\times$ their 12 $\times$ 9 or 54 and their 12 $\times$ 10.5 or 126	M1dep	oe eg $0.5 \times$ their 6.4 $\times$ 4.8 $\times$ $(9 \div 4.8)^2$ and their 12 $\times$ 10.5 <b>or</b> $0.5 \times$ their 12 $\times$ (10.5 + 19.5)
	180	A1	

**Mark scheme and Additional Guidance continues on the next two pages**

<b>13 cont</b>	<b>Alternative method 2</b> Works out $ED$ using similar triangles then works out $EH$		
	$9 \div 4.8 \times 8$ or 15	M1	oe may be on diagram
	(their 15) <sup>2</sup> or 2250 and $9^2$ or 81	M1dep	oe
	$\sqrt{(\text{their } 15)^2 - 9^2}$ or $\sqrt{225 - 81}$ or $\sqrt{144}$ or 12	M1dep	oe full method to work out $EH$ may be on diagram as $EH$ or $FG$ implied by 54 as the area of the larger triangle or 126 as the area of the rectangle
	$0.5 \times \text{their } 12 \times 9$ or 54 and their $12 \times 10.5$ or 126	M1dep	oe eg $0.5 \times \text{their } 6.4 \times 4.8 \times (9 \div 4.8)^2$ and their $12 \times 10.5$ <b>or</b> $0.5 \times \text{their } 12 \times (10.5 + 19.5)$
	180	A1	

**Mark scheme and Additional Guidance continue on the next page**

<b>13 cont</b>	<b>Alternative method 3</b> Uses trigonometry to work out $BC$ then works out $EH$ or uses trigonometry to work out $EH$		
	(angle $ABC =$ ) $\sin^{-1}\left(\frac{4.8}{8}\right)$ or (angle $ABC =$ ) [36.8, 36.9] or (angle $BAC =$ ) $\cos^{-1}\left(\frac{4.8}{8}\right)$ or (angle $BAC =$ ) [53.1, 53.2]	M1	oe full method to work out $ABC$ or $BAC$
	$8 \times \cos$ (their [36.8, 36.9]) or $8 \times \sin$ (their [53.1, 53.2]) or 6.4 or $\tan$ (their [36.8, 36.9]) = $\frac{9}{EH}$ or $\tan$ (their [53.1, 53.2]) = $\frac{EH}{9}$	M1dep	oe full method to work out $BC$ or partial method to work out $EH$
	$9 \div 4.8 \times$ their 6.4 or 12 or $9 \div \tan$ (their [36.8, 36.9]) or $9 \times \tan$ (their [53.1, 53.2])	M1dep	oe full method to work out $EH$ may be on diagram as $EH$ or $FG$ implied by 54 as the area of the larger triangle or 126 as the area of the rectangle
	$0.5 \times$ their $12 \times 9$ or 54 and their $12 \times 10.5$ or 126	M1dep	oe eg $0.5 \times$ their $6.4 \times 4.8 \times (9 \div 4.8)^2$ and their $12 \times 10.5$ <b>or</b> $0.5 \times$ their $12 \times (10.5 + 19.5)$
	180	A1	
	<b>Additional Guidance</b>		
	Up to M3 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts		

Q	Answer	Mark	Comment
14	$14\,250 \times 0.12$ or 1710	M1	oe eg $14\,250 \times 1.12 - 14\,250$
	their $1710 \div 0.3$ or 5700	M1dep	oe may be seen in stages eg $17\,10 \div 30 = 57$ and $57 \times 100$
	their $5700 \times 5$	M1dep	oe
	28 500	A1	SC2 266 000
	<b>Additional Guidance</b>		
	Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts		
	SC2 is from starting with $14\,250 \times 1.12$		

Q	Answer	Mark	Comments
15	$2 \text{ cm}^2 = 400 \text{ mm}^2$	B1	

Q	Answer	Mark	Comment
16	$y = x^3 + 2$	B1	

Q	Answer	Mark	Comment
17	$\frac{40}{11}$	B1	

Q	Answer	Mark	Comment
18(a)	Median = 49	B1	implied by correct line on box plot
	Lower quartile = 46	B1	implied by correct start of box
	Upper quartile = 59	B1	implied by correct end of box
	Fully correct box plot	B1ft	ft their stated median, LQ and UQ whiskers must be correct
	<b>Additional Guidance</b>		
	First 3 marks can be awarded even if a box plot is not drawn		

Q	Answer	Mark	Comment
18(b)	Home and valid reason referring to median	B1ft	eg Home and median is higher (in home games) ft their box plot or their values
	<b>Additional Guidance</b>		
	Strict ft		
	Values for the medians do not need to be stated, but if stated they must be 56 and correct for their box plot		
	Use of any other measure along with correct response is B0 eg Home as median is higher and so is the biggest value		B0
	56 is bigger than 49 so Home		B1
	Home matches as the average was 7 more		B1
	Median home 56 Median away is 49 So Home		B1
	Median home 56 Median away is 49		B0
	Home as my box plot shows it		B0
	Home. The mean is 7 more		B0
	Home as the average is higher		B0
She generally makes more passes in home matches so Home		B0	

Q	Answer	Mark	Comment
<b>18(c)</b>	Away and valid reason referring to interquartile range	B1ft	eg Away and interquartile range is lower (in away games) ft their box plot or their values
	<b>Additional Guidance</b>		
	Strict ft		
	Values for the interquartile ranges do not need to be stated, but if stated they must be 22 and correct for their box plot		
	Answer states that ranges are equal alongside a correct response	B1	
	Answer based on range only	B0	
	Use of any other measure (apart from range) along with correct response is B0 eg Away as IQR is lower and the upper quartile is also lower	B0	
	13 is lower than 22 so Away	B1	
	Away matches as the spread was 9 less	B1	
	Away matches as the spread was lower	B0	
	Away because the box is narrower	B1	
	IQR home 22 IQR away is 13 So Away	B1	
	IQR home 22 IQR away is 13	B0	
	Away as my box plot shows it	B0	
	Away. The LQ is bigger	B0	
	Away as the average is lower	B0	
	She generally makes fewer passes in away matches so Away	B0	

Q	Answer	Mark	Comment
19	$\frac{-3 \pm \sqrt{3^2 - 4 \times 5 \times -7}}{2 \times 5}$ or $-\frac{3}{10} \pm \sqrt{\frac{9}{100} + \frac{14}{10}}$	M1	oe eg $\frac{-3 \pm \sqrt{9 + 140}}{10}$ or $-\frac{3}{10} \pm \sqrt{\frac{9}{100} + \frac{140}{100}}$
	$\frac{-3 \pm \sqrt{149}}{10}$ or $-\frac{3}{10} \pm \sqrt{\frac{149}{100}}$ or 0.9206... and -1.5206...	A1	oe two solutions eg $-\frac{3}{10} + \frac{1}{10} \sqrt{149}$ and $-\frac{3}{10} - \frac{1}{10} \sqrt{149}$ allow decimal solutions rounded to at least 1 dp eg allow 0.92 and -1.52
	<b>Additional Guidance</b>		
	Both solutions correct		M1A1
	Both solutions seen in working but only one on answer line		M1A0
	Ignore conversion attempt after correct surd form solutions seen unless only one solution is subsequently selected		
	Working must be for two solutions to score eg $\frac{-3 + \sqrt{3^2 - 4 \times 5 \times -7}}{2 \times 5}$ not recovered		M0
	Square root sign should cover all appropriate work unless recovered eg $-\frac{3}{10} \pm \sqrt{\frac{9}{100} + \frac{14}{10}}$ not recovered		M0
	Fraction line should be under all appropriate work unless recovered eg $-3 \pm \frac{\sqrt{149}}{10}$ not recovered		M0
	One solution correct does not imply M1		
Both solutions seen in working but signs transposed on answer line		M1A0	
$\sqrt{3^2 - 4 \times 5 \times -7}$ is correct for $\sqrt{3^2 - 4 \times 5 \times -7}$			

Q	Answer	Mark	Comment
20	<b>Alternative method 1</b>		
	$8 \times 7 \times 10$ or 560 or $5 \times 3 \times 4$ or 60 or $\frac{5}{8}$ or $\frac{3}{7}$ or $\frac{4}{10}$	M1	oe
	$\frac{5 \times 3 \times 4}{8 \times 7 \times 10}$ or $\frac{60}{560}$ or 0.107(...)	M1dep	oe eg $\frac{5}{8} \times \frac{3}{7} \times \frac{4}{10}$
	10.7(...) or 0.107(...) and 0.100	A1	allow 11 with M2 scored or allow 0.11 and 0.10 with M2 scored
	<b>Alternative method 2</b>		
	$5 \times 3 \times 4$ or 60	M1	oe
	$0.1 \times 8 \times 7 \times 10$ or $0.1 \times 560$ or 56	M1	oe
	60 and 56	A1	
	<b>Additional Guidance</b>		
	Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts		
	Alt 1 11 or 0.11 without M2 scored is A0		
	Alt 1 10.7(...) with no working		M2A1
	Alt 2 56 and 60 with no working		M2A1
Do not allow any misreads			

Q	Answer	Mark	Comment
21(a)	<b>Alternative method 1</b>		
	$\frac{3(6x-1)+9}{5}$	M1	oe eg $\frac{18x+6}{5}$
	12	A1	SC1 20.6 oe value
	<b>Alternative method 2</b>		
	$\frac{3 \times 17 + 9}{5}$ or 12 or f(17)	M1	oe eg $\frac{51+9}{5}$
	12	A1	SC1 20.6 oe value
	<b>Additional Guidance</b>		
	Answer 12		M1A1
	Working out f(3) and g(3) is M0 unless recovered eg1 $\frac{3 \times 3 + 9}{5} = 3.6$ $6 \times 3 - 1 = 17$ eg2 $3.6 \times 17 = 61.2$		M0A0 M0A0
	12 followed by further work eg $12 \times 3 = 36$		M1A0
	SC1 is for gf(3)		

Q	Answer	Mark	Comment
21(b)	<b>Alternative method 1</b>		
	$\frac{5x-9}{3} \text{ or } \frac{5y-9}{3}$ or $\frac{5 \times 6 - 9}{3}$	M1	oe
	7	A1	
	<b>Alternative method 2</b>		
	$\frac{3x+9}{5} = 6$	M1	oe equation
	7	A1	
	<b>Additional Guidance</b>		
	7	M1A1	

Q	Answer	Mark	Comment
22	$x(x^2 - 81)$ or $(x^2 + 9x)(x - 9)$ or $(x^2 - 9x)(x + 9)$	M1	oe partial factorisation eg $x(x^2 - 9^2)$ any order eg $(x^2 - 81)x$
	$x(x + 9)(x - 9)$	A1	oe full factorisation any order eg $(x + 9)x(x - 9)$
	<b>Additional Guidance</b>		
	M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts		
	Ignore correctly placed multiplication signs		
	Ignore missing final bracket eg $x(x - 9)(x + 9)$		M1A1
	Allow $x$ to be $1x$ throughout		
	Allow $x$ to be $(x + 0)$ or $(x - 0)$ throughout		
	Ignore any equating to zero		
	Ignore any attempt to 'solve'		
$x(-9 + x)(9 + x)$		M1A1	

Q	Answer	Mark	Comment
23(a)	$1 \times 6$ or 6 or $3.5 \times 4$ or 14 or $4.5 \times 2$ or 9 or $2.5 \times 4$ or 10 or $2 \times 4$ or 8	M1	oe values 6, 14, 9, 10 or 8 must be in the correct row in the table or linked to the correct bar on the histogram
	$1 \times 6 \times 3$ or $6 \times 3$ or 18 or $3.5 \times 4 \times 8$ or $14 \times 8$ or 112 or $4.5 \times 2 \times 11$ or $9 \times 11$ or 99 or $2.5 \times 4 \times 14$ or $10 \times 14$ or 140 or $2 \times 4 \times 18$ or $8 \times 18$ or 144 or 513	M1dep	oe values 18, 112, 99, 140 or 144 must be in the correct row in the table
	(their 18 + their 112 + their 99 + their 140 + their 144) $\div$ (their 6 + their 14 + their 9 + their 10 + their 8) or $513 \div 47$	M1dep	oe full correct method eg (their 18 + their 112 + their 99 + their 140 + their 144) $\div$ 47
	[10.9, 10.915]	A1	accept 11 with M3 scored and no errors

Additional Guidance is on the next page

		<b>Additional Guidance</b>																											
<b>23(a) cont</b>	Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts																												
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Time, $x$ , (hours)	Frequency	Midpoint																											
$0 \leq x < 6$	1	3	3																										
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$12 \leq x < 16$	2.5	14	35																										
$16 \leq x < 20$	2	18	36																										

Q	Answer	Mark	Comment
23(b)	Valid reason	B1	eg the data is grouped or the exact values are not used or the midpoints are estimates
	<b>Additional Guidance</b>		
	Because we are using midpoints	B1	
	Midpoint is an average	B1	
	There are no raw data	B1	
	Numbers are rounded	B0	
	There are no data to use	B0	
	The answer is a decimal	B0	
Valid reason with an irrelevant statement	B1		

Q	Answer	Mark	Comment
24	250 – 175 or 75	M1	oe may be on diagram
	$15 \times 1\frac{1}{2}$ or 22.5	M1	oe eg $15 + 7.5$ or $15 \times 90 \div 60$ or $15 \times 1.5$ may be on diagram
	$(\text{their } 22.5)^2 + 80^2 - 2 \times \text{their } 22.5 \times 60 \times \cos(\text{their } 75)$ or [6207, 6208]	M1dep	oe dep on at least one M scored
	$\sqrt{\text{their [6207, 6208]}}$ or 78.7(...)	M1dep	oe eg $\sqrt{22.5^2 + 80^2 - 2 \times 22.5 \times 60 \times \cos 75}$ dep on 3rd M1
	Yes and 78.7(...)	A1	oe eg 78.7 and the car is closer to B accept Yes and 79 with M4 scored
	<b>Additional Guidance</b>		
Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts			
2nd M1 Do not accept $15 \times 1.30$ unless recovered			

Q	Answer	Mark	Comment
25	Any one of $(\overrightarrow{PW}) = \mathbf{b} - \frac{1}{3}\mathbf{a}$ $(\overrightarrow{WX}) = \mathbf{b} - \frac{1}{3}\mathbf{a}$ $(\overrightarrow{PX}) = 2\mathbf{b} - \frac{2}{3}\mathbf{a}$	M1	oe eg $(\overrightarrow{QW}) = -\frac{1}{3}\mathbf{a} + \mathbf{b}$ or $(\overrightarrow{WX}) = -\frac{2}{3}\mathbf{a} + 2\mathbf{b} - (\mathbf{b} - \frac{1}{3}\mathbf{a})$ or $(\overrightarrow{QX}) = \mathbf{a} + \frac{3}{2}\mathbf{b}$ allow use of $\overrightarrow{WP}$ and/or $\overrightarrow{XW}$ and/or $\overrightarrow{XP}$
	Any two of $(\overrightarrow{PW}) = \mathbf{b} - \frac{1}{3}\mathbf{a}$ $(\overrightarrow{WX}) = \mathbf{b} - \frac{1}{3}\mathbf{a}$ $(\overrightarrow{PX}) = 2\mathbf{b} - \frac{2}{3}\mathbf{a}$	M1dep	oe allow use of $\overrightarrow{WP}$ and/or $\overrightarrow{XW}$ and/or $\overrightarrow{XP}$
	Any valid pair of vectors and indication that one vector is a multiple of the other eg $(\overrightarrow{PW}) = \mathbf{b} - \frac{1}{3}\mathbf{a}$ and $(\overrightarrow{PX}) = 2\mathbf{b} - \frac{2}{3}\mathbf{a}$ and $2\mathbf{b} - \frac{2}{3}\mathbf{a} = 2(\mathbf{b} - \frac{1}{3}\mathbf{a})$	A1	eg $\overrightarrow{PW} = \mathbf{b} - \frac{1}{3}\mathbf{a}$ and $\overrightarrow{XP} = \frac{2}{3}\mathbf{a} - 2\mathbf{b}$ and $2\overrightarrow{PW} = -\overrightarrow{XP}$ or $\overrightarrow{PX} = 2\mathbf{b} - \frac{2}{3}\mathbf{a}$ and $\overrightarrow{WX} = \mathbf{b} - \frac{1}{3}\mathbf{a}$ and $WX$ is $\frac{1}{2}$ of $PX$ and $WX$ is parallel to $PX$
	<b>Additional Guidance</b>		
Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts			

Q	Answer	Mark	Comment
<b>26</b>	$6 \times 10 \div 2$ or 30 or $6 \times 90$ or 540 or 570	M1	oe eg $\frac{1}{2} \times \frac{6}{10} \times 10^2$ or $\frac{1}{2} \times (100 + 90) \times 6$ may be on diagram
	$750 - 6 \times 10 \div 2 - 6 \times 90$ or 750 – their 30 – their 540 or 750 – their 570 or 180	M1dep	oe full method for remaining distance may be on diagram may be embedded eg $180 \div 40$
	$\frac{1}{2} \times (v + 6) \times 40 = \text{their } 180$ $2 \times \text{their } 180 \div 40 - 6$	M1dep	oe eg $20v + 120 = \text{their } 180$ any letter
	3	A1	oe value
	<b>Additional Guidance</b>		
Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts			

Q	Answer	Mark	Comment
27	$\frac{n}{45}$ and $\frac{n-1}{44}$	M1	oe may be implied eg $\frac{n(n-1)}{1980}$
	$n^2 - n - 1260 (= 0)$	M1dep	oe with all terms fully simplified eg $n^2 - n = 1260$
	$(n-36)(n+35)$ or $\frac{-(-1) \pm \sqrt{(-1)^2 - 4 \times 1 \times -1260}}{2 \times 1}$ or $\frac{1}{2} \pm \sqrt{1260 + \frac{1}{4}}$	M1	oe eg $\frac{1 \pm \sqrt{5041}}{2}$ or $\frac{1 \pm 71}{2}$ or $0.5 \pm 35.5$ ft their 3-term quadratic
	36	A1	36 and -35 is A0
	<b>Additional Guidance</b>		
	Answer 36 with no working or from trial		M3A1
	Beware Answer 36 from incorrect working eg $\frac{n}{36} \times \frac{n}{36} = \frac{7}{11} \quad n^2 = 1296 \quad n = 36$		MOMOMOA0
	Allow $n$ to be $N$ or $x$ etc		
	3rd M1 Allow $(-1)^2$ to be $1^2$		
	3rd M1 Do not allow $(-1)^2$ to be $-1^2$ unless recovered		
3rd M1 Allow $\pm$ to be $+$			
3rd M1 Square root sign should cover all appropriate work unless recovered eg $\frac{1 \pm \sqrt{1+5040}}{2}$ not recovered		M0	
3rd M1 Fraction line should be under all appropriate work unless recovered eg $1 \pm \frac{\sqrt{5041}}{2}$ not recovered		M0	
3rd M1 $\sqrt{(-1)^2 - 4 \times 1 \times -1260}$ is correct for $\sqrt{(-1)^2 - 4 \times 1 \times -1260}$			

Q	Answer	Mark	Comment	
28	$\frac{PB}{\sin 29} = \frac{32}{\sin 124}$ or $\frac{32 \sin 29}{\sin 124}$	M1	oe eg $\frac{\sin 29}{PB} = \frac{\sin 124}{32}$ or $\frac{PB}{\sin 29} = [38.5, 38.6]$	
	[18.7, 18.8]	A1	accept 19 with M1 scored	
	<b>Additional Guidance</b>			
	<i>PB</i> may be <i>BP</i> or <i>x</i> etc			
	Do not regard 27 as a misread of 29			