AQA

GCSE
Mathematics

Paper 2 Foundation Tier

Mark scheme

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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 $a \leq$ 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	metres	B1	
2	72	B1	
3	1.5	B1	
4	–4 < –3	B1	
5(a)	26.47640(….)	B1	
	Additional Guidance		
5(b)	26.5	B1ft	Correct or ft provided their answer to (a) is given to more than 1 dp
	Additional Guidance		
	8.88326612 in (a) and 8.9 in (b)		B1ft
	8.88326612 in (a) and 26.5 in (b)		B1
	26.50		B0
6(a)	4	B1	
	Additional Guidance		
	4 must be shown on the answer line in the key		

Question	Answer	Mark	Comments
6(b)	15	B1ft	Correct or ft 3.75 × their 4 from (a) if their 4 is a multiple of 4
	Additional Guidance		
	(a) key blank or incorrect (b) 15	B1	
	(a) 8 (b) 30	B1ft	
	(a) 10 (b) 37.5 (or 37 or 38)	B0ft	
	If answer line blank and 15 seen next to female row of pictogram	B1	
6(c)	The sample is too small or the results may be biased or the sample is not representative	B1	
	Additional Guidance		
	This was **only**/ **just** 1 hour	B1	
	More men might come at different times	B1	
	It might have been a girls' school using it	B1	
	There were **only**/ **just** 25 people in the survey	B1	
	The results may change	B1	
	Ignore irrelevant comments alongside a correct statement eg There isn't an equal number of males and females. A bigger sample is needed	B1	
	Biased	B1	
	Unfair	B0	
	Should do it for longer until there is an equal number of males and females	B0	
	It was for 1 hour	B0	
	The results are about people not lockers	B0	
	Not a lot of people use the family changing room	B0	
	In that hour not many people used the changing rooms	B0	

Question	Answer	Mark	Comments
7	17 21 21 21 23 25 29 32 36 or 36 32 29 25 23 21 21 21 17 or 17 21 21 21 23 or 36 32 29 25 23 or $\frac{9+1}{2}$ or 5th value	M1	Puts list into order Allow one omission, extra or transcription error in a full list Allow one transcription error in a list of only the first or last five or Works out the position of the median in the list
	23	A1	
	Additional Guidance		
	Answer 23 (from any or no list)		M1A1
	Puts list into order then finds the mean		M1A0
	Just circles or identifies 29 or gives answer 29		M0
	States 5th and circles 29		M1A0

Question	Answer	Mark	Comments
8(a)	Library	B1	
8(b)	180°	B1	
8(c)	[5.6, 6] (cm) or [56, 60] (mm)	B1	May be on map
	their 5.8 × 200 or their 58 × 20	M1	
	[1120, 1200]	A1ft	ft B0M1 if their 5.8 × 200 correctly evaluated
	Additional Guidance		
	[5.6, 6] can come from measurement or Pythagoras' Theorem		
	Answer in correct range with no incorrect evaluation		B1M1A1
	5.6 × 200, answer 1160 (incorrect evaluation seen)		B1M1A0
	6.2 × 200 = 1240		B0M1A1ft
	3 down, 5 across, 8 × 200 = 1600		B0M1A1ft
	3 × 200, 5 × 200, answer 1600		B0M1A1ft
	3 and 5 seen, answer 1600		B0M1A1ft
	7 seen, answer 1400 (scale method implied)		B0M1A1ft
	Answer only 1400		B0M0A0ft
	Answer [1.12, 1.2] km with or without [1120, 1200] seen		B1M1A0

Question	Answer	Mark	Comments
8(d)	Valid reason	B1	Indication that the shortest distance between two points is a straight line, but you can't generally walk in a straight line between two places in a town
	Additional Guidance		
	You would have to walk along the streets		B1
	There wouldn't be a straight road between them		B1
	You would have to walk along and then down		B1
	There might be buildings in the way		B1
	You can't go as the crow flies		B1
	There may be obstacles in the way		B1
	It isn't a straight path in real life		B1
	Can't go directly		B1
	There might be buildings in the way such as the library		B0
	The monument is in the way		B0
	It's not a walking route		B0
	There is more than one route		B0
	May have taken a different route		B0
	Walking is slower		B0
	You may need to go past the town hall		B0
	You might take a detour		B0

Question	Answer	Mark	Comments
9	**Balance (£)** 212.48 (£)84.09 (£)940.30	B2	Must be in correct boxes B1 (£)84.09 or (£)940.30 or (£)84.09p **and** (£)940.30p or B1ft for their 84.09 + 856.21
	Additional Guidance		
	Date / **Description** / **Credit (£)** / **Debit (£)** / **Balance (£)** 13/12/2016 / Starting balance / / / 212.48 14/12/2016 / Council tax / / 128.39 / 84.09 15/12/2016 / Salary / 856.21 / / 940.30		B2
	340.87 and 1197.08		B1ft
	340.87 and 1197.08p		B0ft
	84.09 and 940.3		B1
	Ignore any working in grey boxes		
	84.09p and 940.30p		B1
	£84.09p and £940.30p		B1
	84.09p and 940.3(p)		B0

Question	Answer	Mark	Comments
10	36 ÷ 9 × 11	M1	oe 36 ÷ 9 and 36 + 2 × 4
	44	A1	
	Additional Guidance		
	Only 36 × 1.2		M0A0
	11 ÷ 9 = 1.2 and 36 × 1.2		M1A0
	11 ÷ 9 = 1.2 and 36 × 1.2 Answer 43.2 (or 43)		M1A0
	11 ÷ 9 = 1.2 and 36 × 1.2 Answer 44 (even after 43.2 seen)		M1A1
	Only $\frac{11}{9}$ of 36		M0
	$\frac{11}{9}$ × 36		M1

Question	Answer	Mark	Comments
11	$4x = 14 + 3$ or $4x = 17$ or $(14 + 3) \div 4$ or $17 \div 4$ or $x - \frac{3}{4} = \frac{14}{4}$	M1	
	4.25 or $\frac{17}{4}$ or $4\frac{1}{4}$	A1	
	Additional Guidance		
	Embedded answer of 4.25 with 4.25 not selected on answer line eg $4 \times 4.25 - 3 = 14$ with no answer given or answer of 14 or 17		M1A0
	14 + 3 and answer 4.25		M1A1
	14 + 3 only		M0A0
	Trial and improvement with answer 4.25		M1A1
	Trial and improvement with no answer or answer other than 4.25		M0A0
	4.25 or $\frac{17}{4}$ or $4\frac{1}{4}$ seen and then answer 4 given		M1A1
	Answer of ×4.25		M1A0
	17 ÷ 4 (and no further)		M1A0

Question	Answer	Mark	Comments
12(a)	Correct criticisms about any two of the incorrect plotting of (17, 80) at (17,60) the incorrect position of the line of best fit the incorrect length of the line of best fit (outside the range of the data)	B2	B1 for one correct comment about point, position or length Allow reference to a better line of best fit drawn eg The line should look like mine
	Additional Guidance		
	A comment about the incorrect point must refer to the specific point		
	One of the points is wrong and point at (17, 60) circled on graph		B1
	Not plotted (17, 80) correctly		B1
	x on 60 should be on 80		B1
	Point at 60 is wrong		B1
	Day 3 is wrong/ there is no day 3 on the graph		B1
	17 is plotted at 60/ 17 should be plotted at 80		B1
	One of the points is wrong		B0
	Points on the graph don't match the table		B0
	Not put all the points in the correct place		B0
	A comment about the line of best fit must not have any misconception		
	The line is not steep enough/ at wrong angle/ should be more vertical		B1
	The line isn't a line of best fit/ the line doesn't fit the points		B1
	The line of best fit goes below 17/ condone past 30 (implies outside range)		B1
	The line of best fit is wrong/ not drawn accurately/ not drawn properly		B0
	It isn't a line of best fit because it doesn't start at 0		B0
	The line of best fit is wrong it should go through (0, 0)		B0
	The line of best fit doesn't go through the points		B0
	The line is wrong it only goes through one cross		B0
	The line of best fit doesn't go to the axis (implies it's too short)		B0

Question	Answer	Mark	Comments
12(b)	Ticks No **and** explanation that it should be the highest value – the lowest value	B1	Allow any unambiguous indication of No, if boxes blank may be in the reason oe eg No, it should be the hottest – the coldest

Additional Guidance	
Does not tick or say No	B0
Ticks No and It should be 30 – 17	B1
Ticks No and It should be 13	B1
Ticks No and He hasn't subtracted the lowest value	B1
Ticks No and It should be 17 – 30 = 13	B1
Ticks No and Range = biggest – smallest	B1
Ticks No and The lowest temperature is 17 not 20	B1
Ticks No and He hasn't used the lowest temperature	B1
Ticks No and The lowest temperature is not 20	B1
Ticks No and The lowest temperature is 17	B1
Ticks No and The numbers range from 17 to 30	B1
Ticks No and It should be 30 – 17 = 23	B0
Ticks No and It should be 17 – 30	B0
Ticks No and You should take the smallest from the largest 30 – 26	B0
Ticks No and You should take the smallest from the largest 180 – 17	B0
Ticks No and It should be the smallest – the largest	B0
Ticks Yes and It should be the highest value – the lowest value	B0

Question	Answer	Mark	Comments
12(c)	**Alternative method 1**		
	180 + 150 + 80 + 130 + 120 or 660	M1	
	their 660 × 0.15 or 99 or their 660 × 0.85 or 561	M1dep	oe
	7 × 5 or 35	M1	
	their 660 – their 99 – their 35 or their 561 – their 35	M1dep	dep on M1M1M1
	526(.00)	A1	SC4 509
	Alternative method 2		
	180 × 0.15 or 27 and 150 × 0.15 or 22.5(0) and 80 × 0.15 or 12 and 130 × 0.15 or 19.5(0) and 120 × 0.15 or 18	M1	oe
	their 27 + their 22.5(0) + their 12 + their 19.5(0) + their 18 or 99	M1dep	
	7 × 5 or 35	M1	
	180 + 150 + 80 + 130 + 120 – their 99 – their 35	M1dep	dep on M1M1M1
	526(.00)	A1	SC4 509

Alternative methods 3, 4 and Additional Guidance continue on the next three pages

Question	Answer	Mark	Comments
12(c) cont	**Alternative method 3**		
	180 × 0.15 or 27 and 150 × 0.15 or 22.5(0) and 80 × 0.15 or 12 and 130 × 0.15 or 19.5(0) and 120 × 0.15 or 18	M1	oe
	180 – their 27 or 153 and 150 – their 22.5(0) or 127.5(0) and 80 – their 12 or 68 and 130 – their 19.5(0) or 110.5(0) and 120 – their 18 or 102	M1dep	Working out 85% of all five sales scores M1M1dep
	7 × 5 or 35 or their 153 – 7 or 146 and their 127.5(0) – 7 or 120.5(0) and their 68 – 7 or 61 and their 110.5(0) – 7 or 103.5(0) and their 102 – 7 or 95	M1	Subtracting five 7s
	their 153 + their 127.5(0) + their 68 + their 110.5(0) + their 102 – their 35 or their 146 + their 120.5(0) + their 61 + their 103.5(0) + their 95	M1dep	dep on M1M1M1
	526(.00)	A1	SC4 509

Alternative method 4 and Additional Guidance continue on the next two pages

Question	Answer	Mark	Comments
12(c) cont	**Alternative method 4**		
	180 × 0.15 or 27 and 150 × 0.15 or 22.5(0) and 80 × 0.15 or 12 and 130 × 0.15 or 19.5(0) and 120 × 0.15 or 18	M1	oe
	their 27 + 7 or 34 and their 22.5(0) + 7 or 29.5(0) and their 12 + 7 or 19 and their 19.5(0) + 7 or 26.5(0) and their 18 + 7 or 25	M1	Adding five 7s
	their 34 + their 29.5(0) + their 19 + their 26.5(0) + their 25 or 134 or 180 – their 34 or 146 and 150 – their 29.5(0) or 120.5(0) and 80 – their 19 or 61 and 130 – their 26.5(0) or 103.5(0) and 120 – their 25 or 95	M1dep	dep on M1M1
	180 + 150 + 80 + 130 + 120 – their 134 or their 146 + their 120.5(0) + their 61 + their 103.5(0) + their 95	M1dep	dep on M1M1M1
	526(.00)	A1	SC4 509

Additional Guidance continues on the next page

	Additional Guidance	
	509 comes from using 60 from the incorrect point on the scatter graph	SC4
	Use the scheme that awards the best mark	
	35	M1
	99	M1M1dep
	134	M1M1M1dep
	660 – 35 = 625 0.15 × 625 = 93.75 Answer 93.75	M1M0M1 M0A0
	Build up method for 15% must be correct or method shown for incorrect parts eg 10% of 660 = 60, 5% = 30, 15% = 90 eg 10% of 660 = 660 ÷ 10 = 60, 5% = 30, 15% = 90	 M1M0dep M1M1dep

Question	Answer	Mark	Comments
13	360 – (21 + 36 + 160 + 90) or 360 – 307 or 270 – (21 + 36 + 160) or 270 – 217	M1	oe
	53	A1	
	Additional Guidance		
	53 (may be on diagram) with no incorrect working or no working		M1A1
	53 on diagram with different answer on answer line		A0
	360 – (21 + 36 + 160) or 360 – 217 or 143 (ignoring 90°)		M0A0
	180 – (90 + 36) = 54		M0A0

Question	Answer	Mark	Comments
14	**Alternative method 1**		
	70 × 2.2 or 154	M1	
	their 154 ÷ 14 or 11 × 14 = 154	M1dep	70 × 2.2 ÷ 14 oe is M1M1dep
	11	A1	
	Alternative method 2		
	14 ÷ 2.2 or 6.36… or 6.4 or 2.2 ÷ 14 or 0.157... or 0.16	M1	
	70 ÷ their 6.36 or 70 × their 0.157 or 11.006... or 10.9375 or 10.99	M1dep	
	11	A1	
	Additional Guidance		
	14 ÷ 2.2 = 6.3 and 70 ÷ 6.3 = 11.1		M1M1depA0
	Only 70 ÷ 6.3 = 11.1		M0M0depA0
	Only 70 ÷ 6.4 (= 10.9375)		M1M1depA0
	eg 10.9375 → answer 11		M1M1dep A1
	Only 70 ÷ 14 or 5		M0
	70 ÷ 14 = 5 and 5 × 2.2		M1M1dep
	70 × 2.2 = 154, 154 ÷ 14 = 11, 11 × 70 Answer 770 (11 seen)		M1M1depA0
	70 × 2.2 = 154, 154 ÷ 14 × 70 Answer 770		M1M0depA0

Question	Answer	Mark	Comments
15	13 20 27 and Add 7 or 15 27 39 and Add 12 or 20 15 10 and Subtract 5 or 27 20 13 and Subtract 7 or 39 27 15 and Subtract 12	B2	oe rule B1 one correct arithmetic progression (using numbers from the list) with no or incorrect rule ie 13 20 27 or 15 27 39 or 20 15 10 or 27 20 13 or 39 27 15

Additional Guidance	
Accept the expression for the nth term as the rule 13 20 27 and $7n + 6$ or eg × 7 + 6 or 15 27 39 and $12n + 3$ or 20 15 10 and $25 – 5n$ or 27 20 13 and $34 – 7n$ or 39 27 15 and $51 – 12n$	B2
Ignore incorrect expression for the nth term alongside a correct rule eg 13 20 27 and Add 7 so $n + 7$	B2
13 20 27 and +7 or 7 more or going up in 7s	B2
20 15 10 and five times table (scores for the arithmetic progression)	B1
13 20 27 and $n + 7$ (scores for the arithmetic progression)	B1
Using number(s) not on the list	B0
10 15 20 and Add 5	B0

Question	Answer	Mark	Comments
16	1 : 4	B1	
17	$\frac{1}{1000}$	B1	
18	3 × 250 or 750	M1	
	1470 × 12 or 17 640	M1	
	538 000 – 464 500 or 73 500	M1	
	their 73 500 × 0.28 or 20 580	M1dep	oe dep on 3rd M1
	their 17 640 + their 20 580 + their 750 or 38 970	M1dep	dep on 3rd and 4th M1 Must be adding salary, profit share and bonus
	38 970 and No	A1	
	Additional Guidance		
	For the last method mark, the 3rd and 4th M must have been awarded, but allow the addition of any number of months' salary and any number of £250 bonuses (at least one month of salary and at least one month of bonus)		
	1470 + 20 580 + 250		M0M0M1 M1dep M1depA0
	20 580		3rdM1 4thM1dep
	Build up method for 28% must be correct or method shown for incorrect parts		
	eg1 1% of 73 500 = 730, 28% = 20 440 (will also lose the 5th Mdep)		4thM0dep
	eg2 1% of 73 500 = 73 500 ÷ 100 = 730, 28% = 20 440		4thM1dep
	eg3 10% of 73 500 = 7350, 1% = 73.5, 28% = 2058 (and 5th Mdep0)		4thM0dep
	eg4 10% of 73 500 = 7350, 1% = 7350 ÷ 10 = 73.5, 28% = 7350 + 7350 + 588 = 15 288		4thM1dep

Question	Answer	Mark	Comments
19	**Alternative method 1 (hits and misses)**		
	A counter example using both ratios or using numbers of hits and misses for both players	B2	eg Katy could be 6 : 2 and Ben hit 5 eg Ben 10 hits and 2 misses and Katy 12 hits and 4 misses B1 for a correct number of hits and misses (not 3 and 1) or a correct equivalent ratio for Katy
	Alternative method 2 (hits and total throws or proportion of hits)		
	A counter example using total throws and number of hits for both players or using proportion of hits for both players	B2	eg Katy could have hit 6 out of 8, Ben hit 5 eg Katy could have $\frac{18}{24}$ and Ben $\frac{10}{12}$ B1 for a correct number of total throws and hits (not 3 out of 4) or a correct proportion of hits (not $\frac{3}{4}$) for Katy
	Additional Guidance		
	Must use the given ratios		
	(Ben) 5 : 1 (Katy) 6 : 2		B2
	15 : 3 and 15 : 5 (so the same hits)		B2
	(Katy) 6 : 2 or (Katy) 6 hits and 2 misses		B1
	List of equivalent ratios for (Ben and) Katy with no counter example chosen		B1
	15 : 3 and 9 : 3		B1
	Fractions of hits out of total throws oe percentages or decimals or words eg $\frac{5}{6}$ and $\frac{3}{4}$ eg $\frac{20}{24}$ and $\frac{18}{24}$ eg $\frac{5}{6}$ and $\frac{6}{8}$		 B0 B1 B2
	Ben had (two) more throws – he had 6 and she had 4		B0

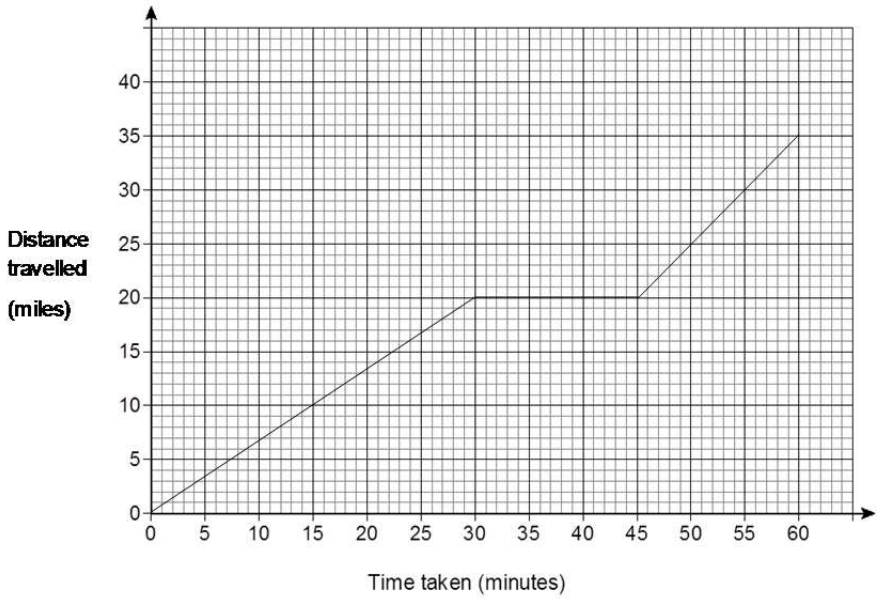
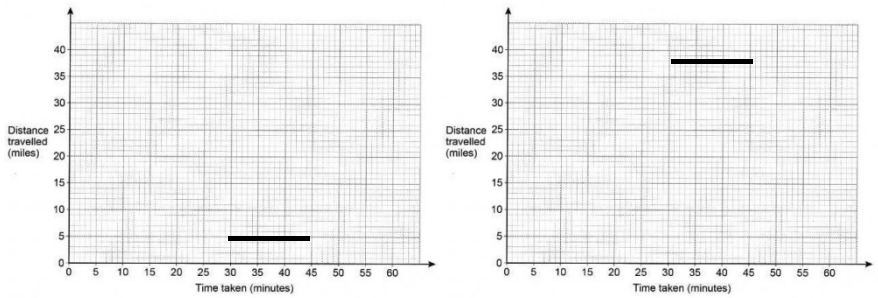
Question	Answer	Mark	Comments
20(a)	$\frac{1}{10}$ or 10% or 0.1	B1	oe
	Additional Guidance		
	Ratio eg 1 : 10 or 1 : 9		B0
	$\frac{1}{10}$ seen and answer 1 : 10		B1
	Expressed only in words eg 1 out of 10		B0
	1 out of 10 and $\frac{1}{10}$		B1
	$\frac{1}{10}$ seen with change to incorrect decimal or incorrect percentage eg $\frac{1}{10}$ and answer 0.01		B1
	Ignore chance words if $\frac{1}{10}$ seen eg $\frac{1}{10}$ and answer Unlikely		B1

Question	Answer	Mark	Comments
20(b)	$\frac{1}{4}$ or 0.25 or 25%	B1	oe
	Additional Guidance		
	Ratio eg 1 : 4 or 1 : 3		B0
	$\frac{1}{4}$ seen and answer 1 : 4		B1
	Expressed only in words eg 1 out of 4		B0
	1 out of 4 and $\frac{1}{4}$		B1
	$\frac{1}{4}$ seen with change to incorrect decimal or incorrect percentage eg $\frac{1}{4}$ and answer 0.4		B1
	Ignore chance words if $\frac{1}{4}$ seen eg $\frac{1}{4}$ and answer Likely		B1

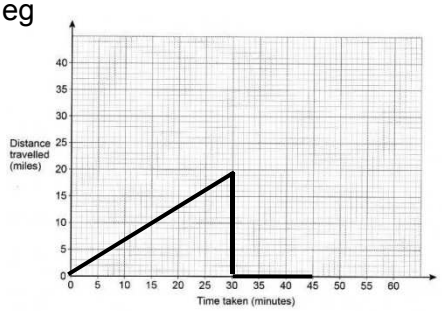
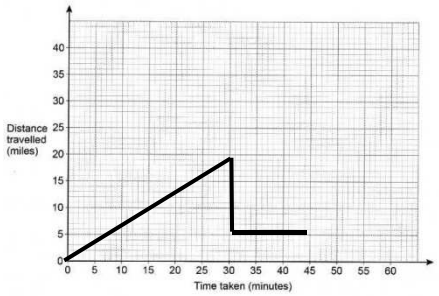
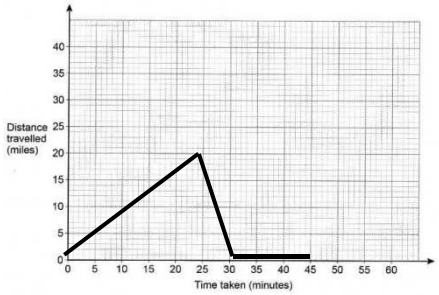
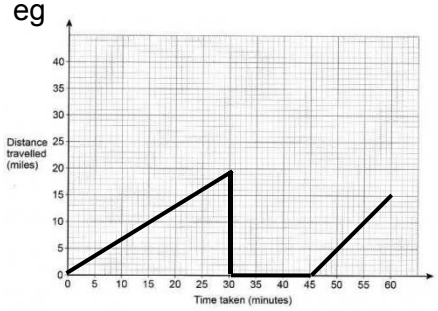
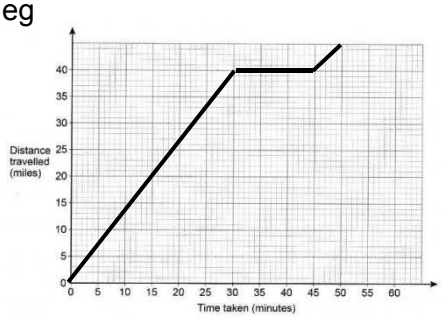
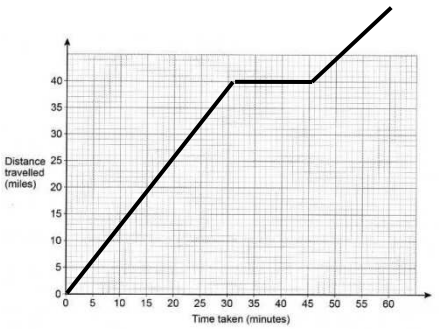
Question	Answer	Mark	Comments
21(a)	**Alternative method 1**		
	10.8 × 8 or 86.4	M1	
	50 × 110 × 35 or 192 500	M1	Must use correct volume formula
	their 192 500 ÷ 1000 or 192.5	M1dep	dep on 2nd M1
	their 192.5 – their 86.4	M1dep	dep on M1M1M1
	106.1 or 106	A1	
	Alternative method 2		
	10.8 × 8 × 1000 or 86 400	M1	oe
	50 × 110 × 35 or 192 500	M1	Must use correct volume formula
	their 192 500 – their 86 400 or 106 100	M1dep	dep on M1M1
	their 106 100 ÷ 1000	M1dep	dep on M1M1M1
	106.1 or 106	A1	
	Additional Guidance		
	192.5		2ndM1M1dep
	106 100		M1M1M1dep
	50 × 110 × 35 = 192 500 ÷ 2		2ndM0

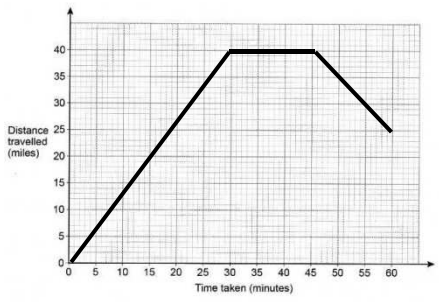
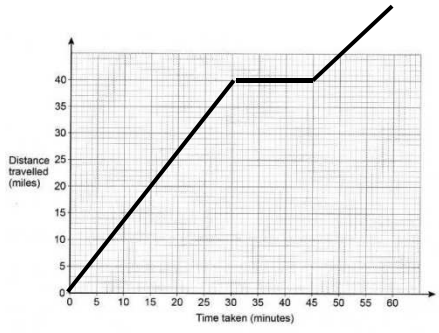
Question	Answer	Mark	Comments
21(b)	A comment that the answer to part (a) was too low or that the amount saved would be greater	B1	
	Additional Guidance		
	It was more	B1	
	More water saved	B1	
	She underestimated it	B1	
	She underestimated the water saved	B1	
	She's saving more water because she's using more water than the cuboid	B1	
	Greater than 106.1 litres (may need to check value in part (a) if they quote a different value)	B1	
	More than Eva's assumption	B1	
	Eva's assumption was not accurate therefore the prediction was wrong	B0	
	She underestimated the water	B0	
	Less water used	B0	
	It was inaccurate	B0	
	A uses more water than B (only talking about the diagram)	B0	
	B saves more than A (only talking about the diagram)	B0	
	Saves a lot of water	B0	
	More water used	B0	
	Cuboid smaller than bath	B0	
	Used more water in the bath than she thought	B0	

Question	Answer	Mark	Comments
22	8^2 and 3^2 seen or 8 × 8 and 3 × 3 seen or 64 and 9 seen or 55	M1	M2 for $\sin^{-1}\left(\frac{3}{8}\right)$ = 22.(...) **and** 8 cos (their 22.(...)) or $\cos^{-1}\left(\frac{3}{8}\right)$ = 67.(...) or 68 **and** 8 sin (their 67.(...))
	$\sqrt{8^2 - 3^2}$ or $\sqrt{64 - 9}$ or $\sqrt{55}$	M1dep	
	[7.4, 7.42]	A1	
	Additional Guidance		
	$\sqrt{8^2 + 3^2}$ or $\sqrt{64 + 9}$ or $8^2 + 3^2$ or 64 + 9		M1M0depA0
	Only $\sqrt{73}$ or only 73 or only 8.5...		M0
	If trigonometry used it must be a fully correct method that would lead to the correct value of x		
	Partial method using trigonometry		M0
	Ignore units given		
	8 cm^2 is not 8^2 unless recovered		
	Correct answer in range seen, ignore further work if truncates or rounds		M2A1
	8^2 = 16 and 3^2 = 6, $\sqrt{16 - 6}$		M1M1depA0
	Scale drawing with answer in range [7.4, 7.42]		M2A1
	Scale drawing with answer **not** in range [7.4, 7.42]		M0

Question	Answer	Mark	Comments
23(a)	Joins (0, 0) to (30, 20)	B1	Line does not need to be straight but must start and finish at correct points and not be decreasing Mark intention
	Horizontal **line** for 15 minutes from their (30, 20)	B1ft	Mark intention
	Line with gradient 1 or a curve from their (45, 20) **and** stops at 60 minutes or stops at top edge of grid or higher but not beyond 60 minutes	B1ft	A curve must not be decreasing and must start and finish at two points that could be joined by a line with gradient 1 Condone a horizontal or vertical line from 60 minutes Mark intention
	Additional Guidance		
		B3	
	Allow any horizontal line between 30 minutes and 45 minutes if first part of journey is blank eg 	B0B1	

Additional Guidance continues on the next page

	Additional Guidance continued	
23(a) cont	Do not allow second mark if their first line is followed by a drop back towards the horizontal axis before she stops eg   	B1B0 B0B0
	If there are more than 3 lines or curves, assume the last part is the part where she completes her journey eg 	B1B0B1ft
	If their (45, 20) is too high to fit a line of gradient 1 ending at 60 minutes, allow the final line to stop at the top of the grid or higher, but not beyond 60 minutes eg  	B0B1ftB1ft
	Points but no lines	B0
	Ignore any lines that could be working for part (a) or part (b)	

Question	Answer	Mark	Comments
23(b)	35	B1ft	Correct or ft total distance travelled for their graph at 60 minutes
	Additional Guidance		
	35 from any or no graph		B1
	If their graph extends beyond 60 minutes, read off at 60 minutes for ft		
	Follow through total distance travelled eg (a)  (b) answer 25 (b) answer 55		B0ft B1ft
	Ignores the stationary parts		B0
	Do not follow through a graph above the grid at 60 eg (a)  (b) answer 55		B0ft

Question	Answer	Mark	Comments
24	**Alternative method 1**		
	360 – 110 or 250 or 360 – 110 – 110 or 140	M1	May be seen on diagram oe
	3360 ÷ their 140 or 24 or 2640 (men) or 6000 (women)	M1dep	their 140 must be from 360 – 110 – 110 oe
	8640	A1	SC2 4838 or 4839
	Alternative method 2		
	$100 - \frac{110}{360} \times 100$ or 100 – 30.5(...) or 100 – 30.6 or 69.4(…%) or 69.5(%) or $100 - \frac{110}{360} \times 100 - \frac{110}{360} \times 100$ or 100 – 30.5(...) – 30.5(...) or 100 – 30.6 – 30.6 or 38.8(…%) or 38.9(%)	M1	May be seen on diagram oe
	3360 ÷ (their 69.4 – their 30.5) or 3360 ÷ their 38.8(...) or 86.4	M1dep	their 69.4 must be from $100 - \frac{110}{360} \times 100$ their 30.5 must be from $\frac{110}{360} \times 100$
	8640	A1	SC2 4838 or 4839

Alternative method 3 and Additional Guidance continue on the next page

Question	Answer	Mark	Comments
24 cont	**Alternative method 3**		
	$\frac{250}{360}x - \frac{110}{360}x = 3360$ or $m = \frac{110}{360} \times (m + 3360 + m)$ or $w = \frac{250}{360} \times (w + w - 3360)$	M1	Sets up a correct equation to work out total (x), men (m) or women (w) oe
	$x = 3360 \div \left(\frac{250-110}{360}\right)$ or $m = 336\,000 \div 140$ or 2640 or $w = 840\,000 \div 140$ or 6000	M1dep	oe
	8640	A1	SC2 4838 or 4839
	Additional Guidance		
	Condone 8639.9… → answer 8640		M2 A1
	2640 or 6000		M2
	4838 and 4839 come from 3360 women		SC2

Question	Answer	Mark	Comments
25	**Alternative method 1**		
	40	B1	May be implied eg $\frac{2}{40}$
	$2 + x + 2x + 5$ = their 40 or $3x + 7$ = their 40 or (their 40 – 2 – 5) ÷ 3 or 33 ÷ 3	M1	oe equation eg $3x + 5 = 38$ (scores B1M1) their 40 must be an integer
	$(x =)$ 11	A1ft	ft B0M1 Does not have to be an integer Accept answer rounded or truncated to at least 2 sf
	$\frac{27}{40}$ or 0.675 or 67.5%	B1ft	Only ft evaluation of $\frac{2 \times \text{their integer } x + 5}{40}$ and 0 < answer < 1 Denominator must be 40 (may subsequently be simplified)
	Alternative method 2		
	$\frac{2}{2+x+2x+5} = \frac{1}{20}$ or $\frac{x+2x+5}{2+x+2x+5} = \frac{19}{20}$	M2	oe equation
	$(x =)$ 11	A1	
	$\frac{27}{40}$ or 0.675 or 67.5%	B1ft	Only ft evaluation of $\frac{2 \times \text{their integer } x + 5}{40}$ and 0 < answer < 1 Denominator must be 40 (may subsequently be simplified)

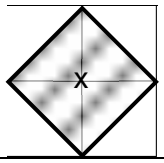
Alternative methods 3, 4 and Additional Guidance continue on the next two pages

Question	Answer	Mark	Comments
25 cont	**Alternative method 3**		
	$3x \rightarrow 100\% - 5\% - 12.5\%$ or $3x \rightarrow 82.5\%$	M1	Using $2 \rightarrow 5\%$ and $5 \rightarrow 12.5\%$ oe
	$x \rightarrow 82.5\% \div 3$ or $x \rightarrow 27.5\%$	M1dep	oe
	$2x + 5 \rightarrow 2 \times 27.5\% + 12.5\%$	M1dep	oe
	$\frac{27}{40}$ or 0.675 or 67.5%	A1	
	Alternative method 4		
	$3x \rightarrow 1 - \frac{1}{20} - \frac{2.5}{20}$ or $3x \rightarrow \frac{16.5}{20}$	M1	Using $2 \rightarrow \frac{1}{20}$ and $5 \rightarrow \frac{2.5}{20}$ oe
	$x \rightarrow \frac{16.5}{20} \div 3$ or $x \rightarrow \frac{5.5}{20}$	M1dep	oe
	$2x + 5 \rightarrow 2 \times \frac{5.5}{20} + \frac{2.5}{20}$ or $2x + 5 \rightarrow \frac{13.5}{20}$	M1dep	oe
	$\frac{27}{40}$ or 0.675 or 67.5%	A1	

Additional Guidance continues on the next page

25 cont	**Additional Guidance**	
	(Alt 1) x = 6 (no working) Answer $\frac{17}{40}$ (first B1 implied)	B1M0A0B1ft
	(Alt 1) $2 + x + 2x + 5 = 20$ $x = \frac{13}{3}$ Answer $\frac{13.666}{20}$	B0M1 A1ftB0ft
	Answer $\frac{13.5}{20}$	B1M1A1B0
	11 by inspection or T & I scores the first 3 marks	
	Answer $\frac{2x+5}{40}$	B1M0A0B0
	Answer $\frac{2x+5}{3x+7}$	Zero
	Ratio eg 27 : 40	B1M1A1B0
	Expressed only in words eg 27 out of 40	B1M1A1B0
	27 out of 40 and $\frac{27}{40}$	B1M1A1B1
	$\frac{27}{40}$ seen with incorrect change of form or incorrect cancelling eg $\frac{27}{40}$ and answer 0.27	B1M1A1B1
	Ignore chance words if $\frac{27}{40}$ seen eg $\frac{27}{40}$ and answer Unlikely	B1M1A1B1

Question	Answer	Mark	Comments
26(a)	x: –2, –1, 0, 1, 2, 3 y: 4, 0, –2, –2, 0, 4	B2	B1 1 or 2 values correct
	Additional Guidance		

26(b)	5 or 6 points plotted correctly	M1	Correct or ft their table in (a) Tolerance of ±1 small square Points can be implied by graph passing through them
	Correct smooth parabolic curve and y-coordinate of minimum point in the range $-2.5 \leq y \leq -2.1$	A1	Tolerance of ±1 small square for the six **correct** points from the table No further tolerance for the minimum
	Additional Guidance		
	Tolerance of ±1 small square means it is on the edges of or within the shaded area 		
	Ignore extra points plotted		
	If their table in (a) has points that are beyond the grid these points will not be able to be plotted correctly		
	Ignore any curve drawn for $x < -2$ or $x > 3$		
	Curve passing through all correct points within tolerance		M1A1
	Ruled straight lines		A0

Question	Answer	Mark	Comments
27	9.56×3^{10} 9563 9.56×10^3 or 564 508 (.44) 9563 9560 with no incorrect evaluations seen	B2	B1 9.563×10^3 or 9560 or 564 508 (.44) or $5.6(450844) \times 10^5$ SC1 9.56×10^3 9563 9.56×3^{10} with no incorrect evaluations seen
	Additional Guidance		
	Allow numbers to be written in original or converted form or as a mixture for B2 or SC1		
	Incorrect evaluation seen scores a maximum of B1		
28	$y - 9 = \frac{x}{3}$ or $3y = x + 27$ or $3y - 27$ or $3(y - 9)$	M1	A correct first step in rearranging or the correct rearrangement without $x =$
	$x = 3y - 27$ or $x = 3(y - 9)$	A1	Accept $3y - 27 = x$ or $3(y - 9) = x$
	Additional Guidance		
	Accept $-27 + 3y$ for $3y - 27$ throughout		
	$x = 3y - 27$ in working with answer $3y - 27$		M1A1
	$x = (y - 9)3$ (unless recovers)		M1A0
	$x = y3 - 27$ (unless recovers)		M1A0
	Multiplication signs are acceptable for M1 but not A1		
	$x = 3 \times y - 27$		M1A0
	$3 \times y = x + 3 \times 9$		M1

Question	Answer	Mark	Comments
29	sin 72 = $\frac{x}{8}$ or 8 × sin 72 or cos (90 – 72) = $\frac{x}{8}$ or 8 × cos (90 – 72) or $\frac{x}{\sin 72} = \frac{8}{\sin 90}$ or $\frac{\sin 72}{x} = \frac{\sin 90}{8}$	M1	oe eg 8 cos 72 or 2.47… or 2.5 **and** $\sqrt{8^2 - (8\cos 72)^2}$
	[7.6, 7.61]	A1	
	Additional Guidance		
	If trigonometry and Pythagoras are used it must be a fully correct method that would lead to the correct value of x		
	Accept sin 72 × 8	M1	
	Accept opp or o for x eg sin 72 = $\frac{\text{opp}}{8}$	M1	
	sin = $\frac{x}{8}$ or $\sin\theta = \frac{x}{8}$ (unless recovered)	M0	
	Answer coming from scale drawing	M0A0	
	Answer in range seen followed by 7 or 8	M1A1	