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GCSE

# Mathematics

93701H Applications of Mathematics

Unit 1: Higher Tier

Mark scheme

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93701H

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June 2015

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Version 1.0 Final 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](http://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.

<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 within the scheme 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 <i>a</i> and <i>b</i> inclusive.
<b>3.14 ...</b>	Allow answers which begin 3.14 eg 3.14, 3.142, 3.149.
<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 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.

Q	Answer	Mark	Comments
1(a)	Line of best fit drawn from between (5,22) and (5,26) reaching to between (10,29) and (10,33) providing there are at least 2 points on each side of their line	B1	Intention to be straight
	Correct reading from their line.	B1ft	ft their line of best fit if increasing $\pm\frac{1}{2}$ square  SC1 [28,29] with no line of best fit
	<b>Additional Guidance</b>		
	The line therefore must go horizontally from 5 to 10 minimum Must be a good attempt at straight but does not have to be ruled. Must be the whole of their line. For B1 ft they must give the reading from their line. This line may be curved, zig,zag (points joined) If any line is seen then the SC does not apply. If they join the points <b>and</b> draw a line of best fit then ft the reading from the line of best fit only Ignore subsequent rounding eg correct value from their line of 28.8 = 29 (ignore the 29)		
1(b)	Only taken for 7 days or Only July in one year or Only small sample or Different parts of London may vary (don't know where they were taken)	B1	
	<b>Additional Guidance</b>		
	It could have been a particularly hot month implies only one July		B1
1(c)	No as temperatures are generally lower (in December /Winter) No. Weather conditions are different in December No. Graph is only for summer No. No data for December	B1	oe

	<b>Additional Guidance</b>
<b>1(c)</b>	<p>Box for 'No' ticked or 'No' used in working lines.</p> <p>Need to give the idea that December is such a different time of year that its not appropriate</p> <p><b>Examples for B1</b></p> <p>Temperatures rarely get above 16 in December</p> <p>Temperatures often below freezing in December</p> <p>They are in different seasons</p> <p>July and December have different weather conditions</p> <p>July temperatures would not be representative of December temperatures.</p> <p>No, because the temperatures in December are completely different to that of July.</p> <p>Because heat does not go as high as it does in summer.</p> <p>It's cold in December</p> <p>Because it won't be summer</p> <p><b>Examples for B0</b></p> <p>Less hours of sunshine in December</p> <p>The graph shows the maximum temperature in July</p> <p>Its only measured on 7 days in July</p> <p>The max temperature doesn't go low enough for December/start low enough</p> <p>Line of best fit is lower in December.</p>

Q	Answer	Mark	Comments
2(a)	$2\frac{2}{3}$ circled	B1	
2(b)	$5 \div \frac{2}{5}$ or $15 \div \frac{2}{5}$ or $5 \div 0.4$ or $15 \div 0.4$ or $5 \times \frac{5}{2}$ or $15 \times \frac{5}{2}$ or 12.5 or 37.5	M1	
	37	A1	SC1 for 36
	<b>Additional Guidance</b>		
	12.5 seen with 12 on the answer line is M1A0 12 on the answer line with no correct working is M0		

Q	Answer	Mark	Comments
3(a)	<p>Doesn't have a time frame eg how often each week month etc</p> <p>or</p> <p>Words rarely, very often,(etc), mean different amount of times to different people or are too vague or are not specific enough/difficult to decide which box to tick</p> <p>or</p> <p>Don't need to include 'Never'</p>	B2	<p>B2 for two distinct criticisms B1 for one correct criticism</p>
<b>Additional Guidance</b>			
<p>Ignore incorrect statements –give credit for correct ones under either criticism eg two correct criticisms under criticism 1 Comments such as 'it should be once a week , twice a week and so on' gain the B1 for the lack of time frame but not for the criticism of the response boxes</p> <p>Condone 'there is a gap between rarely and very often' for the mark for poorly defined boxes</p> <p><b>Examples for B1</b> Doesn't have a weekly/monthly section It's not specific on days, like, it's too rough (Time frame) Not detailed enough – for example how often do you visit per week? (second part gets the mark) No time scale of when they are talking about eg per month Very often could mean different things to different people Response boxes are too vague</p> <p><b>Examples for B0</b> Reference to needing numbered response boxes It is too vague/ It is not specific enough ('it' needs to be clarified eg the words are too vague) It doesn't give a clear amount of how many times people go. The response section doesn't give much information on how many times they came to the restaurant. It isn't specific when they come</p>			



Q	Answer	Mark	Comments
3(b)	Suitable question with time frame	B1	Eg how many times a month/last month do/did you visit this restaurant
	At least 3 response boxes, not overlapping, no gaps, to cover all possible values for their question	B1	'None' or equivalent does not have to be included
<b>Additional guidance</b>			
<p>If the time frame is one week it is reasonable to have boxes covering no more than 7 or for a month it could be 30/31</p> <p>. However they could still have a larger range in case customers have more than one meal per day at the restaurant.</p> <p>Time frame may be in the response section.</p> <p>Response boxes should be appropriate for how often customers visit his restaurant –not some irrelevant question they have asked</p> <p><b>For example</b></p> <p>How many friends come with you to the restaurant</p> <p>Boxes 0, 1, 2, 3 or more B0 B0</p> <p>'Other' is not acceptable to cover any they miss!</p> <p>Allow 5+ (for example) to mean '5 and over' or 'over 5'</p> <p>Inequalities must be used correctly</p>			



<b>4</b>	<b>Alternative method 3</b>		
	$15 \times 1.60$ or £24 or $25 \times 1.20$ or £30	M1	
	$\frac{\text{their } 24}{15 + 25}$ or $\frac{\text{their } 30}{15 + 25}$	M1	oe Implies first M1
	their $\frac{24}{40}$ + their $\frac{30}{40}$  or their 0.6 + their 0.75	M1dep	oe dep on M2
	1.35	A1	
<b>Additional Guidance</b>			
<p>their 24 and their 30 must come from correct method</p> <p>Incorrect conversion from fraction to decimal can still score the method marks</p> <p>For example</p> $\frac{24}{40} = 0.4 \quad \frac{30}{40} = 0.75$ $0.4 + 0.75 = 1.15$ <p style="text-align: right;">This scores M1M1M1 A0</p>			

Q	Answer	Mark	Comments
5	$x + 12$	B1	used for Sam Implied by correct equation
	$x + 2x + \text{their } (x + 12) = 84$	M1	oe their $x + 12$ can be anything, even just 12 but must not contradict anything they give separately for Sam
	$4x = 72$ or $x = 18$	M1	Collection of their like times and rearrangement to $ax = b$
	30	A1	
	Organised algebraic response and solution	Q1ft	Must gain both method marks and give a solution QWC strand (ii) SC3 30 from a numerical/T&I approach. SC2 for 18 from a numerical/T&I approach.
<b>Additional Guidance</b>			
<p>Their <math>x + 12</math> used in the equation must not contradict anything they give separately for Sam</p> <p><math>4x + 12 = 84</math> is B1M1</p> <p>The Q mark is for an algebraic method leading to their solution</p> <p><b>Example</b></p> <p><math>3x + 12 = 84</math>   <math>3x = 72</math></p> <p>Answer 24      B0M1M1A0Q1ft</p> <p>Condone one arithmetical slip for the second Method mark-eg <math>84 - 12 = 76</math></p> <p>Adding 12 instead of subtracting 12 is not an arithmetical error – it is incorrect method</p> <p>Answer 18 from a correct algebraic method is B1M1M1A0Q1</p> <p>Allow omission of <math>x =</math> for their answer of 18 if it comes from solving an equation</p> <p><b>Example</b></p> <p><math>4x + 12 = 84</math></p> <p><math>84 - 12 = 72</math></p> <p><math>72 \div 4 = 18</math></p> <p>Answer 30      B1 (implied) M1M1A1Q1</p> <p>If they give all three answers they must link Sam with 30</p> <p>eg Andrew 18, Nigel 36, Sam 30</p> <p>If awarding SC for a numerical approach do not award B1 for <math>x+12</math> seen</p>			

Q	Answer	Mark	Comments
6(a)	Midpoints used	B1	At least 4 correct
	$(2.5 \times 2) + (7.5 \times 6) + (12.5 \times 8) + (17.5 \times 3) + (22.5 \times 1)$ or $5 + 45 + 100 + 52.5 + 22.5$ or 225	M1	Attempt at $\Sigma fx$ using values on or between class boundaries. Condone 1 error. May be seen in the table.  Correct fx values implies B1
	Their 225 $\div$ 20	M1	Division by 20
	11.25 (minutes) or 11 minutes 15 seconds	A1	Ignore subsequent rounding or incorrect conversion to mins and secs if 11.25 seen  11 with no working is B0M0M0A0  SC2 for 13.75 or 8.75 with no working (use of upper or lower class boundaries)
	<b>Additional Guidance</b> Midpoints must be used correctly. Not just added up and divided by 5 Mark the method that leads to their answer. <b>Example</b> fx column completed correctly but then method shows $20 \div 5$ answer 4 gains no credit for the fx column		
6(b)	Suitable reason eg, Raw data not known Midpoints used to represent the class Data is/are grouped, not individual values	B1	oe
	<b>Additional Guidance</b> Allow reference to just one group eg The average for 0 to 5 may be higher or lower than 2.5		

Q	Answer	Mark	Comments
<b>6(c)</b>	<b>Alternative method 1</b>		
	452.25 ÷ 0.09 or 5025	M1	Allow mix of monetary units eg 452.25 ÷ 9
	Their 5025 ÷ 21	M1	
	239.(2857) (mins)	A1	Allow any rounding Allow 240 as a comparison
	Correct conclusion Eg 239.3 is less than 250 so 1st Friday in Sept was higher than average	Q1ft	QWC strand (iii) ft their 239.3 if M2 awarded SC3 238.(...) and correct conclusion SC2 238.(..) with no conclusion or incorrect conclusion
	<b>Additional Guidance</b>		
	The special case comes from use of 20 after subtracting Fridays minutes from the total for september		
	<b>Alternative method 2</b>		
	250 × 21 or 5250	M1	
	Their 5250 × 0.09	M1	250 × 0.09 × 21 is M2
	(£)472.5(0)	A1	
	Correct conclusion Eg 472.5(0) is greater than 452.25 so 1st Friday in Sept was higher than average	Q1ft	QWC strand (iii) ft their 472.5(0) if M2 awarded

<b>6(c)</b>	<b>Alternative method 3</b>		
	250 × 0.09 or 22.5(0) or 250 × 9 (÷100)	M1	cost for 1st Friday in sept
	452.25 ÷ 21	M1	
	(£)21.53 or (£)21.54 or (£)21.5(0)	A1	Average cost per day
	Correct conclusion Eg 22.5 is greater than 21.5 so 1 <sup>st</sup> Friday in September was higher than average	Q1ft	QWC strand (iii) ft their 21.5 if M2 awarded with correct monetary units compared SC3 21.48 or 21.49 or 21.5(0) with correct conclusion from division by 20 SC2 21.48 or 21.49 or 21.5(0) with no conclusion/incorrect conclusion, from division by 20
<b>Additional Guidance</b>			
<p>Use of 250 × 9 = 225 cannot get the Q mark for comparison with 21.5</p> <p><b>Beware</b> 21.5 can come from division of the cost of 20 days (429.75) by 20</p> <p>This gains SC3 with a conclusion</p> <p><b>Example</b></p> <p>250 × 0.09 = 22.5</p> <p>452.25 – 22.5 = 429.75</p> <p>429.75 ÷ 20 = 21.48 = 21.5</p> <p>so the first Friday in sept was higher than the average      <b>SC3</b></p> <p>Condone comparison of costs to imply comparison of minutes for Q mark</p>			

Q	Answer	Mark	Comments
7	<b>Alternative method 1</b>		
	$230 \times 0.75$ or $230 - (230 \times 0.25)$ or 172.5	M1	oe
	Their $172.5 \times 0.9$ or their $172.5 - (\text{their } 172.5 \times 0.1)$	M1	their 172.5 cannot be 230 oe
	155.25	A1	
	<b>Additional Guidance</b>		
	The second method mark is for working out 90% of their 172.5 This could be by working out 10% and subtracting Their 172.5 must be from trying to work out a reduction of 25% but may be an incorrect method <b>Example</b> $230 \div 25 = 9.2$ $230 - 9.2 = 220.8$ M0 $220.8 \div 10 = 22.08$ $220.8 - 22.08 = 198.72$ M1A0		
	<b>Alternative method 2</b>		
	$0.9 \times 0.75$ or 0.675	M1	
	Their $0.675 \times 230$	M1	
	155.25	A1	



Q	Answer	Mark	Comments
8	Sample size of at least 30 teenage girls and boys	B1	Could be 15 of each Allow 10% of each year group
	Reference to recording/asking the students to record number of hours each person spent on social media sites in a time frame	B1	Eg in one week If response boxes used ignore gaps/overlaps etc
	Reference to calculating mean/average time spent or Draw diagram(s) to compare	B1	For diagrams allow bar chart, line graph, pie chart, histogram, frequency polygon, box plot
	Reference to a comparison and an interpretation	B1	eg compare averages to see which is higher look at graphs to see who spends more time
	For data handling cycle in order and overall narrative with minimum of collecting data, analysing it and reference back to hypothesis	Q1	QWC strand (ii) May imply previous B1
<b>Additional Guidance</b>			
<p>Only one diagram is required or one type of average. They must state what type of diagram so just stating draw graphs is not sufficient</p> <p>For the 4<sup>th</sup> B mark it is not enough just to say compare the results. They must state what they are trying to find</p> <p>But allow 'compare the graphs to see if her hypothesis is correct' for this B mark but not for the Q mark</p> <p>For the Q mark they must state how they will check if the hypothesis is correct</p> <p><b>For example</b></p> <p>If the girls average is higher then the hypothesis/Jade is correct</p>			

Q	Answer	Mark	Comments
9	<b>Alternative method 1</b>		
	1 part = 32 or $64/2 \times 3$ or $64/2 \times 5$	M1	
	(Ben gets) 96 or (Ben and Carla get) 160	A1	
	their 160 = $\frac{4}{7}$	M1	Their 160 must be a total for Ben and Carla May be implied by further method
	their 160 $\div 4 (\times 3)$	M1	Their 160 must be a total for Ben and Carla
	120	A1	
	<b>Alternative method 2</b>		
	$\frac{4}{7} \div 5 \times 2$ or $\frac{8}{35}$	M1	
	$\frac{8}{35} = 64$	A1	
	$64 \div 8 \times 35$ or 280	M1	
	their 280 $\div 7 (\times 3)$	M1	
	120	A1	
	10(a)	1295 circled	B1
10(b)	1753.4 $\dot{9}$ or 1753.5	B2	B1 for [1753.43,1753.5) or B1 for 250.499 or better or 250.5

Q	Answer	Mark	Comments
11(a)	22	B1	
11(b)	18 <b>and</b> 24 chosen or indicated on graph	M1	
	6	A1	
	<p><b>Additional guidance</b></p> <p>Lines drawn at 20 and 60 with attempt to read scale can score M1                      If lines are drawn at 20, 40 and 60 but then they use readings from 40 and 20 or 60 and 40 then M0</p>		
11(c)	18 and their 22 <b>and</b> boys or the boys threw 4m further on average (from 22 in part a) or box plot drawn for boys <b>and</b> boys as their median is higher	B1ft	ft their median from part a)
	<p><b>Additional Guidance</b></p> <p>Just stating 'boys as their median is higher' is not enough unless they have drawn a box plot for the boys (which shows they know which part of the box plot is the median)</p>		

Q	Answer	Mark	Comments
11(d)	<b>Alternative method 1</b>		
	<b>Girls</b> 20 seen	B1	
	<b>Boys</b> 80 – 32 or 48	M1	Allow 80 – 31 or 49
	$\frac{\text{their } 20 + \text{their } 48}{160}$	M1	one figure for girls and one for boys
	$\frac{68}{160}$ or 42.5%	A1	oe Allow 43 from correct method
	<b>Alternative method 2</b>		
	<b>Girls</b> 25% seen	B1	
	<b>Boys</b> $\frac{80 - 32}{80} (\times 100)$ or $\frac{48}{80} (\times 100)$ or 60%	M1	oe Allow 31
	(their 60(%) + 25 (%)) $\div$ 2	M1	oe
	42.5%	A1	

Q	Answer	Mark	Comments
12	$3b + 2t = 4.84$ and $5b + 3t = 7.65$	M1	Setting up both equations
	$9b + 6t = 14.52$ and $10b + 6t = 15.3(0)$ or $15b + 10t = 24.2(0)$ and $15b + 9t = 22.95$	M1	oe equating coefficients Condone one error in <b>totals</b>
	$b = 0.78$ or 78p	A1	
	$t = 1.25$	A1	
	$3 \times$ their 0.78 + their 1.25 or 3.59	M1	3.59 seen implies both previous A marks
	$15 \div$ their 3.59 or 4.17	M1	Implied by 14.36 seen (counting up in 3.59's) Their 3.59 must come from $3 \times$ one of their values plus $1 \times$ their other value
	12 packs of biscuits and 4 packs of teabags	A1ft	
<b>Additional guidance</b>			
Correct values from trial and improvement method do <b>not</b> gain any of the first 4 marks. The values can be used to access the last 3 marks Note there is no ft from a value for $b$ to the value of $t$ (or vice versa) Incorrect values of $b$ and or $t$ can be followed through to access the final 3 marks			

The actual values of  $b$  and or  $t$  may not be seen but can be implied from correct values seen later eg 3.59 seen

Using the ratio the wrong way round for the last 3 marks can gain M0M1A0

Eg  $1 \times 0.78 + 3 \times 1.25 = 4.53$  is M0

$15 \div 4.53$  is then M1 but the A mark cannot be awarded

Beware: 12 and 4 can come from use of incorrect values for  $b$  and  $t$

Correct working must be seen to award full marks

Q	Answer	Mark	Comments
13	<b>Alternative method 1</b>		
	4 × 5 = 20 days for 1 painter to paint 10 rooms	M1	
	2 days per room	M1	For one painter
	$\frac{12 \times 2}{3}$	M1	24 workers for 12 rooms per day divided by 3 days
	8	A1	
	<b>Alternative method 2</b>		
	4 painters take $\frac{1}{2}$ day to paint one bedroom	M1	or paint 2 bedrooms per day
	4 painters take 6 days to paint 12 bedrooms	M1	or need to paint 4 bedrooms per day (for 12 bedrooms in 3 days)
	4 × 2	M1	4 × 2 or $\frac{12}{3} \times 2$
	8	A1	
	<b>Alternative method 3</b>		
	Use of $\frac{5}{3}$	M1	
	Use of $\frac{12}{10}$	M1	
	$4 \times \frac{5}{3} \times \frac{12}{10}$	M1	
	8	A1	
	<b>Additional Guidance</b>		
	8 on the answer line gains full marks unless clearly from incorrect method		

Q	Answer	Mark	Comments
14(a)	$\frac{215}{1200} \times 100$ or 17.9(...)	M1	
	18	A1	SC1 11.8(..)→12 (women part-time) SC1 30.4(...) →30 (men full time)
14(b)	$\frac{365 + 105 + 83 + 162 + 53}{1200} (\times 100)$ or $\frac{768}{1200} (\times 100)$ or $1 - \frac{142 + 75 + 215}{1200}$	M1	
	64	A1	Allow 63 if proportions for each group calculated separately and rounded



Q	Answer	Mark	Comments
15	<b>Alternative method 1</b>		
	330 small squares (=66)	M1	
	1 small square = 0.2 runners	A1	Or 1 runner = 5 small squares
	$(10 \times 9) + (2 \times 16)$ or 122	M1	squares under 62
	Their $122 \times 0.2$ or 24.4	M1	
	24	A1	
	<b>Alternative method 2</b>		
	$13.2 \text{ cm}^2 = 66$ or $66 \div 13.2$	M1	
	1 $\text{cm}^2 = 5$ runners or labels fd scale 1 unit per cm	A1	
	$3.6 + (0.4 \times 3.2)$ or $4.88 \text{ cm}^2$ or $10 \times 1.8$ or $2 \times 3.2$	M1	or $3 \times 3.2 + 5 \times 4.8 + 20 \times 0.4$ or 41.6 (number above 62 minutes)
	Their $4.88 \times 5$ or $10 \times 1.8 + 2 \times 3.2$ or 24.4	M1	or $66 - \text{their } 41.6$ or 24.4
	24	A1	
	<b>Alternative method 3</b>		
	330 small squares (= 66)	M1	
	$(10 \times 9) + (2 \times 16)$ or 122	M1	
	$\frac{122}{330}$ or 0.369	A1	
	their $\frac{122}{330} \times 66$ or 24.4	M1	
	24	A1	

Q	Answer	Mark	Comments
16(a)	$x \rightarrow$ number of hours mowing lawns $y \rightarrow$ number of hours delivering leaflets	B1	
	<b>Additional guidance</b>		
	Must say number of hours, not just the time spent mowing lawns etc $x$ is mowing lawns (hrs) is sufficient		
16(b)	$x + y \leq 16$ or $x + y \geq 6$	B1	Allow $6 \leq x + y \leq 16$
16(c)	$y = 2$ drawn <b>and</b> $x + y = 16$ drawn <b>and</b> correct region shown	B3	B2 $y = 2$ drawn <b>and</b> $x + y = 16$ drawn or B2 $x + y = 16$ drawn and correct region shown for the two lines (bounded by the $x$ -axis)  B1 $x + y = 16$ drawn or B1ft correct region for their lines if at least 2 lines on graph with an enclosed region (which may be enclosed by the $x$ -axis)
	<b>Additional Guidance</b>		
	B1 ft eg draws their $x + y = 16$ and shows region bounded by their 2 lines and the $x$ -axis Their $x + y = 16$ must be a diagonal line with negative gradient Ignore other lines drawn in addition to $x + y = 16$ and $y = 2$		

Q	Answer	Mark	Comments
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16(d)	(4 × 6) + (12 × 4.5) or 78 or (14 × 6) + (2 × 4.5) or 93 or Objective line $E = 6x + 4.5y$ eg through (0,6) and (4.5,0)	M1	Checking their max vertices or using a numerical approach
	93 is max and No	A1ft	ft their clear feasible closed region if their $x + y = 16$ is drawn
	<b>Additional Guidance</b>		
This part may be answered without reference to their graph Note M1 is not awarded for just use of (4,2) If 93 is not seen then check their graph for possible ft for their vertices.			

