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# Level 3 Certificate

# Mathematical Studies

1350/2C Graphical Techniques  
Final Mark Scheme

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1350  
June 2017

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Version/Stage: v1.0

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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)

## Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
✓ or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
-x EE	deduct x marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

### No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

**Otherwise we require evidence of a correct method for any marks to be awarded.**

Q	Answer	Mark	Comments
1(a)	<p><b>Errors</b></p> <p>Information from one operator is missing</p> <p>Inappropriate use of currency notation eg £189.99p with both the pence and the pounds symbol.</p> <p>The one-off payment for Operator D may have been wrong/possibly a decimal point is missing</p> <p>No time frame for rental cost/contract</p>	E2	<p>E1 for each valid error</p> <p>Ignore any extras even if not valid</p>
	<p><b>Improvement</b></p> <p>Name the operator</p> <p>Add information from the missing operator</p> <p>Remove the p sign when £ sign is used</p> <p>Replace the one-off payment for Operator D with a correct value/£99.99</p> <p>State if the rental is per month or per year</p> <p>State the duration of the contracts for each operator</p> <p>Add more information on allowances eg minutes, texts, downloads</p> <p>Include a separate table for pay-as-you-go</p>	E2	<p>E1 for each valid suggestion for improvement</p> <p>Ignore any extras even if not valid</p> <p>Condone £99.99p</p>
	<b>Additional Guidance</b>		
	Improvements are independent of errors eg information from one operator is missing, they don't have to state as improvement 'add information from missing operator'		
	Work out how much he will pay overall scores E0		

Q	Answer	Mark	Comments
1(b)	<b>Alternative method 1</b> $37.49 \times 24$ or $899(\dots)$ or $37.49 \times 0.7$ or $26(\dots)$	M1	
	their $899(\dots) \times 0.7$ or $629(\dots)$ or their $26(\dots) \times 24$ or $629(\dots)$ or $629(\dots)$	M1	
	their $629(\dots) + 109.99$ or $739(\dots)$	M1	
	$739.82$ <b>and No</b> or $739.75$ <b>and No</b>	A1	AWRT 739.8 Condone 739.8

1(b)	<b>Alternative method 2</b> $37.49 \times 24$ or $899(\dots)$ or $37.49 \times 0.7$ or $26(\dots)$	M1	
	their $899(\dots) \times 0.7$ or $629(\dots)$ or their $26(\dots) \times 24$ or $629(\dots)$ or $629(\dots)$	M1	
	$700 -$ their $629(\dots)$ or $70(\dots)$ <b>and compares with 109.99</b>	M1	
	$70(\dots) < 109.99$ <b>and No</b>	A1	

<b>1(b)</b>	<b>Alternative method 3</b> 700 – 109.99 or 590.01	M1	
	37.49 × 0.7 or 26.(...)	M1	
	their 590.01 ÷ their 26.(...) or 22.(...) or their 590.01 ÷ 24 or 24.(...)	M1	
	22.5 and No or 26.24 and 24.58 and No	A1	
	<b>Additional Guidance</b>		

Q	Answer	Mark	Comments
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2(a)	80 000	B1	
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2(b)	<b>Always Young</b>		
	$\frac{16.9 - 13.7}{16.9} (\times 100\%)$ <p>or</p> $\frac{13.7}{16.9} (\times 100\%) \text{ and compares with } 100\%$ <p>or <math>\frac{4}{5} \times 16.9</math></p>	M1	<p>OE</p> <p>SC2 for</p> $\frac{1}{5} \times 764\,000 = 152\,800 \neq 136\,000$ <p>or <math>764\,000 - 152\,800 = 611\,200 \neq 628\,000</math></p> <p>or <math>\frac{136\,000}{764\,000} (\times 100\%) = 17.8\%</math></p> <p>or <math>\frac{628\,000}{764\,000} (\times 100\%) = 82.2\%</math></p> <p><b>and</b> Always Young is wrong/the statement is incorrect/it isn't quite one-fifth/ could be true it's nearly one-fifth</p>
	[18.9,19] % or 13.5(...) <b>and</b> 13.7 seen	A1	
	Always Young is wrong or the statement/headline is incorrect or it isn't quite one-fifth or could be true it's nearly one-fifth	E1	E1 one correct statement/agreement OE
	<b>Dynamic Youth</b>		
Working out the total number men 16-24 or women aged 16-24 Men: $362\,000 \div 0.152$ or Women: $265\,000 \div 0.121$	M1	This can be implied in the correct number of men/women aged 16-24 given below	
	A1		

	Any value within range [2 380 000, 2 400 000]		
	Any value within range [2 100 000, 2 200 000]	A1	
	Putting their values as a ratio with attempts to simplify it (i.e 1.09:1 etc) or comparing it to 11:10	A1	
	Ratio of 1.09:1 calculated and Dynamic Youth is correct/the statement/headline is correct	E1	OE
<b>Additional Guidance</b>			
	For Always Young, if candidates use 15.1%/12.2% leading to 19.2(...) % or 15.1%/12.3% leading to 18.5(...) % can score M1 A0 E1		

Q	Answer	Mark	Comments
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<b>2(c)</b>	<p>Any three of</p> <p>Display figures in tables e.g. give the actual figures for each quarter/year rather than the differences</p> <p>Ensure data is accurate before publishing it (eg for 16-24, 362 000 (men) + 265 000 (women) ≠ 628 000)</p> <p>Use a consistent time period throughout (eg for youth long term unemployment, the period was August – October but in all other parts of the briefing paper, references were made for September – November)</p> <p>Improve clarity of definitions</p> <p>Graph needs to be more accurate eg larger scale</p> <p>Sort into categories</p> <p>Axes need to be labelled</p> <p>Use more charts (to make information clearer)</p>	E3	<p>E1 for each valid suggestion</p> <p>Ignore any additional but incorrect suggestions</p> <p>SC1 (for two or three errors identified with no/incorrect suggestions for improvement)</p> <p>OE</p> <p>OE</p>
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Q	Answer	Mark	Comments	
3a	100 ÷ 9.58	M1		
	10.4(384134)	A1		
	<b>Additional Guidance</b>			
3b	3.62	B1		
	<b>Additional Guidance</b>			
3c	Bolt decreases his acceleration until around 7 seconds or 70 metres	B1	OE the graph shows a decrease in acceleration until around 7 seconds or 70 metres	
	then Bolt decelerates (in the last 3 seconds or 30 metres)	B1	OE the graph shows deceleration (in the last 3 seconds or 30 metres)	
	<b>Additional Guidance</b>			
	Accept negative acceleration for deceleration			
	For B1B1 the time or distance must be mentioned in at least one answer			

Q	Answer	Mark	Comments
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4(a)	$(c =) 4$	B1		
	$5 = a \times 2^2 + 2 + c$	M1		
	$5 = 4a$ $5 = 4a + 2 + \text{their } 4$ or $5 = 4a + 6$	M1		
	$a = -0.25$	A1	OE	
	<b>Additional Guidance</b>			

4(b)	<b>Alternative method 1</b>		
	their $(-0.25) \times x^2 + x + \text{their}(4) =$	M1	their $(-0.25) \times x^2 + x + \text{their } 4$
	6.47	A1ft	follow through their $a$ and $c$
	Overestimate	B1ft	ft their 6.47 with M1 scored
	<b>Alternative method 2</b>		
	their $(-0.25) \times 6.5^2 + 6.5 + \text{their}(4)$	M1	their $(-0.25) \times 6.5^2 + 6.5 + \text{their } 4$
	- 0.0625	A1ft	follow through their $a$ and $c$ .
	Overestimate	B1ft	ft their $(-0.0625)$ with M1 scored
	<b>Additional Guidance</b>		

Q	Answer	Mark	Comments
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5(a)	Draws tangent	M1	
	Finds gradient of this line	M1	Correct method to find gradient of their "line" Must be change in radius divided by change in time
	[0.3,0.45]	A1	
	<b>Additional Guidance</b>		

5(b)	Decreases	B1	OE
	<b>Additional Guidance</b>		

5(c)	Use of volume formula with at least one radius	M1	
	Volume at $t = 2$ : 44	A1	
	Volume at $t = 4$ : 84	A1	
	<b>Additional Guidance</b>		

Q	Answer	Mark	Comments	
5(d)	$\frac{\text{their } 44 - 4}{2} \text{ or } \frac{\text{their } 84 - \text{their } 44}{2}$ or $\frac{40}{2}$	M1		
	20	A1ft	ft their values in 5(c)	
	Units: cm <sup>3</sup> /s or cm <sup>3</sup> s <sup>-1</sup> or cubic cm per second or cm <sup>3</sup> per second	B1		
	<b>Additional Guidance</b>			

Q	Answer	Mark	Comments
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5(e)	<b>Alternative method 1</b>																				
	$V_A = 4 + \text{their}(20)t$	M1																			
	$V_B = 4 + 30(t - 1)$	M1																			
	$4 + \text{their}(20)t = 4 + 30(t - 1)$	M1																			
	$(t =)3$	A1ft	ft 5(d)																		
	<b>Alternative method 2</b>																				
	Correct graph for first balloon	M1																			
	Correct graph for second balloon	M1																			
	Point of intersection used to find the time	M1																			
	$(t =)3$	A1ft	ft 5(d)																		
	<b>Alternative method 3</b>																				
	Creates tables of values for both balloons.	M1																			
	Correct table	M1	<table border="1"> <tr> <td><math>t</math></td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td><math>V_1</math></td> <td>4</td> <td>24</td> <td>44</td> <td>64</td> <td>84</td> </tr> <tr> <td><math>V_2</math></td> <td>-</td> <td>4</td> <td>34</td> <td>64</td> <td>94</td> </tr> </table>	$t$	0	1	2	3	4	$V_1$	4	24	44	64	84	$V_2$	-	4	34	64	94
	$t$	0	1	2	3	4															
	$V_1$	4	24	44	64	84															
	$V_2$	-	4	34	64	94															
	Identifies identical volumes	M1																			
	$(t =)3$	A1ft																			

	<b>Additional Guidance</b>	

Q	Answer	Mark	Comments
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6(a)	0	B1	
	<b>Additional Guidance</b>		

6(b)	$Q = 6(1 - e^{-3})$	M1	
	$Q = 5.70$	A1	
	$5.70 = Ae^{-3(1-1)}$	M1	
	$A = 5.70$	A1	
	<b>Additional Guidance</b>		

Q	Answer	Mark	Comments
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6(c)				
	Exponential graphs in both sections		M1	
	Correct shapes		A1	
	Max of 5.7		B1	
	<b>Additional Guidance</b>			

6(d)	$4 = 6(1 - e^{-3t})$	M1	Allow inequalities throughout
	$t = 0.366$	A1	
	$4 = 5.7e^{-3(t-1)}$	M1	
	$t = 1.118$	A1	
	$1.118 - 0.366 = 0.752$	M1	
	40% of 2 = 0.8 so does satisfy requirement	A1ft	OE ft their 0.752 with all M marks scored
	<b>Additional Guidance</b>		