
LEVEL 3 CERTIFICATE

Mathematical Studies

1350/2B Critical Path Analysis

Mark scheme

1350

June 2016

Version 1.0: Final Mark Scheme

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

Examinations are marked in such a way as to award positive achievement wherever possible. Thus, for 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	mark is for method
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
ft	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
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

Q	Answer	Mark	Comments
1(a)	1.23×10^9	B1	
1(a) Additional Guidance			
1(b)	<p>Label (horizontal) x axis (eg number of users) and/or (vertical) y axis (eg year) or label axis</p> <p>Correctly place the year before the number of users (eg year 2004-2007)</p> <p>Use key to indicate (eg for the 'm' or indicate what 'm' is or use ' '000 000s) or make it clear what 'm' stands for</p> <p>Bar should be drawn in proportion or accept similar explanation or add a scale on the axis</p> <p>Improve title/make it clear what the numbers represent eg what part of the year</p>	E2	<p>E1 for each valid improvement</p> <p>Ignore any additional but incorrect suggestions</p> <p>SC1 (two errors identified but no suggestions for improvement made)</p> <p>oe for all</p>
1(b) Additional Guidance			
	E0 for suggesting other form of graphs eg line graph, vertical bar chart etc		
1(c)	<p>It should be 608 not 680, making reference to (680 - 360)</p> <p>He should have stated the number in 'm' or millions (should put 'm' next to his numbers)</p> <p>The denominator should be 6 not 5 or seen in calculation</p> <p>He could use a quicker way to calculate using $\frac{\text{final value} - \text{initial value}}{n}$</p> <p>or $\frac{1230 - 58}{n}$</p> <p>He should have stated his answer/the answer is not given</p>	B3	<p>Award B1 for each error or improvement</p> <p>Calculating the mean doesn't score a mark</p>

Q	Answer	Mark	Comments
1(d)	Alt 1		
	900 + 40 or 940	M1	
	$(40 \div 940) \times 350$	M1	Award M1 for using stratified sampling
	14 or 15	A1	
	Says that the data doesn't support the claim or They should have selected 14 or 15 users not 25 or The number of Instagram users selected in the survey is too large	E1	Dep on second M1
	Alt 2		
	900 + 40 or 940	M1	
	$\frac{25}{350}$ or $\frac{40}{940}$ or 0.07(14...) or 0.04(26...) or 7.(14...) % or 4.(26...)%	M1	Award M1 for using proportionality
	'not equal' or 'not similar' or 'disproportionate' eg: $\frac{25}{350} \neq \frac{40}{940}$ or 0.0714 \neq 0.0426 or 7.14% \neq 4.26%	A1	Award A1 for comparing both fractions/decimals/% and concluding that they are not equal/disproportionate ft their '940' \neq can be implied
	Says that the data doesn't support the claim (must have compared two figures before concluding)	E1	Dep on second M1

Alt 3		
350 – 25 or 325 or 900 + 40 or 940	M1	
Using ratios $\frac{325}{25}$ or $\frac{900}{40}$ or 13 or 22.5 or $\frac{325}{350}$ or $\frac{900}{940}$ or 0.92(85...) or 0.95(74...)	M1	
'not equal' or 'not similar' or 'disproportionate' $\frac{325}{25} \neq \frac{900}{40}$ or $13 \neq 22.5$ or $\frac{325}{350} \neq \frac{900}{940}$ or $0.92(85...) \neq 0.95(74...)$	A1	Award A1 for comparing both fractions/decimals/ratios and concluding that they are not equal/disproportionate ft their '940' \neq can be implied
Says that the data doesn't support the claim (must have compared two figures before concluding)	E1	Dep on second M1

1(d) Additional Guidance	
	For A1, must compare two fractions with same denominator or two decimals or percentages
	Pairs of fractions can be inverted
	Candidates may attempt to work out the actual numbers and compare. Eg $\frac{25}{350} \times 940$ or 67.(...) or $\frac{25}{325} \times 900$ or 69.(...) scores M1M1A1 Note: 350 must be paired with 940 or 325 must be paired with 900 to score A1 Incorrect pairing can score M1M1A0E1

Q	Answer	Mark	Comments
2(a)(i)	(Figure 1) The shapes are too close to each other or overlap Can't see where anything is in Central Asia You can't work out the values accurately The lines and the shapes don't correspond with the numbers Use of shapes makes readings inaccurate	E1	E1 for one valid reason Ignore any additional but incorrect reason oe for all

2(a)(ii)	(Table 1) Some data were not shown/missing (eg total population/illiterate men) (On the right column) it got mixed with % and numbers	E1	E1 for one valid reason Ignore any additional but incorrect reason
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2(a)(ii)	Additional Guidance
	Suggested improvements can imply the errors

Q	Answer	Mark	Comments
2(b)	Alt 1 Paul's Statement		
	0.157 or 15.7%	B1	
	781m ÷ their '0.157' or 4975m (or value rounds to 5billion)	M1	ft their 0.157 for [0.15,0.18]
	their '84.3%' of their '4975m' (or value rounds to 5billion)	M1	their '84.3%' must be 100 – their [15,18]%
	4194m (or value rounds to 4.2 billion) and Paul is right/statement is correct	A1	SC2 5billion x 84.3% = 4215m and Paul is right SC1 without conclusion
	Alt 2 Paul's Statement		
	0.157 or 15.7%	B1	
	4.2billion ÷ their '84.3%' or 4982m (or value rounds to 5billion)	M1	their '84.3%' must be 100 – their '15.7%'
	their 4982m (or value rounds to 5billion) x their '0.157 or 15.7%'	M1	ft their 0.157 for [0.15,0.18]
	782m and Paul is right/statement is correct	A1	SC2 5billion x 15.7% = 782m and Paul is right SC1 without conclusion
	Rena's statement		
	Cannot use the '20 years/2 decades' alongside the points in the graph/ Graph does not support/Graph cannot be used to check this or Although 20 years cannot be worked out/calculated from the diagram, it is evident that several other regions have made much greater progress from their starting point or Central Asia has made the least progress in terms of raising percentage. or Other regions made greater progress	B1	
Not possible to check/tell/confirm Rena's statement. or Rena is wrong/ Her statement is incorrect.	E1	ft their reasoning	
2(b) Additional Guidance			
There are 4 marks for Paul and 2 marks for Rena			

Q	Answer	Mark	Comments
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3(a)		<p>SCA at least 4 activities with labelling and attempt at timescale</p> <p>8 tasks plotted, labelled and with correct start times</p> <p>2 or more correct floats seen</p> <p>All correct including timescale evenly spaced and units labelled</p>	<p>M1</p> <p>M1</p> <p>M1 (dep)</p> <p>A1</p>	<p>Accept without floats</p> <p>Must have scored first M1 mark</p> <p>See diagram above</p>
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3(a) Additional Guidance	
	Time on x -axis may state hours and minutes or just minutes
	For 1 st M1 not all activities starting at zero

Q	Answer	Mark	Comments

3(b)	H	B1	
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3(b) Additional Guidance			

4(a)	6 or 13 seen	B1	oe fraction, decimal or percentage
	$= \frac{6}{13}$	B1	

4(a) Additional Guidance			

4(b) Alt 1	66 + 4 + 2 + 5	M1	Attempts to sum the percentages not in the hay fever circle
	= 77 (%)	A1	oe fraction, decimal or percentage
4(b) Alt 2	100 – (14 + 3 + 5 + 1)	M1	Attempts to subtract percentages in the hay fever circle from 100
	77 (%)	A1	oe fraction, decimal or percentage

4(b) Additional Guidance			

4(c)	Person chosen at random may not be taking medication for hay fever at that precise moment in time	E1	May not be on medication/ wrong time of year for hay fever/ may use natural remedies/ fewer people may have developed hay fever since the study was conducted
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4(c) Additional Guidance			
	Allow any reasonable statements		

Q	Answer	Mark	Comments
5(a)	0.31 seen	M1	At least 2 dp
	0.29(45)	A1	
5(a) Additional Guidance			
5(b) Alt 1	Use of 'their' part (a) or 0.2945 seen	M1	Probability of sales by telephone
	0.69 x 0.85 or 0.5865 seen	M1	Probability of sales from internet
	0.2945 + 0.5865 or 0.881 seen	M1	Sums 'their' 0.2945 and 'their' 0.5865
	0.881 x 200 x 40 or 176.2 or 35.24 seen	M1	Multiplies 'their' probability by 200 or 40
	(£) 7048	A1ft	ft from part (a) Total expected sales
5(b) Alt 2	Use of 'their' part (a) or 0.2945 seen	M1	Probability of sales by telephone
	0.2945 x 200 x 40 or 2356	M1	Expected sales by telephone or 'their' part (a) x 200 x 40
	0.69 x 0.85 or 0.5865	M1	Probability of sales from internet.
	0.5865 x 200 x 40 or 4692	M1	Expected sales from internet or 'their' 0.5865 x 200 x 40
	(£2356 + £4692) = (£) 7048	A1	ft from part (a) Total expected sales
5(b) Alt 3	Use of 'their' part (a) or 0.2945 seen	M1	Probability of sales by telephone
	0.69 x 0.85 or 0.5865 seen	M1	Probability of sales from internet
	0.2945 + 0.5865 or 0.881 seen	M1	Sums 'their' 0.2945 and 'their' 0.5865
	(0.881 x 200) = 176.2 176 people when rounded or 176 x 40	M1	Multiplies 'their' probability by 200 and then rounds to nearest whole number of people
	(£) 7040	A1	ft from part (a) Total expected sales

5(b) Alt 4	200 x 0.69 or 138 and 200 – 138 or 200 x 0.31 or 62	M1	For both
	138 x 0.85 or 117.3 or 117	M1	
	62 x 0.95 or 58.9 or 59	M1	
	Their 117 + their 59 or 176	M1	
	(176 x 40 =) (£) 7040	A1	ft from part (a) Total expected sales
5(b) Alt 4	200 x 0.69 or 138 and 200 – 138 or 200 x 0.31 or 62	M1	For both
	138 x 0.85 or 117.3 or 117	M1	
	62 x 0.95 or 58.9 or 59	M1	
	59 x 40 or 2360 and 117 x 40 or 4680	M1	For both
	(2360 +4680=) (£) 7040	A1	ft from part (a) Total expected sales
5(b) Additional Guidance			
Probabilities may be expressed explicitly or may be expressed as a tree diagram			
Check method used			

Q	Answer	Mark	Comments
6(a) Alt 1	250	B1	Expected profit at CF
	(600 – 800) or -200 or (1500 – 800) or 700	M1	Attempts to subtract fee from expected takings at AS
	$\frac{93}{310} = 0.3$ or $\frac{217}{310} = 0.7$ used as a probability	M1	Used only in AS calculations
	Their 0.3 x their -200 or their 0.7 x their 700	M1	ft their values
	their 0.3 x their -200 + their 0.7 x their 700 or 430	A1	Expected profit at AS
	(250 < 430) so Agricultural Show	E1	Dep A1
6(a) Alt 2	(450 – 200) or 250	B1	Expected profit at CF
	$\frac{93}{310} = 0.3$ or $\frac{217}{310} = 0.7$ used as a probability	M1	Used only in AS calculations
	Their 0.3 x 600 or their 0.7 x 1500	M1	
	their 0.3 x 600 + their 0.7 x 1500 or 1230	M1	their total expected takings at AS
	1230 – 800 or 430	A1	Expected profit at AS
	(250 < 430) Agricultural Show	E1	Dep A1

6(a) Additional guidance	

Q	Answer	Mark	Comments
6(b) Alt 1	$(0.3 \times (600+300)) + 0.7 \times 1500$ Or (£) 1320 their 1320 – 800 - 100 (£) 420 This is less than the expected profit without insurance so Lila should not take out insurance	M1 M1 A1	Calculates the expected takings including insurance payout and returned cost of insurance. Subtracts fee and insurance costs from their expected takings.
6(b) Alt 2	If rains takings (= 600 + 300) = 900 Costs (= 800+100) = 900 Part of expected profit from rain(= 0 x 0.3) = (£)0 If does not rain takings = 1500 Costs (= 800+100) = 900 Part of expected profit from no rain (= 600 x 0.7) = (£) 420 Expected profit = (£) 420 This is less than the expected profit without insurance so Lila should not take out insurance	M1 M1 A1	Subtract costs from takings to get expected profit if it rains Subtracts costs from takings to get expected profit if it does not rain
6(b) Alt 3	0.3×300 or 90 $90 < 100$ or $90 - 100 = -10$ Negative profit / she makes a loss	M1 M1 A1	Expected profit calculated
6(b) Alt 4	$((300 - 100) \times 0.3) = 60$ $(100 \times 0.7) = 70$ $60 - 70$ or -10 Expected loss so Lila should not take our insurance or $(430 + 60 - 70) = (£) 420$ This is less than the expected profit without insurance so Lila should not take out insurance	M1 M1 A1	Finds extra profit from insurance payout if rains Finds extra cost of taking insurance if no rain Uses the expected profit from part (a) to correctly find the expected profit with insurance

6(b) Additional guidance

Q	Answer	Mark	Comments
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7(a)			
	Network, at least 5 activities and 4 arcs	B1	
	Task B immediately preceding tasks F, C and J only	M1	
	Only tasks F, E and G immediately preceding task H	M1	
	Activity network correct	A1	
	Start times at C, F and J correct	M1	Allow follow through from their part (a)
	Start time at H correct	M1	FT
	All start times correct	A1	
	Finish times correct at H, I, K, L	M1	Allow follow through from their part (a)
	Finish time correct at D	M1	FT
All finish times correct	A1		

7(a) Additional guidance	
	Arrows are not required on arcs as long as the direction is obvious
	Any mark for finish time can only be awarded if (finish time) < (start time)

Q	Answer	Mark	Comments
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7(b)	ABCDEHL	B1	
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7(b) Additional guidance			

7(c) Alt 1	$(20 - 15) = 5$ days extra needed for task I	B1	5 days – ‘their float time’ FT their latest finish time for L in part 6(a)
	$(5 - 2) = 3$ days extra overall	M1	
	65	A1	
7(c) Alt 2	$44 + 20$ or 64	M1	FT their latest finish time for L in part 6(a)
	$64 + 1$	M1	
	65	A1	

7(c) Additional guidance			