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LEVEL 3 CERTIFICATE
Mathematical Studies

1350/2C Graphical techniques
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**		

Q	Answer	Mark	Comments
1(b)	Label (horizontal) x axis (eg number of users) and/or (vertical) y axis (eg year) or label axis Correctly place the year before the number of users (eg year 2004-2007) 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 Bar should be drawn in proportion or accept similar explanation or add a scale on the axis Improve title/make it clear what the numbers represent eg what part of the year	E2	E1 for each valid improvement Ignore any additional but incorrect suggestions SC1 (two errors identified but no suggestions for improvement made) oe for all

1(b)	**Additional Guidance**
	E0 for suggesting other form of graphs eg line graph, vertical bar chart etc

Q	Answer	Mark	Comments
1(c)	It should be 608 not 680, making reference to (680 - 360) He should have stated the number in 'm' or millions (should put 'm' next to his numbers) The denominator should be 6 not 5 or seen in calculation He could use a quicker way to calculate using $\dfrac{\text{final value} - \text{initial value}}{n}$ or $\dfrac{1230 - 58}{n}$ He should have stated his answer/the answer is not given	B3	Award B1 for each error or improvement Calculating the mean doesn't score a mark

Q	Answer	Mark	Comments

Alt 1

900 + 40 or 940	M1	
(40 ÷ 940) × 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

1(d)	900 + 40 or 940	M1	
	25 or 40 350 940 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: 25 ≠ 40 350 940 or 0.0714 ≠ 0.0426 or 7.14% ≠ 4.26%	A1	Award A1 for comparing both fractions/decimals/% and concluding that they are not equal/disproportionate ft their '940' ≠ 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 $\dfrac{325}{25}$ or $\dfrac{900}{40}$ or 13 or 22.5 or $\dfrac{325}{350}$ or $\dfrac{900}{940}$ or 0.92(85…) or 0.95(74…)	M1	
'not equal' or 'not similar' or 'disproportionate' $\dfrac{325}{25}$ ≠ $\dfrac{900}{40}$ or 13 ≠ 22.5 or $\dfrac{325}{350}$ ≠ $\dfrac{900}{940}$ or 0.92(85…) ≠ 0.95(74…)	A1	Award A1 for comparing both fractions/decimals/ratios and concluding that they are not equal/disproportionate ft their '940' ≠ 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 $\dfrac{25}{350}$ x 940 or 67.(…) or $\dfrac{25}{325}$ x 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
1(e)	50 x 61.48 ÷ 1.60 or 2000 x 1.60 ÷ 50 or 2000 x 1.60 ÷ 61.48 or 50 x 61.48 and 2000 x 1.6	M1	
	(£) 1921.(…) or ($) 64 or 52.(…) (shares) or ($) 3074 and ($) 3200 **and statement** No she is wrong/not correct	A1	Allow 1900 or 1920 oe

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

Q	Answer	Mark	Comments
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

2(a)(ii)	Additional Guidance
	Suggested improvements can imply the errors

Q	Answer	Mark	Comments
	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%'
2(b)	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
3(a)	$0.14 \times 1000 + 40 = 180$	B1	AG

Q	Answer	Mark	Comments
3(b) Alt 1 Graphical method	A: $y = 0.16x$ B: $y = 0.14x + 40$ C: $y = 0.12x + 100$	B2	B1 for any one correct equation B2 for all three correct equations Can be implied by correctly drawn graph
	Graph of $y = 0.16x$ drawn correctly	M1	(0,0), (3000, 480), (3500, 560)
	Graph of $y = 0.14x + 40$ or graph of $y = 0.12x + 100$ drawn correctly	M2	(0, 40), (3000, 460), (3500, 530) (0,100), (3000, 460), (3500, 520)
	Three graphs correct	A1	
	Advice: Tariff A for $x < 2000$ or $0 < x \leq 2000$ etc	A1	Allow [1900, 2100]
	Advice: Tariff C for $x > 3000$ or $x \geq 3000$ or $3000 \leq x \leq 4000$ etc	A1	Allow [2900, 3100]
	Advice: Tariff B for $2000 \leq x \leq 3000$ etc	A1	Allow [1900, 2100] and [2900, 3100]

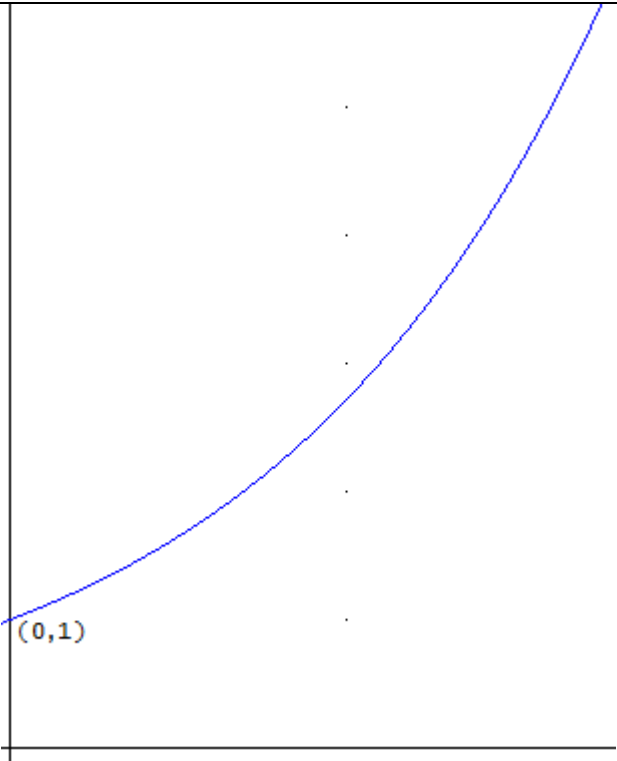| Q	Answer	Mark	Comments
3(b) Alt 2	A: $y = 0.16x$ B: $y = 0.14x + 40$ C: $y = 0.12x + 100$	B2	B1 for any one correct equation
	Intersection of A and B: $0.16x = 0.14x + 40$ Or $0.02x = 40$	M1	For either; or for intersection of A and C $0.16x = 0.12x + 100$
	$x = 2000$	A1	Or for intersection of A and C $x = 2500$
	Intersection of B and C: $0.14x + 40 = 0.12x + 100$ Or $0.02x = 60$	M1	For either
	$x = 3000$	A1	
	Advice: Tariff A for $x < 2000$ or $1500 < x \leq 2000$ etc	A1	Inequality notation is not required.

	Advice: Tariff C for $x > 3000$ or $x \geq 3000$ or $3000 \leq x \leq 3500$ etc	A1	
	Advice: Tariff B for $2000 \leq x \leq 3000$ etc	A1	

3(b) Additional guidance	
	If no algebra or graphs are used, and no ranges of values appear in the advice given, the following marks can be awarded.
	Cost of two different amounts of electricity correctly worked out, giving two different correct recommendations using ranges: up to M2A1
	Cost of three different amounts of electricity correctly worked out, giving three different correct recommendations using ranges: up to M3A2

4(a)	$640 = c$	B1	
	$560 = a\left(1^2 - 2 \times 1\right) + c$	M1	
	$560 = -a + 640$	M1	
	$a = 80$	A1	

4(a) Additional guidance	
	Could be done by simultaneous equations! $0a + c = 640$ $-a + c = 560$

4(b)	Cubic	B1	

Q	Answer	Mark	Comments
5(a)	(0,1)	B2	B1 Correct shape for graph, not through the origin. B1 Intersection with axis shown at (0, 1) 1 at intercept is B1

Q	Answer	Mark	Comments
5(b)	$90 = e^t$ Or $\ln 90 \ \ (=t)$	M1	Forming a correct equation to find t
	4.5 Or 4 min 30 sec	A1	AWFW [4.4998, 4.5] SC1 $\ln 90\,000$ or 11.4

Q	Answer	Mark	Comments
5(c)	90 000	B1	

Q	Answer	Mark	Comments
6(a)	120 and 12 used to find average speed	M1	Using 120 and 12 must include division
	10 m s⁻¹	A1	Correct average speed

6(b)		M1	Drawing a tangent at a point in the range 5 to 7
		M1	" $\dfrac{\Delta y}{\Delta x}$ "
	Speed in range 15 to 18, and tangent drawn.	A1	

6(c)		B1	Approximate correct shape. Must show two constant speeds and increase and decrease.
	Initial speed at 5 Final speed between 7 and 8	B1	
	Maximum speed shown between $t = 5$ and 7	B1ft	FT working from 6b (but must be a maximum).

| **7(a)** | $v = 54(1 - e^{-0.6})$ or $v = 54(1 - e^{-0.2 \times 3})$ | M1 | Substituting 3 into formula. |
| | 24.4 | A1 | AWFW [24.36, 24.4]
Accept 24 with correct working. |

7(b)			
			Through (0,0)
	Through (0,0)	B1	
	$v = 8$ as asymptote	B1	Equation does not need to be stated.
	Maximum above 8	B1 ft	ft from **7(a)** if more than 8

7(c)	$8 + B = 24.4$	M1	Forming equation to find B.
	$B = 16.4$	A1ft	Correct value for B
	$10 = 8 + 16.4e^{-2k}$	M1	Forming an equation which would lead to the value of k.
	$e^{-2k} = \dfrac{2}{16.4}$ $2k = 2.10$	M1	Solving equation to find k
	$k = 1.05$	A1F	Correct value for k (FT Their value for B)
	$V(5) = 8 + 16.4e^{-2.5 \times 1.05}$	M1	Substituting $t = 2.5$ to obtain speed at 2.5 seconds.
	9.19 ms^{-1}	A1ft	Correct speed with correct units (ft their values for k and B) SC2: Seeing $Be^{-2k} = 2$