Level 3 Certificate
Mathematical Studies

1350/2C - Paper 2C - Graphical techniques

Mark scheme

1350

June 2018

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Q	Answer	Mark	Comments
1a	71.5	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
1b	**Graph 1**: EU immigration in the UK Identify 'm' as millions or state what 'm' means Reposition 'm' Use grid/graph paper to enable more accurate readings Extend the all curves to 2045/ same point Add a broken axis Add a line for high net migration The starting point for each line should be the same **Graph 2**: Brexit's impact on the pound Use a key Indicate what 'NIESR' or 'OECD' stands for Use lines/points rather than bars Switch or remove the higher and lower labels Add more organisations Add space between each column Add (horizontal) grid lines Make it clear which currency they are comparing with	E4	E1 for each valid improvement with a maximum of E2 for each graph Ignore any additional but incorrect suggestions Not label the axes Not make lines distinct from each other Not define 'high' or 'low' Not make a bar chart SC1 (two errors identified but no suggestions for improvement) SC2 (three errors identified but no suggestions for improvement) eg. Don't know what 'm' stands for, line not extended to 2045 etc
	Additional Guidance		

Q	Answer	Mark	Comments
1c	**Alternative method 1**		
	14 600 000 000 ÷ 52 or $1.46 \times 10^{10} \div 52$ or 14.6 ÷ 52 or [280 000 000, 281 000 000]	M1	oe
	[280 000 000, 281 000 000] **and** No	A1	oe SC1 14 600 000 000 ÷ 48 = 304million **and** No
	Alternative method 2		
	350 000 000 × 52 or $3.5 \times 10^{8} \times 52$ or [18 000 000 000, 18 300 000 000]	M1	oe
	[18 000 000 000, 18 300 000 000] **and** No	A1	oe SC1 350 000 000 × 48 = 16.8billion **and** No
	Alternative method 3		
	14.6billion ÷ 350million	M1	
	41.7 **weeks and** No or 41.7 **and** 52 **and** No	A1	
	Additional Guidance		
	For use of [48, 52) use SC1 rule		
	Use of 365 ÷ 7 or 365.25 ÷ 7 in place of 52 is correct		
	Allow use of words such as million/billion or standard form rather than full ordinary figures		
	'Exaggeration' implies No		
	For final answer, allow self-correction		

Q	Answer	Mark	Comments
1d	**Tim** **Alternative method 1**		
	(46 500 001 – 33 577 342) ÷ 46 500 001 or 12 922 659 ÷ 46 500 001 or 0.278 or 33 577 342 ÷ 46 500 001 or 0.72	M1	oe Condone interchange of 33 577 342 with 33 551 983 accept [0.26, 0.285] or [27, 28]% accept [0.715, 0.74] or [71.5, 74]%
	0.278 or 27.8(%) **and** No or 72 **and** 80 **and** No	A1	accept [0.27, 0.28] or [27, 28]% accept [71.5, 74]%
	Tim **Alternative method 2**		
	0.2 × 46 500 001 or 9 300 000 **and** 46 500 001 – 33 577 342	M1	accept [9 200 000, 9 400 000] accept [46 000 000, 13 000 000] Condone interchange of 33 577 342 with 33 551 983
	9 300 000 **and** 12 922 659 **and** No	A1	
	Kelly **Alternative method 1**		
	16 141 241 ÷ 12 or 1 345 103 **and** 17 410 742 ÷ 1 345 103 or 12.9(…)	M1	allow reverse order
	12.9(...) **and** Yes or 12.0(…) **and** Yes	A1	
	Kelly **Alternative method 2**		
	16 141 241 ÷ 17 410 742 or [0.925,0.928] or 12 ÷ 13 or 0.923	M1	allow reverse order
	[0.925,0.928] **and** 0.923 **and** Yes	A1	

	Kelly **Alternative method 3**		
	33 551 983 ÷ 25 ×12 or 16 104 951.(84) or 33 551 983 ÷ 25 ×13 or 17 447 031.(16)	M1	Condone interchange of 33 577 342 with 33 551 983
	16 104 951 **and** 17 447 031 **and** Yes	A1	
	Kelly **Alternative method 4**		
	12 ÷ 25 or 0.48 or 13 ÷ 25 or 0.52	M1	oe
	0.48 **and** 0.52 **and** Yes	A1	oe
	Kelly **Alternative method 5**		
	16 141 241 ÷ 12 or 1 345 103 and 17 410 742 ÷ 13 or 1 339 288	M1	
	1 345 103 **and** 1 339 288 **and** Yes	A1	
	Larissa		
	2 000 000 + 16 141 241 or 18 141 241 or 2 000 000 + 33 577 342 or 35 577 342 or 2 000 000 + 33 551 983 or 35 551 983	M1	Condone interchange of 33 577 342 with 33 551 983
	18 141 241 ÷ 35 577 342 (×100)	18 141 241 ÷ 35 551 983 (×100)	M1	oe Condone interchange of 33 577 342 with 33 551 983
	0.509(…) or 0.51 **and** No (from using 35 577 342)	0.5102(…) or 0.5103 **and** Yes (from using 35 551 983)	A1	oe A1 for the correct answer **and** statement SC1 for 54.(...)%
	Additional Guidance		
	Be careful not all possible alternatives are shown for this question.		
	Any fully correct method gains full marks.		
	Condone interchange of 33 577 342 with 33 551 983		

Q	Answer	Mark	Comments
2	**Alternative method 1 – Euros**		
	1.08 ÷ 0.9 or 1.2	M1	
	17 000 × their 1.2 or 20 400	M1	Allow 1.08 or 1.188 or 1.19 in place of 1.2 to obtain 18 360 or 20 196 or 20 230
	253 000 × 1.125 or 284 625	M1	oe
	their 284 625 × 1.08 or 307 395	M1	oe
	their 20 400 + 307 395 or 20 400 + their 307 395 or 327 795	M1	
	327 795 **and** Yes	A1	SC4 for 325 755 or 327 591or 327 625
	Alternative method 2– Pounds		
	1.08 ÷ 0.9 or 1.2	M1	
	17 000 × their 1.2 or 20 400	M1	Allow 1.08 or 1.188 or 1.19 in place of 1.2 to obtain 18 360 or 20 196 or 20 230
	253 000 × 1.125 or 284 625	M1	oe
	their 20 400 ÷ 1.08 or 18 888.(89) or 327 500 ÷ 1.08 or 303 240.(74)	M1	oe
	their 18 888.(89) + 284 625 or 18 888.(89) + their 284 625 or 303 513.(89)	M1	
	303 513.(89) and 303 240.(74) **and** Yes	A1	SC4 for 301 625 or 303 325 or 303 356.(4815)
	Additional Guidance		
	Alternative 2: Method of 17 000 ÷ 0.9 (=18 888.89) scores the 1st M1, 2nd M1 and 4th M1		

Q	Answer	Mark	Comments
3a	150 ÷ 60	M1	
	2.5	A1	

Q	Answer	Mark	Comments
3b	t = 0, 30, 60	B2	B1 for two times correct Maximum of B1 if there are extra times.

Q	Answer	Mark	Comments
3c	Draws tangent	M1	
	Finds gradient of their line	M1	
	Obtains gradient in the range 3.5 to 4.5	A1	

Q	Answer	Mark	Comments
3d	$150 = \frac{1}{8} \times 60^2 - 60^3 k$ Or $75 = \frac{1}{8} \times 30^2 - 30^3 k$	M1	Any correct coordinates from the curve can be used Can use 74 or 76 instead of 75.
	$150 = 450 - 216000k$ or $75 = 112.5 - 27000k$	M1	Follow through their coordinates.
	$k = \frac{1}{720}$ or 0.00138 or 0.00139 or 1.38×10^{-3} $1.38\dot{} \times 10^{-3}$ or 1.39×10^{-3}	A1	Note that 74 gives 0.001425 And that 76 gives0.00135 Accept AWRT 0.0014

Q	Answer	Mark	Comments
4a	(4910 – 2495) and (123.2 – 72.4)	M1	
	2415 ÷ 50.8 = 47.539… 47.54	A1	Answer Given

Q	Answer	Mark	Comments
4b	**Alternative 1**		
	Draws a straight line through y = 47.54 **and** attempts to read x values at 4 intersection points or finds total time between intersections.	M1	
	$\frac{(99.5 - 95.5) + (108.5 - 101)}{(123.2 - 72.4)} \times 100$	M1	Award mark if candidate correctly uses their time values in the numerator.
	$\frac{4 + 7.5}{50.8} \times 100$ 22.6(37795)% so No extra points	A1	Numerator in the range 10.5 to 12.5. FT their values Note: 10.5 gives 20.7% 11 gives 21.7% 11.5 gives 22.6% 12 gives 23.6% 12.5 gives 24.6%
	Alternative 2		
	Draws a straight line through y = 47.54 **and** attempts to read x values at 4 intersection points or finds total time between intersections.	M1	
	(132.2 – 72.4)×0.25 = 12.7	M1	Condone using 72 and 123.
		A1	FT their values

	$(99.5 - 95.5) + (108.5 - 101) = 11.5$ 11.5 < 12.7 so No extra points		Time from graph in the range 10.5 to 12.5

Q	Answer	Mark	Comments
4c	5	B1	There are 3 maximum points and 2 minimum points on the graph
	Zero gradient or turning or stationary points	B1	If candidate gives 3 as an answer (looks at the maximum points only) but gives the correct reason award B0 B1

Q	Answer	Mark	Comments
5a	Before T hours, the rate (gradient) is variable	B1	Allow changes (variable);
	After T hours the rate is constant	B1	Stays the same (constant) Allow a specific value for the gradient eg -0.381.

Q	Answer	Mark	Comments
5b	**Alternative Method 1**		
	States or uses m = - 0.39	B1	Allow ± 0.39
	Uses (19.2, 0) and "their m" to find c 0 = (-0.39 x 19.2) + c	M1	SC1 Award for seeing 7.488 at any stage in their working.
	c = 7.5	A1	from c = 7.488
	Uses h = 5 and "their m" to find T 5 = ("their m" x T) + "their c"	M1	SC1 Award for seeing 12.82 at any stage in their working.
	T = 6.4	A1	from T = 6.379…
	Alternative Method 2		
	States or uses m = - 0.39	B1	Allow ± 0.39
	Uses (19.2, 0) to get 0 = (19.2 x "m") + c and (T, 5) to get 5 = (T x "m") + c	M1	
	5 = (T x "m") – 19.2 x "m"	M1	Or equivalent for their values
	T = 6.4 and c = 7.5	A2	

Q	Answer	Mark	Comments
5c	**Alternative Method 1**		
	Uses 0.39	B1	
	0.39 × 4.8 = 1.872	M1	
	11 + 1.872 = 12.872	A1	AWRT 12.9 or 12.8
	Alternative Method 2		
	Uses same gradient to find new linear function h_2 = - 0.39t + c_2	B1	
	Uses (24, 0) to find c_2 = 9.36 and subtracts "their c_1" from "their c_2"	M1	
	New height = 11 + 1.87 = 12.87	A1	AWRT 12.9 or 12.8
	Alternative Method 3		
	Draws triangle joining (6.38, 0), (6.38, h) and (24, 0)	B1	May be implied by calculations. Allow use of 6.4
	$\frac{h}{24-6.38} = 0.39$ $h = 17.62 \times 0.39 = 6.872$	M1	
	New height = 6 + 6.872 = 12.87	A1	AWRT 12.9 or 12.8

Q	Answer	Mark	Comments
6a	8103	B1	Accept 8100

Q	Answer	Mark	Comments
6b	$3000 = e^{0.6t}$	M1	
	$t = \frac{1}{0.6}\ln 3000$	A1	May be implied by final answer.
	13.34 Or 13hours and 20 or 21 minutes	A1	ARWT 13.3

Q	Answer	Mark	Comments
6c	Table completed correctly	M1	(0,1) (1,1.822) (2, 3.320) (3, 6.050) (4, 11.023) (5, 20.085) Allow 1 error.
	Accurate curve based on their points	A1	
	Uses a tangent to find gradient	M1	
	Gradient in the range 3.2 to 3.8	A1	

Q	Answer	Mark	Comments
6d	**Alternative 1**		
	Seeing $e^{0.6(t+T)}$	M1	
	Seeing $2e^{0.6t}$	M1	
	$2e^{0.6t} = e^{0.6(t+T)}$	A1	
	$2 = e^{0.6T}$	M1	
	$T = \frac{1}{0.6}\ln 2 = 1.16$ hours	A1	AWRT 1.2
	Alternative 2 (Example)		
	$100 = e^{0.6t_1}$	M1	Uses a specific value for *N*
	$200 = e^{0.6t_2}$	M1	Uses twice their specific value
	$t_1 = \frac{\ln 100}{0.6}$=7.675 and $t_2 = \frac{\ln 200}{0.6}$=8.8305	A1	
	$t_2 - t_1$	M1	
	$= 1.16$	A1	AWRT 1.2