AQA

Level 3 Certificate
MATHEMATICAL STUDIES
1350/2C

Paper 2C Graphical Techniques

Mark scheme

June 2021

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Q	Answer	Mark	Comments
1 (a)	1 : 3	B1	

Q	Answer	Mark	Comments
1 (b)	**Statement 1**		
	5810 + 6900 + 7640 or 20 350	M1	
	their 20 350 × 27 000 or 549 450 000 or 500 000 000 ÷ 27 000 or 18 518(…) or 500 000 000 ÷ their 20 350 or 24 570(…)	M1dep	
	549 450 000 **and** Yes or 18 518(…) **and** 23 500 **and** Yes or 24 570(…) **and** Yes	A1	SC2 543 240 000 **and** Yes SC1 543 240 000
	Statement 2		
	Alternative method 1		
	2615 ÷ 5810 (× 100) or 0.45(0…) (× 100) or 45(.0…)% and 5450 ÷ 7640 (× 100) or 0.71(3…) (× 100) or 71.(3…)%	M1	
	their 0.45 × 1.5 or 0.675 or their 45 × 1.5 or 67.5 or their 0.71 ÷ their 0.45 or 1.57… or their 71 ÷ their 45 or 1.58	M1dep	oe
	Yes **and** 1.57 … or 1.58 or Yes **and** 0.71 **and** 0.675 or Yes **and** 71 **and** 67.5	A1	

1 (b) cont'd	**Alternative method 2**		
	5810 ÷ 2615 (× 100) or 2.22(1…) (× 100) or 222(.1…)% and 7640 ÷ 5450 (× 100) or 1.40(1…) (× 100) or 140(.1…)%	M1	
	their 2.22 ÷ 1.5 or 1.48 or their 222 ÷ 150 or 1.48 or their 2.22 ÷ their 1.40 or 1.58… or their 222 ÷ their 140 or 1.58… or 1.59	M1dep	oe
	Yes **and** 1.58 or 1.59 or Yes **and** 1.40 **and** 1.48 or Yes **and** 140 **and** 148	A1	
	Additional Guidance		
	Statement 2 award the first M1 seen even if not subsequently used		

Q	Answer	Mark	Comments
2(a)	Add extra value(s) to the scale (eg every 10% to Chart 1 or add 1.0 to Chart 2) Move the million tonnes label from the title to the vertical axis Label the axes Show actual numbers on the charts Use a grid so values can be read more accurately Explain what 'EU28' on Chart 1 stands for Move the/Add a y-axis on the left-hand side of the graph	E2	E1 for each valid improvement with up to a maximum of E2 ignore any additional but incorrect suggestions SC1 two errors identified but no suggestions for improvement
	Additional Guidance		

Q	Answer	Mark	Comments
2(b)	No key for abbreviation WWF/EU Years used for comparison vary each time Some data were not shown/missing (eg other exports to countries) The article is inconsistent with mixed % and numbers/figures The latest estimates available are several years before the publication of the briefing paper and so may be out of date / no longer representative The different streams make it difficult to understand the full picture, especially across the official and WWF figures The term 'waste stream' is undefined Sweden and the Netherlands are not larger than the UK in terms of population Netherlands isn't larger than the UK in terms of area They do not list all the different types of treatment (it just says etc)	E3	oe E1 for each valid reason
	Additional Guidance		
	Suggested improvements can imply the reason		
	Too many percentages and/or figures scores E0		

Q	Answer	Mark	Comments
2 (c)	**Ecofriends**		
	Alternative method 1		
	$122\,400 - 53\,400$ or $69\,000$	M1	
	their $69\,000 \div 122\,400 \times 100$ (%) or $56.(3\ldots)$ or 56.4	M1dep	
	$56.(3\ldots)$ or 56.4 (%) **and** No/false/incorrect/invalid	A1	condone $-56.(3\ldots)$ or -56.4 (%)
	Alternative method 2		
	$53\,400 \div 122\,400$ or $0.43(\ldots)$ or 0.44	M1	
	$(1 - \text{their } 0.43(\ldots)) \times 100$ (%) or $56.(3\ldots)$ or 56.4	M1dep	
	$56.(3\ldots)$ or 56.4 (%) **and** No/false/incorrect/invalid	A1	condone $-56.(3\ldots)$ or -56.4 (%)
	Alternative method 3		
	$122\,400 \times 0.6$ or $73\,440$	M1	oe
	$122\,400 - \text{their } 73\,440$ or $48\,960$	M1dep	
	$48\,960$ **and** No/false/incorrect/invalid	A1	
	Alternative method 4		
	$100(\%) - 60(\%)$ or $40(\%)$ or 0.4 seen	M1	oe
	$122\,400 \times \text{their } 0.4$ or $48\,960$	M1dep	
	$48\,960$ and $53\,400$ **and** No/false/incorrect/invalid	A1	

Q	Answer	Mark	Comments
2 (c) cont'd	**Greenusers**		
	Alternative method 1		
	1.53 ÷ 1.24 or 1.23(…)	M1	oe eg working in tonnes
	1.53 − their 1.23(…)	M1dep	
	0.3 or 0.296(…) (million tonnes) or 296 129 **and** Yes/true/correct/valid	A1	
	Alternative method 2		
	(1.53 − 0.3) × 1.24 or 1.52(5…)	M2	oe eg working in tonnes
	1.52(5…) **and** Yes/true/correct/valid	A1	
	Alternative method 3		
	1.53 ÷ (1.53 − 0.3) or 1.243(9….)	M2	oe eg working in tonnes
	24.3(9…) or 24.4 **and** Yes/true/correct/valid	A1	

Q	Answer	Mark	Comments
2 (d)	No units on y-axis One of the bars is incorrect (Malaysia) No title for the graph Not showing all other countries to make up to 100% The y-axis says 'Amount' rather than 'Percentage' All bars are wrong because the vertical axis states amount	E2	E1 for each valid error identification of errors may be implied by suggestions for improvement
	Additional Guidance		
	Allow two errors in one answer space Ignore incorrect statement if non-contradictory		

Q	Answer	Mark	Comments
3(a)	$\frac{10}{60}$ or $\frac{20}{120}$ (days)	B2	oe implied by correct answer B1 [9, 11] seen or [18, 22] (days) seen
	[15, 19]	B1	

Q	Answer	Mark	Comments
3(b)	cubic	B1	

Q	Answer	Mark	Comments
3(c)	9 November	B1	oe
	[4.30 am, 7.30 am]	B1	oe
	Additional Guidance		
	Answer 6.00 or 6 o'clock or 6.00 pm		B0

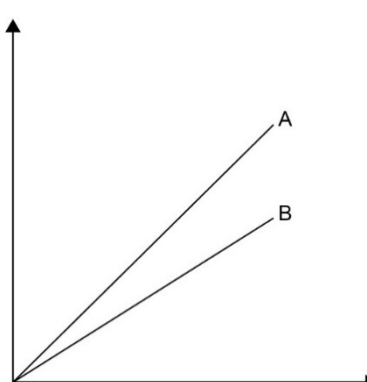| Q	Answer	Mark	Comments
3(d)(i)	$\dfrac{\text{difference in } y}{\text{difference in } x}$ for any 2 points on the given line	M1	$\pm \frac{1}{2}$ square
	$A = [–0.012, –0.009]$	A1	accept any fraction with a decimal value in the given range eg $-\frac{1}{96}$
	$B = [6.7, 6.9]$	B1	

Q	Answer	Mark	Comments
3(d)(ii)	$3.18 =$ their $A \times t +$ their B	M1	oe equation ft their A and B from **3 (d) (i)**
	their $t \div 24$ or 15(.08...) days seen	M1	
	24 November (2019) with M1M1 awarded	A1ft	ft their A and B from **3 (d) (i)**
	Additional Guidance		
	Method using an extension of the graph		M0A0

Q	Answer	Mark	Comments
4(a)	692.5 or 693	B1	

Q	Answer	Mark	Comments
4(b)	Speed must be lower (than 693 km/h)	B1ft	ft their answer to **4(a)** if their **4(a)** > 900 accept 'more than'

Q	Answer	Mark	Comments
4(c)(i)	Both graphs start at the origin and stop at the same time value and lift-off speed A > lift-off speed B and both graphs are linear and labelling that clearly identifies plane A and plane B	B2	B1 both graphs start at the origin and stop at the same time value, are labelled, but are not linear or B1 fully correct but unlabelled

Additional Guidance

Ignore any third line for plane C shown, may be used for answering **4(c)(ii)**

Q	Answer	Mark	Comments
4(c)(ii)	Time for plane C is longer (than plane A or B)	E1	oe

Q	Answer	Mark	Comments
5(a)(i)	Condition: large values of t and Reason: number of views would exceed population or Condition: large values of t and Reason: rate of views would stop growing after a period of time or Condition: small values of t and Reason: model predicts no more than one view (until $t > 5.75$)	E2	oe E1 valid reason with no condition if t has been quantified accept $t > 150$ as 'large' accept $t < 6$ as 'small'

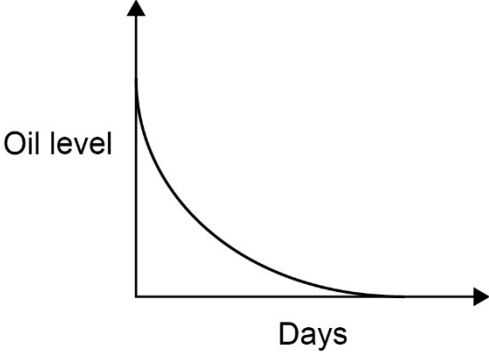| Additional Guidance	
Condition without reason	E0
Reason: model predicts non-integer values	E0
Large values of t and post will no longer attract interest	E2
Post will no longer attract interest	E1

Q	Answer	Mark	Comments
5(a)(ii)	$1\,000\,000 = e^{0.12t}$	M1	oe substitution
	$0.12t = \ln(1\,000\,000)$	M1	oe
	$t = 115.12(\dots)$ or 115.13 or 116	A1	

Additional Guidance	
Correct answer by trial and improvement	M1M1A1

Q	Answer	Mark	Comments
5(b)	1278 seen as rate of change of views for linear equation	B1	implied by correct answer
	$1278 = 0.001e^m$	M1	oe equation
	$\ln(1278 \div 0.001)$	M1	oe
	14(.06…)	A1	
	Additional Guidance		
	$1278m = 0.001e^m$ oe		B0M0A0

Q	Answer	Mark	Comments
6(a)	28	B2	may be indicated on graph B1 indicates correct section of graph using y-values [82,86] , [54,58] or answer [24,32]

Q	Answer	Mark	Comments
6b(i)	Coordinates correctly plotted (0, 100), (1, 99.5), (2, 98.9), (3, 98.1), (4, 97.1), (5, 95.9), (6, 94.4), (7, 92.5)	B1	$\pm$ ½ square
	joined with a smooth curve	B1	

Q	Answer	Mark	Comments
6(b)(ii)	Tangent seen at day 4	M1	may be in the form of a triangle must not pass through the curve
	$\dfrac{\text{difference in } y}{\text{difference in } x}$ for any 2 points on their tangent or [0.8, 1.2]	M1dep	
	[0.8, 1.2] cm/day	A1	oe A0 for no units equivalents: [5.6, 8.4] cm/week [0.008, 0.012] m/day [0.056, 0.084] m/week

Additional Guidance			
Actual gradient $= -1.04$ based on the polynomial $y = -0.08x^2 - 0.4x + 100$			
[–0.8, –1.2] cm/day oe			M1M1A0

Q	Answer	Mark	Comments
6(b)(iii)	Decreasing concave curve 	B1	does not have to reach x-axis does not have to flatten to zero gradient
	Additional Guidance		
	Curve starts to increase		B0

Q	Answer	Mark	Comments
7(a)	Graph shows decay or the concentration is reducing	E1	oe condone "Graph goes down" condone "Graph is decreasing"

Q	Answer	Mark	Comments
7(b)	$A = 100$	B1	may be seen or implied at any stage when using the equation
	$\dfrac{C}{A} = e^{kt}$	M1	may be implied with substitution of numbers with their A used
	$kt = \ln\dfrac{C}{A}$ or $k = \dfrac{\ln\frac{C}{A}}{t}$	M1	oe award any correct application of ln
	Substitutes the coordinates of any point on the curve into their equation, correctly for variables C and t	M1dep	correct substitution may have taken place at any stage
	$k = [-0.03, -0.05]$	A1ft	ft their A
	Additional Guidance		
	Likely t and C values used for substitution (10, 67), (20, 45), (30, 30), (40, 20), (50, 14)		
	For off-specification derivation $k = \dfrac{\ln C - \ln A}{t}$ treat this as an equivalency		M1M1