



Level 3 Certificate
MATHEMATICAL STUDIES
1350/1

Paper 1

Mark scheme

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Q	Answer	Mark	Comments	
1(a)	Amount of time → quantitative and continuous (box 1 on left to box 4 on right)	B1		
	Make → qualitative and discrete (box 2 on left to box 1 on right)	B1		
	Number of people → quantitative and discrete (box 3 on left to box 3 on right)	B1		
	Additional Guidance			
	Additional Guidance			
Two lines from one box on the left is choice				

Q	Answer	Mark	Comments	
1(b)	$\left(\frac{129}{345 + 406 + 129 + 162 + 56 + 42}\right) \times 80$ or $\frac{129}{1140} \times 80$ or $0.113... \times 80$ or $129 \times 0.07(0..)$ or $[9.03, 9.1]$	M1	oe eg $\frac{43}{380} \times 80$ or $129 \div (1140 \div 80)$	
	9 with no incorrect method or total seen		A1	
	Additional Guidance			
	$1140 \div 129 = 8.8(\dots)$ so 9			M0A0
	Addition not shown and not totalling 1140			M0
	Use of 0.11 leading to 8.8 which rounds to 9			M1A0
	Rounding to 9 from a value not in the range [9.03, 9.1] can gain max M1			
$129 \div 1140 = 0.11 \times 80$ ans 9 No incorrect value seen from range so assume full value used			M1A1	

Q	Answer	Mark	Comments
2(a)	Both correct values completed March 148 585.76 or 148 585.77 April 148 111.51 or 148 111.52 or 148 111.53	B2	B1 for one correct or B1ft April correct ft from their March value with answer rounded or truncated to 2dp
	Additional Guidance		
	For the ft for April it must be their March value $\times 1.003 - 920$ oe		
	Spreadsheet values take precedence. If the spreadsheet has not been completed mark the values in the working lines if clear which month they are.		

Q	Answer	Mark	Comments
2(b)	Alternative method 1		
	920 × 6 or 5520 or 150 000 – 147 158.77 or 2841.23	M1	
	920 × 6 – (150 000 – 147 158.77) or 147 158.77 – (150 000 – 920 × 6)	M1dep	oe
	2678.77	A1	
	Alternative method 2		
	At least 4 from 150 000 × 0.003 or 450 and 149 530 × 0.003 or 448.59 and 149 058.59 × 0.003 or [447.17, 447.18] and their 148 585.77 × 0.003 or [445.75, 445.76] and their 148 111.52 × 0.003 or [444.33, 444.34] and 147 635.86 × 0.003 or [442.90, 442.91]	M1	ft their March and April balances from part 2(a)
	their 450 + their 448.59 + their [447.17, 447.18] + their [445.75, 445.76] + their [444.33, 444.34] + their [442.90, 442.91]	M1dep	must be 6 months
	[2678.74, 2678.78]	A1	
	Additional Guidance		
	In Alt 2 use of more than 6 months can score the first M1 only		

Q	Answer	Mark	Comments
2(c)	$=B8/B2*100$	B1	

Q	Answer	Mark	Comments
3(a)	Lowest 5 and highest 30	B1	
	Lower quartile 13 and upper quartile 28	B1	
	Median 22	B1	
	Additional Guidance		
	In order the five values are 5, 13, 22, 28, 30		

Q	Answer	Mark	Comments	
3(b)	Both fully completed box and whisker plots drawn accurately with at least one labelled	B3ft	$\pm\frac{1}{2}sq$ ft all their values for the Mathematics marks B2 one fully completed box and whisker plot drawn accurately and labelled or both diagrams correct but no labels B1 one box and whisker plot fully correct with no labels or both boxes (median and quartiles box) correctly drawn (no label needed)	
			Additional Guidance	
			Ignore whiskers extended into box Whiskers do not need end lines Any height of box is allowed If boxes overlap mark to scheme if clear which is which	

Q	Answer	Mark	Comments
	<p>On average the Maths results were better than the English results as their median is higher/better</p> <p>or</p> <p>The higher Maths median shows students performed better in Maths than they did in English</p>	B1ft	<p>oe</p> <p>ft their median for Maths</p> <p>must be in context</p> <p>must not mention IQR</p>
Additional Guidance			
Must refer to either marks/scores/grades or results/performance			
3(c)	The Maths median is higher	B0	
	Maths results were better as their median and upper quartile were higher	B1	
	On average Maths marks were higher than English	B1	
	In Maths the average score/mark was 3 more than the English exam	B1	
	As the English median is lower the average is lower	B0	
	The maths results were better as the median and IQR are higher (mark as choice)	B0	
	Means cannot be compared so any reference to means does not score	B0	

Q	Answer	Mark	Comments
3(d)	English and valid comment about IQR eg English as their IQR was 9 but Maths IQR was 15 or English as the box width is narrower or English as the upper and lower quartiles are closer together	B1ft	oe ft their Maths LQ and UQ
	Additional Guidance		
	Ignore reference to range but do not condone reference to other statistical measures eg English is more consistent as the median and IQR are smaller	B0	
	Ranges were the same so they were both equally consistent	B0	
	Although the ranges were the same the English marks were more consistent as their IQR is 9 and Maths is 15	B1	
	No values given just English (was more consistent) as the interquartile range was smaller	B1	
	Allow use of word average where it is not referring to the median eg English was more consistent on average as the IQR is smaller	B1	

Q	Answer	Mark	Comments	
4(a)	$318.5(0) \leq I \leq 319.49$	B2	B1 318.5(0) or 319.49 in correct position or B1 $2318.5(0) \leq I \leq 2319.49$ SC1 $319.49 \leq I \leq 318.5(0)$	
	Additional Guidance			
	SC1 is for misunderstanding the inequality sign (taking it as greater than or equal to)			

Q	Answer	Mark	Comments
4(b)	1.024 or 1.031	M1	may be implied
	1.024^2 and 1.031^5	M1dep	may be implied
	$1.024^2 \times 1.031^5$ or [1.22, 1.222] or any amount $\times 1.024^2 \times 1.031^5$	M1	oe eg (£)100 $\times 1.024^2 \times 1.031^5 = 122.(1\dots)$ oe eg year on year calculations [1.22, 1.222] scores M3
	[22, 22.2] (%)	A1	
	Additional Guidance		
	Calculations worked out separately must be to at least 3dp eg $1.024^2 = 1.049$, $1.031^5 = 1.165$ (both have been rounded to 3dp) $1.049 \times 1.165 = 1.222$ so 22.2%		M1M1M1A1
	Year on year can imply M3 eg uses a starting amount Yr 1 2.4% calculated and added on Yr 2 works out 2.4 % of new total and adds , Yr 3 works out 3.1% of end of Yr 2 total and adds on etc for years 4,5,6 and 7 years with 3.1% compounded each year Correct method scores M3 even with arithmetical error(s)		

Q	Answer	Mark	Comments
5	Alternative method 1		
	Makes an assumption about number of loads of washing per week/month	B1	allow 3 to 7 per week allow 12 to 30 per month
	Makes an assumption about the number of hours one cycle takes	B1	allow 1 to 3 hours may be a decimal
	Their number of loads per week \times their hours per load \times weeks in a year or Their number of loads per month \times their hours per load \times months in a year	M1	allow 48 to 52 for weeks in a year allow 11 or 12 months
	Accurate answer for their calculation	A1	allow decimal answers
	Alternative method 2		
	Makes an assumption about number of hours per week or month a washing machine is on for an average household	B2	allow 3 to 21 per week or 12 to 90 per month or B1 makes an assumption about number of days a week or month washing machine is on for an average household allow 3 to 7 per week allow 12 to 30 per month or makes an assumption about number of hours a day washing machine is on allow 1 to 3 hours
	Their days per week \times hours per day \times weeks in a year or their days per month \times hours per month \times in a year or their days per year \times hours per day	M1	allow 48 to 52 for weeks in a year allow 336 to 365 days per year
	Accurate answer for their calculation	A1	allow decimal answers

Additional Guidance		
5 cont'd	<p>For the final 2 marks they may use numbers outside the allowed ranges for the assumptions</p> <p>Example $14 \times 4 \times 52 = 2912$</p>	B0B0M1A1

Q	Answer	Mark	Comments
6	Alternative method 1-calculating tax and NI annually		
	$49\,000 \times 0.92$ or $49\,000 - (49\,000 \times 0.08)$ or 45 080	M1	oe only award if used for at least one of tax or NI
	$(\text{their } 45\,080 - 12\,570) \times 0.2$ or $32\,510 \times 0.2$ or 6502	M1	oe standard rate of tax per year their 45 080 can be 49 000 6502 is M2
	$(\text{their } 45\,080 - 9\,568) \times 0.12$ or $35\,512 \times 0.12$ or 4261.44	M1	oe allow 9568.01 basic rate of NI per year their 45 080 can be 49 000
	their 6502 + their 4261.44 or 10 763.44	M1	total tax and NI per year may be implied 10 763.44 scores M4
	their 45 080 – their 10 763.44	M1	their 45 080 can be 49 000 but must be their gross salary with or without their pension deducted ignore subtraction of their pension here if 49 000 used as their 45 080
	34 316.56 or 34 316.57	A1	annual net pay
	$(\text{their } 34\,316.56 \div 12) \times \frac{2}{5}$ or 1143.(..) or $(1050 \times 12) \div \text{their } 34\,316.56$ or 0.36(7...) or 0.37	M1	oe oe percentage
	1143.(..) and Yes or 0.36(7...) and 0.4 and Yes or	A1ft	ft their annual net pay oe percentages or fractions with the same denominator

6 cont'd	0.37 and 0.4 and Yes		
	Alternative method 2 – calculating tax and NI monthly		
	49 000 × 0.92 or 49 000 – (49 000 × 0.08) or 45 080 (÷ 12) or 3756.66 or 3756.67	M1	oe only award if used for at least one of tax or NI
	(their 45 080 – 12 570) × 0.2 (÷ 12) or 6502 (÷ 12) or 541.83	M1	oe eg $(\text{their } 3756.66 - \frac{12570}{12}) \times 0.2$ standard rate of tax per year or per month their 45 080 can be 49 000 their 3756.6(..) can be 4083.33(..)
	$\frac{\text{their } 45080}{12} - 797) \times 0.12$ or (their 3756.6(..) – 797) × 0.12 or 355.16	M1	oe basic rate of NI their 45 080 can be 49 000 their 3756.6(..) can be 4083.33(..)
	(their 6502 ÷ 12) + their 355.16 or their 541.83 + their 355.16 or 896.99 or their 6502 + (their 355.16 × 12) or 10 763.92	M1	may be implied total tax and NI per month total tax and NI per year
	$\frac{\text{their } 45080}{12} - \text{their } 896.99$ or their 3756.6(...) – their 896.99 or their 45 080 – their 10 763.92	M1	their 45 080 can be 49 000 but must be their gross salary with or without their pension deducted their 3756.6(..) can be 4083.33(..) ignore subtraction of their pension here if 49 000 used as their 45 080 or 4803.33(..) used as their 3756.6(...)

6 cont'd	2859.67 or 2859.68 or 34316.08	A1	monthly net pay annual net pay
	their $2859.67 \times \frac{2}{5}$ or (their $34316.08 \div 12$) $\times \frac{2}{5}$ or 1143.(...) or $1050 \div \text{their } 2859.67 (\times 100)$ or 0.36(7...) or 0.37	M1	oe percentage
	1143.(...) and Yes or 0.36(...) and 0.4 and Yes	A1ft	ft their monthly or annual net pay allow 0.37 oe percentages or fractions with the same denominator

Additional Guidance is on the next page

Additional Guidance		
6 cont'd	<p>Note that calculating monthly gives a slightly different net pay per year due to government rounding of monthly figures</p> <p>The final answer is the same for monthly or annual calculations</p>	
	<p>If tax is calculated annually but NI monthly then award the first 3 marks for the correct method for their time frame</p> <p>eg monthly tax = 541.83 and annual NI = 4261.44 gains M1M1 on Alt 2 for tax and the 3rd M1 on Alt 1 for NI. For the 4th mark the values must be for a consistent time period</p>	
	<p>If the 8% deduction for pension is not deducted then a maximum 6 marks can be scored on either Alt method</p> <p>eg following Alt 1 annually</p> $(49\,000 - 12\,570) \times 0.2 = 7286$ $(49\,000 - 9568) \times 0.12 = 4731.84$ $49\,000 - (7286 + 4731.84) = 36982.16$ $(36\,982.16 \div 12) \times \frac{2}{5}$ <p>1232.74 and yes</p>	<p>M0M1</p> <p>M1</p> <p>M1M1A0</p> <p>M1</p> <p>A1ft</p>
	<p>If the 8% deduction is seen (eg 45080) but then not used at all withhold the first mark</p>	

Q	Answer	Mark	Comments	
7(a)	$[(140 \times 12) + (180 \times 23) + (220 \times 45) + (260 \times 32) + (300 \times 18)] \div 130$ or $(1680 + 4140 + 9900 + 8320 + 5400) \div 130$ or $29440 \div 130$	M1	condone one incorrect midpoint or total	
	226.(46...) or 226.5	A1		
	$\frac{\text{their } 226.46... - 193}{193} \times 100 \text{ or } 0.17...$ or $193 \times 1.15 \text{ or } 221.95 \text{ or } 222$ or $193 \times 0.15 \text{ and their } 226.46 - 193$ or 28.(95) and 33.(46)	M1	accept 29 for 28.(95)	
	17% and Yes or 226.(...) and 221.95 and Yes or 28.(95) and 33.(46) and Yes	A1ft	ft their mean accept 222 for 221.95 accept 29 for 28.(95)	
	Additional Guidance			
	Although question says You must show your working a correct mean without working – presume from calculator stats functions	M1A1		
	Yes may be implied eg the advert is justified			
	Attempt at median cannot gain the first 2 marks but may be awarded the M1A1ft			
	If their mean is less than 193 then they can state No it has decreased for the 2nd M1A1 Any percentage calculation used must however be correct			

Q	Answer	Mark	Comments
7(b)	Alternative method 1		
	$\frac{3}{10} \times 40 \times 1.25$ or 15 or 20×1.7 or 34 or 40×0.8 or 32	M1	oe may be seen on histogram
	$\frac{3}{10} \times 40 \times 1.25$ or 15 and 20×1.7 or 34 and 40×0.8 or 32	M1	may be seen on histogram
	their 15 + their 34 + their 32	M1dep	dep on 1 st M1 must only add the three relevant values
	81	A1	
	Alternative method 2		
	1 cm ² = 5 potatoes	M1	oe eg 1 line of 5 small squares = 1 potato seen or implied
	3 + 6.8 + 6.4 or 16.2	M1	oe must only add the three relevant values
	their 16.2 × 5	M1dep	dep on 1st M1
	81	A1	
	Additional Guidance		
	Values on the histogram may imply method marks eg 188-200 has 3's in each part square (would give 3 × 5 or 15) or 200-220 bar has 5 written in each full sq cm and 4 in the extra part at the top or 220-260 bar has 5's in each full sq cm and 1's in the two top bits		M1 for one correct, M2 for all 3 correct
	Ignore calculation of percentage that are medium once 81 is seen		

Q	Answer	Mark	Comments
8(a)	[145, 155]	B1	reading from graph may be implied
	their $[145, 155] \div 100 \times 1.9(0)$ or $[1.45, 1.55] \times 1.9(0)$ or $[0.45, 0.55] \times 1.9(0) + 1.9(0)$	M1	oe
	[2.75, 2.95]	A1ft	ft their reading rounded or truncated to nearest penny
	Additional Guidance		
	Reading of 150 gives answer of 2.85		

Q	Answer	Mark	Comments
8(b)	$129 \div [290, 300] \times [190, 200]$ or $129 \div [2.9, 3] \times [1.9, 2.0]$ or $[0.43, 0.445] \times [190, 200]$	M1	oe implies reading of [290, 300]
	[81.7, 89] with correct readings seen	A1	readings may be on the graph
	Additional Guidance		
	129 ÷ [290, 300] may be seen as a decimal		

Q	Answer	Mark	Comments
9(a)	Alternative method 1		
	Makes an assumption about number of hours factory is open per day or number of hours production per day eg 12 – 1.5 or 10.5	B1	8 to 18 or production hours 5 to 17
	Makes an assumption about number of sweets produced per minute eg 14 500	B1	must be [12 000, 16 000] implied by being used in a calculation
	Volume of sweet $\frac{4}{3} \times \pi \times 0.8^3$ or [2.1, 2.15] or [0.68,0.63] π	M1	only allow rounding to 2 if method seen
	Volume of cylindrical tube $\pi \times 2^2 \times 10$ or [125,126] or 40π	M1	
	Assumption of waste space deducted	B1	allow 20% to 60% wasted space may be implied
	Divides their tube volume by their sweet volume with deduction for wastage eg waste stated as 40% $125.7 \div 2.14 \times 0.6$ or 35 eg $125.7 \div 2.14 = 58$ sweets with wastage say 40 sweets	M1	number of sweets per tube deduction of wastage may be applied to volume of the cylinder first wastage may be a number of sweets deducted. If this fits the percentage range then award the previous B1
	their production hours \times 60 \times their number of sweets per minute eg $10.5 \times 60 \times 14\,500 = 9\,135\,000$ or their number of sweets per minute \div their number of sweets per tube eg $14\,500 \div 35 = 414$	M1	calculates number of sweets per day production hours = factory hours – [1,3] follow their assumption for number of hours open allow max production hours of 23 or calculates number of tubes per minute number of sweets per tube must be an integer

9a cont'd	their sweets per day \div their sweets per tube eg $9\,135\,000 \div 35$ or their tubes per minute \times their production hours $\times 60$ eg $414 \times 10.5 \times 60$	M1	number of sweets per tube must be an integer production hours = factory hours – [1,3] follow their assumption for number of hours open allow max production hours of 23
	Correct total for their assumptions and integer number of sweets in a tube eg 261 000	A1ft	ft their assumptions and volumes with final two method marks scored answer cannot be a decimal it may be rounded suitably eg to nearest 10, 100, or 1000

Mark scheme and Additional Guidance continue on the following pages

9(a) cont'd	Alternative method 2		
	Makes an assumption about number of hours factory is open per day or number of hours production per day eg 12 – 1.5 or 10.5	B1	8 to 18 or production hours 5 to 17
	Makes an assumption about number of sweets produced per minute eg 14 500	B1	must be [12 000, 16 000] implied by being used in a calculation
	Makes an assumption about number of sweets per layer in tube	B1	allow only 3, 4 or 5
	Minimum layers of sweets $10 \div 1.6$ or 6.25	M1	
	Rounds up their 6.25 to 7 to assume overlapping layers or rounds down to 6 complete layers	M1dep	dep on previous M1
	their sweets per layer \times their layers per tube eg 4×8 or 32	M1	number of sweets per tube any values allowed
	their production hours \times 60 \times their number of sweets per minute eg $10.5 \times 60 \times 14\,500 = 9\,135\,000$ or their number of sweets per minute \div their number of sweets per tube eg $14\,500 \div 32 = 453$	M1	calculates number of sweets per day production hours = factory hours – [1,3] follow their assumption for number of hours open allow max production hours of 23 or calculates number of tubes per minute number of sweets per tube must be an integer
their sweets per day \div their sweets per tube eg $9\,135\,000 \div 32$ or	M1	number of sweets per tube must be an integer production hours = factory hours – [1,3]	

	<p>their tubes per minute \times their production hours \times 60 eg $453 \times 10.5 \times 60$</p>		<p>follow their assumption for number of hours open allow max production hours of 23</p>
	<p>Correct total for their assumptions and integer number of sweets in a tube eg 285 470</p>	A1ft	<p>ft their assumptions and volumes with final two method marks scored answer cannot be a decimal it may be rounded suitably eg to nearest 10, 100, or 1000</p>

Additional Guidance is on the next page

Additional Guidance	
9a cont'd	<p>Note that not all the method marks have to be awarded for the A1 to be awarded but the final two method marks must be awarded</p> <p>eg an incorrect volume will lose the method mark but the A1ft may still be awarded for a correct total using their volume</p>
	<p>Allow 1 to 3 hours for the time before production starts</p>
	<p>Working out the number of sweets per day using their production hours but then adding back on a number of sweets for the hours before production starts loses the mark for their production hours $\times 60 \times$ their number of sweets per minute (7th or 8th mark depending on their approach order).</p> <p>eg states factory open 12 hours a day. Does $12 - 1.5 = 10.5$ hours production</p> <p>Then $10.5 \times 60 \times 14\,000 = 8\,820\,000$ (normally awarded M1)</p> <p>$8\,820\,000 + 21\,000 = 8\,841\,000$ sweets for 12 hours (the M1 is now not awarded/is retracted)</p>
	<p>If their answer to volume \div volume is a decimal, then rounding that value up or down to an integer is not to be counted as wastage</p> <p>eg $125.66 \div 2.114 = 58.7$ so 58 sweets. This is not to be counted as wastage.</p>
	<p>If wastage is counted as a number of sweets allow rounding to integer even if this takes their answer out of tolerance</p> <p>eg calculates 58 sweets for full volume uses 60% wastage = 34.8 allow 35 or 34 subtracted for wastage</p>
	<p>Wastage can be considered by reducing the volume of the cylinder or increasing the volume of the sweet</p> <p>eg sweet volume = 2.14, makes it 3 to account for wastage/space around oe</p> <p>This would be awarded the B1 for wastage as the increase is within the wastage tolerance</p>
	<p>Those who multiply the number of sweets per day by the volume of one sweet are treating the volume as one entity and therefore not using an integer number of sweets. This leads to an incorrect number of tubes. They cannot be awarded the final M1 or the A1</p> <p>eg factory open 12 hours a day. $12 - 1.5 = 10.5$ hours production</p> <p>Assume 15 000 sweets per minute</p> <p>$10.5 \times 60 \times 15\,000 = 9\,450\,000$</p> <p>Volume of sweet = 2.14</p> <p>$9\,450\,000 \times 2.14 = 20\,223\,000 \text{ cm}^3$</p> <p>Vol of cylinder = 126 cm^3</p> <p>Assume 25% wastage $126 \times 0.75 = 94.5 \text{ cm}^3$</p> <p>$20\,223\,000 \div 94.5 = 214\,000$</p>

B1B1M1M1
B1M1M1M0
A0

Q	Answer	Mark	Comments	
9(b)	Suitable comment eg Number of hours per day may be lower so the number of sweets/tubes would be lower or may produce more/less sweets per minute so more/ less tubes would be needed or amount/percentage wastage may be higher so less tubes would be filled	B1	oe must state how the answer is affected	
	Additional Guidance			
	Just stating that an assumed value may be different is insufficient eg there may be more sweets produced per minute			B0
	They cannot comment about changing the size of the sweet/size of the tube			