Level 3 Certificate
MATHEMATICAL STUDIES 1350/1
Paper 1

Mark scheme

June 2022

Version: 1.0 Final

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 Examiner.

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.

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Q	Answer	Mark	Comments
	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	
1(a)	**Additional Guidance**		
	Additional Guidance		
	Two lines from one box on the left is choice		

Q	Answer	Mark	Comments
1(b)	$\left(\dfrac{129}{345 + 406 + 129 + 162 + 56 + 42}\right) \times 80$ or $\dfrac{129}{1140} \times 80$ or $0.113\ldots \times 80$ or $129 \times 0.07(0..)$ or [9.03, 9.1]	M1	oe eg $\dfrac{43}{380} \times 80$ or $129 \div (1140 \div 80)$
	9 with no incorrect method or total seen	A1	

Additional Guidance	
$1140 \div 129 = 8.8(\ldots)$ 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 × 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]	M1	ft their March and April balances from part **2(a)**

6	and 147 635.86 × 0.003 or [442.90, 442.91]		
	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		B3

Q	Answer	Mark	Comments
3(b)	Both fully completed box and whisker plots drawn accurately with at least one labelled	B3ft	±½sq 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
3(c)	On average the Maths results were better than the English results as their median is higher/better or The higher Maths median shows students performed better in Maths than they did in English	B1ft	oe ft their median for Maths must be in context must not mention IQR

Additional Guidance	
Must refer to either marks/scores/grades or results/performance	
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)	$318.5(0) \leqslant I \leqslant 319.49$	B2	B1 318.5(0) or 319.49 in correct position or B1 $2318.5(0) \leqslant I \leqslant 2319.49$ SC1 $319.49 \leqslant I \leqslant 318.5(0)$
	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 $\times\ 1.024^2 \times 1.031^5 = 122.(1\ldots)$ 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
	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 × their hours per load × weeks in a year or Their number of loads per month × their hours per load × 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		
5	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 × hours per day × weeks in a year or their days per month × hours per month × in a year or their days per year × 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	For the final 2 marks they may use numbers outside the allowed ranges for the assumptions Example 14 × 4 × 52 = 2912	B0B0M1A1

Q	Answer	Mark	Comments
	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
	(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
6	(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
	(their $34\,316.56 \div 12) \times \dfrac{2}{5}$ or $1143.(..)$ or $(1050 \times 12) \div$ their $34\,316.56$ or $0.36(7\dots)$ or 0.37	M1	oe oe percentage
	$1143.(..)$ and Yes or $0.36(7\dots)$ 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		
	$49\,000 \times 0.92$ or $49\,000 - (49\,000 \times 0.08)$ or $45\,080\ (\div 12)$ or 3756.66 or 3756.67	M1	oe only award if used for at least one of tax or NI
	(their $45\,080 - 12\,570) \times 0.2\ (\div 12)$ or $6502\ (\div 12)$ or 541.83	M1	oe eg (their $3756.66 - \dfrac{12570}{12}$) $\times 0.2$ standard rate of tax per year or per month their $45\,080$ can be $49\,000$ their $3756.6(..)$ can be $4083.33(..)$
	$(\dfrac{\text{their } 45\,080}{12} - 797) \times 0.12$ or (their $3756.6(..) - 797) \times 0.12$ or 355.16	M1	oe basic rate of NI their $45\,080$ can be $49\,000$ their $3756.6(..)$ can be $4083.33(..)$
	(their $6502 \div 12$) + their 355.16 or their 541.83 + their 355.16 or 896.99 or their 6502 + (their 355.16 $\times$ 12) or 10\,763.92	M1	may be implied total tax and NI per month total tax and NI per year
	$\dfrac{\text{their } 45\,080}{12}$ − their 896.99 or their $3756.6(\ldots)$ − 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 $3756.6(\ldots)$

6 cont'd	2 859.67 or 2859.68 or 34 316.08	A1	monthly net pay annual net pay
	their 2859.67 $\times \dfrac{2}{5}$ or (their 34 316.08 ÷ 12) $\times \dfrac{2}{5}$ or 1143.(...) or 1050 ÷ 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	Note that calculating monthly gives a slightly different net pay per year due to government rounding of monthly figures The final answer is the same for monthly or annual calculations	
	If tax is calculated annually but NI monthly then award the first 3 marks for the correct method for their time frame 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	
	If the 8% deduction for pension is not deducted then a maximum 6 marks can be scored on either Alt method eg following Alt 1 annually $(49\,000 - 12\,570) \times 0.2 = 7286$ $(49\,000 - 9568) \times 0.12 = 4731.84$ $49\,000 - (7286 + 4731.84) = 36982.16$ $(36\,982.16 \div 12) \times \dfrac{2}{5}$ 1232.74 and yes	M0M1 M1 M1M1A0 M1 A1ft
	If the 8% deduction is seen (eg 45080) but then not used at all withhold the first mark	

Q	Answer	Mark	Comments
7(a)	[(140 × 12) + (180 × 23) + (220 × 45) + (260 × 32) + (300 × 18)] ÷ 130 or (1680 + 4140 + 9900 + 8320 + 5400) ÷ 130 or 29440 ÷ 130	M1	condone one incorrect midpoint or total
	226.(46…) or 226.5	A1	
	$\dfrac{\text{their } 226.46\dots - 193}{193}$ × 100 or 0.17… or 193 × 1.15 or 221.95 or 222 or 193 × 0.15 **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**		
	$\dfrac{3}{10} \times 40 \times 1.25$ or 15 or 20×1.7 or 34 or 40×0.8 or 32	M1	oe may be seen on histogram
	$\dfrac{3}{10} \times 40 \times 1.25$ 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 1st 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] ÷ 100 × 1.9(0) or [1.45, 1.55] × 1.9(0) or [0.45, 0.55] × 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 ÷ [290, 300] × [190, 200] or 129 ÷ [2.9, 3] × [1.9, 2.0] or [0.43, 0.445] × [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 ÷ 2.14 × 0.6 or 35 eg 125.7 ÷ 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 × 60 × their number of sweets per minute eg 10.5 × 60 × 14 500 = 9 135 000 or their number of sweets per minute ÷ their number of sweets per tube eg 14 500 ÷ 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 ÷ their sweets per tube eg 9 135 000 ÷ 35 or their tubes per minute × their production hours × 60 eg 414 × 10.5 × 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

	Alternative method 2		
9(a) cont'd	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 to18 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 ÷ 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 × their layers per tube eg 4 × 8 or 32	M1	number of sweets per tube any values allowed
	their production hours × 60 × their number of sweets per minute eg 10.5 × 60 × 14 500 = 9 135 000 or their number of sweets per minute ÷ their number of sweets per tube eg 14 500 ÷ 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 ÷ their sweets per tube eg 9 135 000 ÷ 32 or	M1	number of sweets per tube must be an integer production hours = factory hours − [1,3]

	their tubes per minute × their production hours × 60 eg 453 × 10.5 × 60		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 285 470	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

Additional Guidance is on the next page

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