AQA

A-LEVEL
Mathematics

MS1B – Statistics 1B
Mark scheme

6360

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Version/Stage: 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 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

Key to mark scheme abbreviations

M	mark is for method
m or 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
√or ft or F	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
–*x* EE	deduct *x* marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

General Notes for MS1B

GN1 There is no allowance for misreads (MR) or miscopies (MC) unless specifically stated in a question.

GN2 In general, a correct answer (to accuracy required) without working scores full marks but an incorrect answer (or an answer not to required accuracy) scores no marks.

GN3 In general, a correct answer (to accuracy required) without units scores full marks.

GN4 When applying AWFW, a slightly inaccurate numerical answer that is subsequently rounded to fall within the accepted range cannot be awarded full marks.

GN5 Where percentage equivalent answers are permitted in a question, then penalise by **one accuracy mark** at the first **correct** answer but only if no indication of percentage (eg %) is shown.

GN6 In questions involving probabilities, do **not** award **accuracy** marks for answers given in the form of a ratio or odds such as 13/47 given as 13:47 or 13:34 .

GN7 Accept decimal answers, providing that they have **at least two** leading zeros, in the form $c \times 10^{-n}$ (eg 0.00321 as 3.21×10^{-3}) .

GN8 **Where a candidate's response to a part of a question is simply to label the part (eg (d)(i)) with nothing else (ie no attempt at a solution), then this is still treated as a response and marked as 0 rather than NR. Also, deleted work, if not replaced, should be marked and not treated as NR.**

Specific Notes for MS1B

1. Question 1

2. Question 2

3. Question 3

4. Question 4

5. Question 5

6. Question 6

7. Question 7

Q	Solution	Mark	Total	Comment
1	**Emboldened words (at least one chosen from emboldened options) are required in parts (a) & (d)**			
(a)(i)	Mode: **5** is **minimum/smallest/lowest** value	B1		
(ii)	Range: is **affected/skewed/distorted/increased /large/wide/big/high** due to value of **95**	B1	**2**	
Notes	**1** Use only of "inaccurate or incorrect or wrong OE" ⇒ B0 **2** Reasons must relate specifically to the data in the question; general comments (eg mode does not use all values, large spread or range, range only uses maximum and minimum values) ⇒ B0 **3** Ignore additional comments, even if incorrect or inaccurate **4** If parts not labelled, then reasons must clearly reference mode or range			
(b)	Median = **17**	B1		CAO; ignore method
	Interquartile range (22 – 10) = **12**	B1	**2**	CAO; ignore method
(c)	Mean = **20**	B1		CAO; see Note 2 $(\sum x = 460)$ & $(\sum x^2 = 16608)$
	Standard deviation (n) = **17.9 to 18.0** **or** Standard deviation (n–1) = **18.3 to 18.4**	B2		AWFW (17.94678) Do not ignore method; see Note 3 AWFW (18.35013)
	or Standard deviation (n or n–1) = **17 to 19**	(B1)	**3**	AWFW
Notes	**1** Where no method is shown for mean and standard deviation simply mark numerical values stated **2** If an incorrect method for mean is followed by a numerically correct value ⇒ B1 **3** If an incorrect method for standard deviation is followed by a numerically correct value ⇒ 2 solutions so B2 becomes B1 or (B1) becomes (B0)			
(d)	Data is **not symmetrical** **or** data is (positively) **skewed**	B1		Reference only to 'normal' ⇒ B0
	Median **and** IQR **or** measures/results in (b) **or** "they" **ARE NOT affected/skewed/distorted/influenced/changed** by **95/maximum/outlying/extreme/large** value **OR** Mean **and** SD **or** measures/results in (c) **ARE affected/skewed/distorted/influenced/changed** by **95/maximum/outlying/extreme/large** value	B1	**2**	
Note	**1** Comments simply about the data (eg large spread) and/or comments or comparisons of measures (eg large Sd or mean > median or Sd > IQR) ⇒ B0			
		Total	**9**	

Q	Solution	Mark	Total	Comment
2	**Emboldened words are required in part (b)(ii)**			
(a) **(i)**	r = **–0.75 to –0.95**	B1		AWFW (–0.89935)
(ii)	r = **–0.20 to +0.20**	B1	**2**	AWFW (–0.00743)
(b) **(i)**	r = **0.00375**	B3		CAO; (see GN7) (0.0037498)
	r = **0.0037 to 0.0038**	(B2)		AWFW; (see GN7)
	r = **0.003 to 0.004**	(B1)		AWFW; (see GN7)
	or			
	$\sum t = 290$ $\sum t^2 = 9326$ $\sum tc = 13346.27$ $\sum c = 460$ $\sum c^2 = 24212.2686$	(M1)		Correct attempt at 5 summations (Look for $\sum tc = \sum t \sum c = 133400$)
	or $S_{tt} = 916$ $S_{cc} = 3052.2686$ $S_{tc} = 6.27$			Correct attempt at 3 summations
	Attempt at substitution into a **correct** corresponding formula for r	(m1)		
	r = **0.00375**	(A1)	**3**	CAO; (see GN7)
(ii)	There is **no** (linear) correlation	Bdep1		Dep on r = 0.003 to 0.004
Notes	**1** Statements **must** include the word "no" without qualification or additional phrases **together with only** "correlation" **or** "association" **or** "relationship" **2** Use of any of the following terms (even in conjunction with "no"): "almost or virtually or low or little or small or weak or mild or slightly or fairly or pretty or significant" ⇒ Bdep0			
	between the **time** and **cost of items**	Bdep1	**2**	Dep on r = –0.99 to +0.99
Notes	**1** Accept order of "cost of items" and "time" **2** "As time spent increases, cost of items purchased remains the same" ⇒ Bdep0 Bdep1 **3** "As time/t increases, cost/c remains the same" ⇒ Bdep0 Bdep0 **4** Any suggestion that "as time spent increases, cost of items purchased increases" ⇒ Bdep0 Bdep0			
		Total	**7**	

Q	Solution	Mark	Total	Comment
3	**Accept the equivalent percentage answers with %-sign (see GN5)**			
(a)(i)	$P(X > 757) = P\left(Z > \dfrac{\mathbf{757-730}}{\mathbf{20}}\right) =$	M1		Standardising **757** with **730** and **20** but allow (730 – 757)
	$P(Z > 1.35) = 1 - P(Z < 1.35) = 1 - 0.91149$	m1		Area change; may be implied but only by the **correct** answer
	$= \underline{\mathbf{0.088 \text{ to } 0.089}}$	A1	**3**	AWFW (0.08851)
(ii)	$P(706 < X < 730)$ $= P(\underline{\mathbf{-1.2}} < Z < \underline{\mathbf{0}})$ **or** $P(\underline{\mathbf{0}} < Z < \underline{\mathbf{1.2}})$	B1		CAO 0 and 1.2
	$= (0.5 - (1 - 0.88493))$ **or** $(0.88493 - 0.5)$			
	$= \underline{\mathbf{0.384 \text{ to } 0.386}}$	B1	**2**	AWFW (0.38493)
(b) **(i)**	$\left(\dfrac{350-\mu}{\sigma} = 0\right) \Rightarrow \quad \mu = \underline{\mathbf{350}}$	B1		CAO; this should result immediately from the two 'standard' simultaneous equations; other one is below for M1
	$0.99 \Rightarrow z = \underline{\mathbf{-2.32 \text{ to } -2.33}}$	B1		AWFW; ignore sign (–2.3263)
	$\dfrac{\mathbf{320} - (\mathbf{350} \text{ or } \mu)}{\sigma} = \begin{pmatrix} \pm 2.05 \text{ to } \pm 2.06 \\ \pm 2.32 \text{ to } \pm 2.33 \\ \pm 2.57 \text{ to } \pm 2.58 \end{pmatrix}$	M1		Standardising **320** with (**350** or μ) and σ but allow ((350 or μ) – 320) **and** equating to one of 3 listed z-values but **allow inconsistent signs**
	$\Rightarrow \sigma = \underline{\mathbf{13}}$	A1	**4**	CAO; (12.87 to 12.94) Penalise inconsistent signs here
(ii)	$P(Y < \mu + w) = 0.90 \Rightarrow z = \underline{\mathbf{1.28}}$ **or** $P(Y > \mu - w) = 0.90 \Rightarrow z = \underline{\mathbf{-1.28}}$	B1		AWRT; ignore sign (1.2816)
	$\dfrac{((350 \text{ or } \mu) + w) - (350 \text{ or } \mu)}{(12.87 \text{ to } 12.94) \text{ or } 13} = \begin{pmatrix} 0.84 \text{ AWRT} \\ 1.28 \text{ AWRT} \\ 1.64 \text{ to } 1.65 \end{pmatrix}$ **or** $w = (\text{listed } (+z\text{-value})) \times ((12.87 \text{ to } 12.94) \text{ or } 13)$ (OE)	M1		Standardising ($\boldsymbol{w}$ with **0**) (OE) and (**+12.8 to +13**, even if A0 awarded in (b)(i)) **and** equating to one of 3 listed z-values **with consistent signs**
	$w = \underline{\mathbf{16.4 \text{ to } 16.7}}$	A1	**3**	AWFW (16.47 or 16.66)
Notes	**1** To score M1 the expression $\dfrac{\pm(w(-0))}{(12.87 \text{ to} 12.94) \text{ or } 13}$ (OE) MUST be equated to one of the 3 listed (±)z-values which then leads, without fudging, to a POSITIVE value for w **2** The expression $\dfrac{\pm 2w}{(12.87 \text{ to} 12.94) \text{ or } 13} = 1.28 \Rightarrow$ M0			
		Total	**12**	

Q	Solution	Mark	Total	Comment
4	**Emboldened words (at least one chosen from emboldened options) are required in parts (a), (b)(ii) & (d)**			
(a)	x is the **independent/controlled** variable **or** y is the **response/dependent** variable **or** y **depends on** x **or** x **does not depend on** y **or** x are **set/fixed values/intervals**	B1	**1**	Accept x and y in context of question
(b)(i)	b (gradient/slope) = **0.0355 to 0.0356** b (gradient/slope) = **0.035 to 0.036** a (intercept) = **0.214 to 0.222** a (intercept) = **0.19 to 0.25** **or**	B2 (B1) B2 (B1)		AWFW (0.035544) AWFW AWFW (0.217363) AWFW
	$\sum x = 780$ $\sum x^2 = 65000$ $\left(\sum y^2 = 95.0731\right)$ $\sum y = 30.55$ $\sum xy = 2479.9$ **or** $S_{xx} = 18200$ $S_{xy} = 646.9$ $\left(S_{yy} = 23.2806\right)$ Attempt at substitution into a **correct** corresponding formula for b b (gradient/slope) = **0.0355 to 0.0356** a (intercept) = **0.214 to 0.222**	(M1) (m1) (A1) (A1)	**4**	Correct attempt at 4 summations (Look for $\sum xy = \sum x \sum y = 23829$) Correct attempt at 2 summations AWFW (0.035544) AWFW (0.217363)
Notes	**1** **Only if equation stated without "b = and a ="**, then award marks as detailed above for $y = a + bx$ stated in (b)(i); deduct 1 mark if "y =" or "x" is missing; deduct 2 marks if both "x and y =" are missing **2** Values of a and b interchanged and equation $y = ax + b$ stated in (b)(i) ⇒ max of 4 marks **3** Values of a and b interchanged and equation $y = a + bx$ stated in (b)(i) ⇒ 0 marks **4** Values are **not** identified or simply a = # and b = #, then (0.035 to 0.036) ⇒ B1 and (0.19 to 0.25) ⇒ B1 but accept, for example, as identification, [a = #, b = # with $y = a + bx$ stated with no substitution for a & b] **or** [intercept(a) = #, gradient(b) = #] **5** (x or y) = –5.3 + 27.8(y or x) ⇒ 0 marks; unless corrected later, this will result in only the **first B1 in (d)** being available **6** Some/all of marks can be scored in (b)(ii), (c) & (d), even if some/all of marks are lost in (b)(i), but marks lost in (b)(i) **cannot** be recouped by subsequent working in (b)(ii), (c) or (d)			
(ii)	a (intercept): (expected/average/mean/usual/typical) **yield of tomatoes** when **no/0/zero potassium** in a plant's liquid feed **or** **similar/close/near** to **observed yield** (of 0.31)	Bdep1		Dep on $0.19 \le a \le 0.25$
Note	**1** Value of y/yield when x/potassium = 0 ⇒ B0			
	b (gradient/slope): for **each/every** increase of a/one **mg/l** of **potassium** in a plant's liquid feed a plant's (expected/average/mean/usual/typical) **yield of tomatoes increases by** a value within **0.035** (kg) **to 0.036** (kg)	B1 Bdep1	**3**	 Dep on B1
Notes	**1** To score any marks, an explanation must indicate change in x affecting change in y, **not** change in y affecting change in x **2** Any increase in potassium must be matched by a correct increase in yield to score B1dep (eg 10 (mg/l) and 0.35 (kg) to 0.36 (kg)) **3** Reference **only** to correlation ⇒ B0 Bdep0			
SC	**1** As x/potassium/mg increases then y/yield/kg increases by b (OE) ⇒ B1; **only if** the value of b ($0.035 \le b \le 0.036$) is stated here but context and/or units are **not** required			
	Parts (a) & (b)	**Total**	**8**	

Q	Solution	Mark	Total	Comment
4	**Continued**			
	Parts (a) & (b)	**Total**	**8**	
(c)(i)	Res_H = **–0.28 to –0.23**	B2		AWFW; do not ignore sign (–0.25544)
	Res_H = **–0.32 to –0.19** **or** = **+0.19 to +0.32**	(B1)	**2**	AWFW; either
(ii)	Sum_{11} = **+0.14 to +0.19**	B2		AWFW; do not ignore sign (0.16544)
	Sum_{11} = **–0.19 to –0.14** **or** = **0.10 to 0.23** **or** = **–0.41 to –0.28**	(B1)	**2**	AWFW; do not ignore sign
(d)	**Extrapolation/outside range or outside data** May kill plants Plants have maximum yield	B1		150 & 200 > 120
	y_{150} = **(5.44 to 5.65) > 4.63**			AWFW (5.54896)
	and/or	B1		
	y_{200} = **(7.19 to 7.45) > 4.89**		**2**	AWFW (7.32615)
Notes	**1** Must evaluate one or both of above y-values to within range(s) **and** clearly compare with corresponding given y-value(s) **2** Accept as comparison(s) "(much) greater or (much) larger or (much) bigger or (much) more than or exceeds or above" (OE) **3** Accept corresponding wording if comparison(s) reversed			
SCs	**1** r_{150} = (–1.02 to –0.81) < (–0.32 to –0.19) and/or r_{200} = (–2.56 to –2.30) < (–0.32 to –0.19) ⇒ B1 **2** ((5.44 to 5.65) – 4.63))/4.63 = 17.0% to 22.0% and/or ((7.19 to 7.45) –4.89))/4.89 = 47% to 53% ⇒ B1 **3** (4.89 – 4.63) = 0.26 < 50 × (0.035 to 0.036) = (1.75 to 1.80) ⇒ B1 **4** (4.89 – 4.63)/(200 – 150) = 0.26/50 = (0.005 to 0.0052) < (0.035 to 0.036) ⇒ B1			
		Total	**14**	

Q	Solution	Mark	Total	Comment
5	**Accept 3 dp rounding of probabilities** **Accept the equivalent percentage answers with %-sign (see GN5)** **Emboldened words (at least one chosen from emboldened options) are required in part (a)**			
(a)	**(i)** Appropriate or Yes **(ii)** Not appropriate or No **(iii)** Not appropriate or No	B1		All 3 stated correctly Cannot be implied
(i)	n = **20**	B1		CAO B(20, 0.33 (OE)) ⇒ B2
	p = **2/6 or 1/3 or 0.3r or 0.33 or 33%**	B1		CAO
(ii)	**Number of trials or tosses or *n*** is **not fixed**	B1		No other alternatives
(iii)	**P(yellow highlighter pen)** or ***p*** is **not constant/not fixed/variable/changes/varies** or **selection of pens** or **events** is/are **dependent/not independent**	B1	**5**	No other alternatives
(b) **(i)**	$P(M_{LH} \leq 3)$ = **0.471**	B1	**(1)**	AWRT (0.471121)
(ii)	$P(2 \leq W_{LH} \leq 6)$ = 0.9005 **or** 0.7937 (p_1)	M1		Seen as **first term** in a **subtraction**
	minus 0.0805 **or** 0.2228 (p_2)	M1		Seen as **second term** in a **subtraction**
	= **0.82**	A1	**(3)**	AWRT (0.820001)
Notes	**1** For no method **or** calculation of individual terms; award **B3** for 0.82 (AWRT); **B2** for 0.677 to 0.678 (AWFW); **B2** for 0.713 to 0.714 (AWFW); **B2** for 0.570 to 0.572 (AWFW); **B0** for anything else **2** Answers seen using [(0.9195 or 0.7772) – (0.0995 or 0..2063)] [ie $(1-p_2) - (1-p_1)$] ⇒ M1 M1 A1 max **3** Answers seen using $[1 - (p_1 - p_2)]$ even after $(p_1 - p_2)$ [eg 1 – (0.9005 – 0.0805) = **0.18**] ⇒ 0 marks **4** Use of $p_1 \times p_2$ or $p_1 \div p_2$ or $p_1 + p_2$ or p_1 only or p_2 only ⇒ 0 marks			
(iii)	Use of **B(50, 0.10)**	B1		Seen or used; can be implied by either 0.9755 or 0.9906 seen
	$P(W_{NLH} > 40) = P(W_{LH} \leq 9)$ or $P(W_{LH} < 10)$			
	= 0.9755 **or** 0.9906	M1		
	= **0.975 to 0.976**	A1		AWFW (0.975462)
	or			
	Use of **B(50, 0.90)**	(B1)		Seen or used; can be implied by 0.0245 or 0.0094 or 0.9906 seen
	$P(W_{NLH} > 40) = 1 - P(W_{NLH} \leq 40)$			
	= 1 – (0.0245 **or** 0.0094)	(M1)		
	= **0.975 to 0.976**	(A1)	**(3)**	AWFW (0.975462)
			7	
		Total	**12**	

Q	Solution	Mark	Total	Comment
6				
(a)(i)	95% $\Rightarrow$ z = **1.96**	B1		AWRT (1.95996)
	CI for μ is:			Ignore any notation
	$1075 \pm \begin{pmatrix} 1.96 \text{ AWRT} \\ 1.64 \text{ to } 1.65 \text{ AWFW} \end{pmatrix} \times \frac{36}{\sqrt{50}}$	M2 (–1 ee)		M0 if CI is not of the form: $\begin{pmatrix} 1075 \\ 1072 \end{pmatrix} \pm \begin{pmatrix} 1.96 \\ 1.64 \text{ to } 1.65 \end{pmatrix} \times \begin{pmatrix} 36 \\ 6 \end{pmatrix} \Big/ \sqrt{\begin{pmatrix} 50 \\ 49 \end{pmatrix}}$
	Thus:			
	1075 ± 10			CAO (1075 ± 9.97869)
	or	Adep1		Dependent on award of M2
	(1065, 1085)			CAO (1065.02, 1084.98)
			4	
Note	**1** If award of M0 or M1 is followed by a numerically correct CI $\Rightarrow$ possibly 2 solutions			
SC	**1** NMS for CI then (1065, 1085) $\Rightarrow$ 4 marks; (1065.0, 1085.0) (AWRT) $\Rightarrow$ B3			
(ii)	CI includes 1072 **or** 1072 ε CI	BF1		F on (a)(i); providing LCL < 1072 < UCL and 1072 is **not used** in CI construction
	Hence **accept/agree with claim** that μ = 1072	Bdep1		OE; dependent on BF1
			2	
Notes	**1** Statement must **clearly** indicate that "1072 is **within** the **corresponding** CI" OE **2** Statements of the form "It/this/mean/value/etc is within the (corresponding) CI" $\Rightarrow$ BF0 Bdep0 **3** Statements of the form "1072 is within 95% of the data/values/millilitres/bottles" $\Rightarrow$ BF0 Bdep0 **4** Statements such as "Claim is likely to be reasonable/supported/possible/valid/true/right/correct/accurate" $\Rightarrow$ Bdep1 but only providing BF1 scored			
(b)	98% $\Rightarrow$ z = **2.32 to 2.33**	B1		AWFW (2.32635)
	$\begin{pmatrix} 1075 \\ \mu \text{ or } \bar{x} \end{pmatrix} + \begin{pmatrix} 2.32 \text{ to } 2.33 \\ 2.57 \text{ to } 2.58 \end{pmatrix} \times \frac{36}{\sqrt{n}} = 1080$	M1		Use of μ or $\bar{x}$ can score 4 marks Use of 1075 $\Rightarrow$ B1 M1 max Use of anything else $\Rightarrow$ B1 max
	and			
	$\begin{pmatrix} 1075 \\ \mu \text{ or } \bar{x} \end{pmatrix} - \begin{pmatrix} 2.32 \text{ to } 2.33 \\ 2.57 \text{ to } 2.58 \end{pmatrix} \times \frac{36}{\sqrt{n}} = 1060$			
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	or $1070 + \begin{pmatrix} 2.32 \text{ to } 2.33 \\ 2.57 \text{ to } 2.58 \end{pmatrix} \times \frac{36}{\sqrt{n}} = 1080$			
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	or $1070 - \begin{pmatrix} 2.32 \text{ to } 2.33 \\ 2.57 \text{ to } 2.58 \end{pmatrix} \times \frac{36}{\sqrt{n}} = 1060$			
	Thus:			
	$\begin{pmatrix} 2.32 \text{ to } 2.33 \\ 2.57 \text{ to } 2.58 \end{pmatrix} \times \frac{36}{10} = \sqrt{n}$	m1		Re-arranging for $\sqrt{n}$ or n
	n = 69.76 to 70.36 $\Rightarrow$ **70 or 71**	A1		CAO either (70.14)
			4	
SC	**1** Method of T&I; z = 2.32 to 2.33 $\Rightarrow$ B1; evaluation of $\begin{pmatrix} 2.32 \text{ to } 2.33 \\ 2.57 \text{ to } 2.58 \end{pmatrix} \times \frac{36}{\sqrt{n}}$ with a numerical integer value for n $\Rightarrow$ M1; since $2.32 \times 36 / \sqrt{64} = 10.44(10)$ and $2.33 \times 36 / \sqrt{77} = 9.56(10)$ then n = int (64 to 77) $\Rightarrow$ A1 but n = 70 or 71 $\Rightarrow$ A2			
		Total	**10**	

Q	Solution	Mark	Total	Comment
7	**Accept the equivalent percentage answers with %-sign (see GN5)**			
(a)				
(i)	$P(L \cap M) = 0.55 \times 0.28 = \underline{\mathbf{0.154}}$	B1		CAO; accept 154/1000 or 77/500
(ii)	$P(L \cup M) = 0.55 + 0.28 = \underline{\mathbf{0.83}}$	B1		CAO; accept 83/100
(iii)	$P(L \cup M) = 0.83 - 0.154 = \underline{\mathbf{0.676}}$	B1	**3**	CAO; accept 676/1000 or 338/500 or 169/250
Note	**1** For fractional answers, do **not** penalise errors in simplifications; eg 154/1000 = 67/500 ⇒ B1 (for 154/1000)			
(b)				
(i)	$P(A = 3) = 0.94 \times 0.88 \times 0.76$ $= \underline{\mathbf{0.628 \text{ to } 0.629}}$	B1	**1**	AWFW (0.628672)
(ii)	$P(A = 1) = (0.94 \times 0.12 \times 0.24) +$ $(0.06 \times 0.88 \times 0.24) +$ $(0.06 \times 0.12 \times 0.76)$	M1		Fully correct; not (1 – 0.88), etc
	or $= 0.027072 + 0.012672 + 0.005472$			Fully correct to 4dp
	$= \underline{\mathbf{0.045 \text{ to } 0.0455}}$	A1	**2**	AWFW (0.045216)
(iii)	$P(A \geq 2) = (0.94 \times 0.88 \times 0.76)$ **or** (b)(i) + $(0.94 \times 0.88 \times 0.24) +$ $(0.94 \times 0.12 \times 0.76) +$ $(0.06 \times 0.88 \times 0.76)$	M1		Fully correct (c's (b)(i)); not (1 – 0.76), etc
	or = 0.628672 or (b)(i) + 0.198528 + 0.085728+ 0.040128			Fully correct to 4dp (c's (b)(i))
	$= \underline{\mathbf{0.953 \text{ to } 0.9535}}$	A1		AWFW (0.953056)
	or			
	$P(A \geq 2) =$ $1 - [0.045216$ **or** (b)(ii)$] - (0.06 \times 0.12 \times 0.24)$	(M1)		1 – (b)(ii) – 0.001728
	$= \underline{\mathbf{0.953 \text{ to } 0.9535}}$	(A1)	**2**	AWFW (0.953056)
(iv)				
(A)	$P(A = 4) = \underline{\mathbf{0.603 \text{ to } 0.604}}$	B1	**(1)**	AWFW (0.60352512)
(B)	$P(A = 0) = (0.06 \times 0.12 \times 0.24) \times 0.52$	M1		Fully correct
	$= \underline{\mathbf{0.000898 \text{ to } 0.000899}}$	A1	**(2)**	AWFW; (see GN7) (0.00089856)
			3	
		Total	**11**	