AQA

AS
Mathematics

MS1B Statistics 1B
Final Mark Scheme

6360
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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**
In part(a), the equation is NOT required but, if simply quoted, can score marks.

2. **Question 2**
In part (b), for example, "LCL < 25 < UCL so agree (with claim)" scores 2 marks.

3. **Question 3**
In parts (b) & (c), note the ranges if using Bdep1, Bdep1 and Mdep1.

4. **Question 4**
In part (c), equivalent contextual explanations to "positive" and "negative" are NOT acceptable.

5. **Question 5**
In part (b)(i), be aware of Note 3 in part (b)(i) when then marking part (b)(ii)(B).

6. **Question 6**
In part (b)(i), the Special Cases are by no means rare events!

7. **Question 7**
In part (a)(iii), note the stricter conditions for the awarding of the method marks.
In part(b)(ii), there is NO follow-through from part(b)(i).

Q	Solution	Marks	Total	Comments
1 (a)	b (gradient/slope) $= \dfrac{44725}{89375}$	M1		Can be implied by a **correct** answer for b
	b (gradient/slope) $=$ **0.5(00) to 0.501**	A1		AWFW (0.50042)
	a (intercept) $= 83 - b \times 162.5$			
	a (intercept) $=$ **1.58 to 1.78**	A1	**3**	AWFW (1.68182)
Note	**1** For fractional answers only accept b (gradient/slope) $= \frac{1789}{3575}$ or $\frac{1}{2}$ for A1 and a (intercept) $= \frac{37}{22}$ or $1\frac{15}{22}$ or $\frac{7}{4}$ or $1\frac{3}{4}$ for A1			
(b) (i)	$y(175) =$ **89 to 90**	B1		AWFW (89.25524)
Note	**1** If a and b are interchanged, then $y(175) = 277$ to $307 \Rightarrow$ B0 **2** Do NOT accept fractional answers here			
(ii)	**4 m > 3 m or 400 cm > 300 cm** **or** **4 m > 300 cm or 400 cm > 3 m** **or** (a) 4 m or 400 cm is (b) above/out(side)/extrapolation of the (c) x-heights/x-values/x-data (set)/x-range/ observed x-values/ [25 (cm) to 300 cm (OE)] range or interval	B1 (B1)		Correct comparison **quoting units** Must include **one** (OE) from **each** of the **three** lists (a), (b) & (c) **and quoting units** Allow "drop(ped)" instead of "x"
Notes	**1** For example, "4 > 3" **or** "4 > 300 cm" $\Rightarrow$ B0 **2** For example, "4 m is above observed x-values" $\Rightarrow$ B1 **3** Answers using (a), (b) & (c) must give a clear comparison between 4 m (OE) and observed x-values (OE) **4** For example, "4 is outside x-heights" **or** "400 cm is outside the heights" $\Rightarrow$ B0 **5** At **4 m / >300 cm**, **air resistance or forces** may **have effect/change/invalidate equation** $\Rightarrow$ B1			
			2	
		Total	**5**	

Q	Solution	Marks	Total	Comments
2 (a)	**Sample** is **random**	B1		Must include **both emboldened** words
	Durations are **normal**(ly distributed)	B1		Must include **both emboldened** words
Notes	**1** "Sample (data/values/durations/(telephone) calls) is random and is normally distributed" ⇒ B1 B0 **2** "Durations (of (telephone) calls) are random and normally distributed" ⇒ B0 B1 **3** "Length of calls are independent and normal(ly distributed)" ⇒ B0 B1			
	95% (0.95) ⇒ z = **1.96**	B1		AWRT (1.95996)
	Mean / $\bar{x}$ = **21.5**	B1		CAO (Ignore notation)
	CI for μ is: $(20.5 \text{ to } 22.5 \text{ AWFW}) \pm \begin{pmatrix} 1.96 \text{ AWRT} \\ \textbf{or} \\ 1.64 \text{ to } 1.65 \text{ AWFW} \end{pmatrix} \times \frac{7.5}{\sqrt{10}}$	M2,1 (–1 ee)		M0 if CI is not an interval **or** is not of the form $\bar{x} \pm z \times \frac{7.5}{\sqrt{10}}$
	Hence **21.5 ± (4.6 to 4.7)**			CAO/AWFW (21.5 ± 4.64855)
	or	Adep1		Dependent on award of M2
	(16.8 to 16.9, 26.1 to 26.2)		**7**	AWFW (16.85, 26.15)
Notes	**1** If award of M0 is followed by a numerically correct CI ⇒ 2 solutions **2** Use of z-value of 1.28 to 1.29 or 2.05 to 2.06, 2.32 to 2.33 or 2.57 to 2.58 ⇒ 1 error but any other z/t values ⇒ M0 **3** Use of $s^2(n\text{-}1) = 96.11$, $s(n\text{-}1) = 9.98$, $s^2(n) = 89.65$ or $s(n) = 9.47$ ⇒ M0			
(b)	**Clear correct comparison** of **25** with **CI in (a)** (eg 25 is within CI or interval)	BF1		Statement must include reference to 25 F on CI providing it **includes** 25 Must have found an **interval** in (a) but quoting values for CI or CLs is **not** required **Ignore additional statements** such as those in Notes 3 & 4 below `
	Agree with or accept claim **or** Claim is (likely to be) **true/correct/right/valid/accurate/supported/ reasonable/possible**	Bdep1	**2**	OE; dependent on BF1 Do **NOT** ignore conflicting conclusions such as that in Note 5 below
Notes	**1** Statement must **clearly** indicate that "25 is **within** the interval" OE **2** Statements of the form "25 is below the UCL" **or** "25 is above the LCL" ⇒ BF0 **3** Statements of the form "It/this/mean/value/duration/minutes/(telephone)calls/etc is within the interval" ⇒ BF0 **4** Statements of the form "25 is within 95% of the data/values/durations/minutes/(telephone)calls/etc" ⇒ BF0 **5** Statements of the form "25 is within the interval but it is towards the UCL so may/may not be true" (OE) ⇒ BF1 Bdep0			
		Total	**9**	

Q	Solution	Marks	Total	Comments
3 (a)	Mean = **7.35**	B2		CAO $\left(\sum x = 588\right)$
	= **7.3 to 7.4**	(B1)		AWFW
	Var (n) = **10.5** **or** Var(n–1) = **10.6**	B2		AWRT (10.47750 or 10.61013) $\left(\sum x^2 = 5160\right)$
	Var (n or n–1) = **10.4 to 10.7**	(B1)	**4**	AWFW
Notes	**1** Mean = 182 to 182.4 ⇒ B0 B2 max **2** Answer quoted as 3.22^2 **to** 3.26^2 **alone** ⇒ B2 B1 max **3** Answer quoted as 3.22 **to** 3.26 **alone** ⇒ B2 B0 max **4** If answers not identified, then mark as mean followed by variance			
SC	**1** If and only if B0 B0, then award M1 for **at least 4** of 1, 3, 5, 7, 9, 11, 13 seen **or** for $\frac{(508 \text{ to } 668)}{80}$ **or** (6.35 to 8.35)			
(b)	Mean = **182 to 182.4**	B1		AWFW; **irrespective** of value quoted/stated as mean in (a)
	or			
	Mean = **175 + (mean in (a))**	(Bdep1)		**Evaluated** (at least 3sf) using value quoted/stated as mean in (a) and dep on **6 < Mean < 9** in (a)
	Var (n or n–1) = **10.4 to 10.7**	B1		AWFW; **irrespective** of value quoted/stated as variance in (a)
	or			
	Var (n or n–1) = **value of Var stated in (a)**	(Bdep1)	**2**	Must be **identical** (at least 3 sf) to value quoted/stated as variance in (a) and dep on **9 < Var < 12** in (a)
(c)	Mean = **5.97 or 5.98 or 5.99**	B1		CAO (5.98261)
	Var = $\frac{(\text{Var(b) or Var(a)})}{30.48^2 \text{ or } 929}$	Mdep1		Dep on **9 < Var < 12** in (a) or (b) ($30.48^2 = 929.0304$)
	or			
	Var = $\left(\frac{(\text{Sd(a) or Sd(b)})}{30.48}\right)^2$			Dep on **3 < Sd < 3.5** in (a) or (b)
	Var (n or n–1) = **0.0112 or 0.0113 or 0.0114 or 0.0115**	A1	**3**	CAO (0.0113 or 0.0114)
		Total	**9**	

Q	Solution	Marks	Total	Comments
4 (a)	$r =$ **–0.524** $=$ **–0.52 to –0.53** $=$ **–0.4 to –0.6**	B3 (B2) (B1)		AWRT (–0.52387) AWFW AWFW
	Attempt at $\sum x$ $\sum x^2$ $\sum y$ $\sum y^2$ & $\sum xy$ **or** Attempt at S_{xx} S_{yy} & S_{xy}	(M1)		7631 4496183 5031 1966807 & **2943644** (all 5 attempted) 16786 19810 & **–9553** (all 3 attempted) M0 mo A0 if r not in [–1, +1]
	Attempt at substitution into **correct** corresponding formula for r	(m1)		
	$r =$ **–0.524**	(A1)	**3**	AWRT
(b)	**Moderate or some negative** (linear) correlation	Bdep1		Dependent on **$-0.6 \leq r \leq -0.4$**
Notes	**1** Statements **must** include the words "moderate **or** some **and** negative" **or** "spurious" **together with** "correlation" **or** "association" **or** "relationship"; ignore additional comments unless clearly contradictory **2** Use of any of the following terms (even in conjunction with moderate or some): "strong or high or big or good or low or little or small or weak or slight or fairly or mild or medium or average or reasonable or pretty" ⇒ Bdep0			
	between total **weight(s)** of 4 **apples** and 3 **bananas**	B1	**2**	Context; providing **$-1 < r < 1$**
Notes	**1** "As weights of (4) apples increase weights of (3) bananas decrease" (OE) Bdep0 B1 **2** "As weights/x increase weights/y decrease" (OE) Bdep0 B0 **3** Allow "mass(es) or gram(s)" instead of "weight(s)"			
SCs	**Special cases 1 and 2 depend upon $-1 < r < 1$** **1** Any answer suggesting that the **correlation** between the **two variables** is nonsensical/tenuous/dodgy/rubbish/OE ⇒ B1 **2** Any answer suggesting that the **correlation** between the **weight(s)** of 4 **apples** and 3 **bananas** is nonsensical/tenuous/dodgy/rubbish/OE ⇒ B2			
(c)	Howard's claim suggests **positive** correlation but Hilda's data/calculated value shows **negative** correlation	Bdep1		**Correct** comparison of claim and calculated value using **positive and negative** Dependent on **$-1 < r < 0$**
	Disagree with or reject claim **or**	Bdep1		OE; dependent on Bdep1
	Claim is (likely to be) **false/incorrect/wrong/invalid/inaccurate/ unsupported/ unreasonable**		**2**	
		Total	**7**	

Q	Solution	Marks	Total	Comments
5(a)	**Accept the equivalent percentage answers with %-sign (see GN5)**			
(i)	$P(X < 105) =$ **0.5 or 1/2 or half or 50%**	B1	**(1)**	CAO; accept nothing else but ignore zeros after 0.5 (eg 0.50) Ignore additional words providing that they are not contradictory
(ii)	$P(X \neq 100) =$ **1 or one or unity or 100%**	B1	**(1)**	CAO; accept nothing else but ignore zeros after decimal point (eg 1.00) Ignore additional words providing that they are not contradictory (eg certain so = 1)
(iii)	$P(X > 110) = P\left(Z > \frac{\mathbf{110-105}}{\mathbf{4}}\right) =$	M1		Standardising **110** with **105** and **4** but allow (105 – 110)
	$P(Z > 1.25) = 1 - 0.89435 =$ **0.105 to 0.106**	A2	**(3)**	AWFW (0.10565)
SCs	**1** Answer of 0.894 to 0.895 ⇒ M1 A1 **2** **Correct seen** standardisation with 0 < **incorrect** answer < 0.5 ⇒ M1 A1 **3** **Incorrect or no seen** standardisation with 0 < **incorrect** answer < 0.5 ⇒ M1 A0			
(iv)	$P(102 < X < 108) = P($**–0.75** $< Z <$ **0.75**$)$	M1		CAO –0.75 **and** +0.75
	$= (p - (1 - p))$ **or** $(2p - 1)$	M1		OE; $0 < p < 1$ Independent of previous M1
	$= 0.77337 - (1 - 0.77337)$			
	$=$ **0.546 to 0.547**	A1	**(3)**	AWFW (0.54674)
			8	
(b) **(i)**	5% (0.05) ⇒ $z =$ **1.64 to 1.65**	B1		AWFW (1.64485) Seen; ignore sign
	$\frac{\pm((150 \text{ or } 170) - 160)}{\sigma / s} = \pm(1.64 \text{ to } 1.65)$	M1		Standardising 150 with 160 and σ / s; allow $(160 - (150 \text{ or } 170))$ **and** equating to ±(1.64 to 1.65) **and** with **consistent** signs
	$\sigma / s =$ **6.06 or 6.08 or 6.10**	A1	**3**	CAO (6.07957) **Seen** incorrect rounding ⇒ A0
Notes	**1** Award max of B1 M0 A0 for **any inconsistency of signs** **2** Award of B0 ⇒ 0/3 marks here **3** Whilst the use of $z = 1.96$ ($\sigma = 5.1$) or $z = 1.28$ ($\sigma = 7.8$) ⇒ 0/3 marks here, a max of B1 M1 is available in **(b)(ii)(B)**			
	Parts (a) & (b)(i)	**Total**	**11**	

Q	Solution	Marks	Total	Comments
5	**Continued**			
	Parts (a) & (b)(i)	**Total**	**11**	
(b)(ii) (A)	$P(Y > 150) = 1 - 0.05 = 0.95$ $P(Y_1 \,\&\, Y_2 \,\&\, Y_3 > 150) = 0.95^3$ $= \underline{\mathbf{0.857 \text{ to } 0.858}}$	B1	**(1)**	AWFW (0.857375)
Note	**1** A calculation of $P(Y > 150) = p$ followed by $p^3 \Rightarrow$ B1 only if result falls within above range			
(B)				
	$V(\bar{Y}) = \frac{(5.1 \text{ to } 7.9)^2}{3}$ **or** $\frac{(26 \text{ to } 61.1)}{3}$ **or** $\underline{\mathbf{8.6 \text{ to } 20.4}}$ **or** $Sd(\bar{Y}) = \frac{5.1 \text{ to } 7.9}{\sqrt{3}}$ **or** $\underline{\mathbf{2.93 \text{ to } 4.57}}$	B1		AWFW (12.32038) Can be implied by what follows AWFW (3.51004)
	$P(\bar{Y} > 162.5) = P\left(Z > \frac{\mathbf{162.5 - 160}}{(\mathbf{5.1 \text{ to } 7.9})/\sqrt{\mathbf{3}}}\right)$	M1		Standardising **162.5** with **160** and $(\mathbf{5.1 \text{ to } 7.9})/\sqrt{\mathbf{3}}$ **(OE)**; allow (160 – 162.5)
	$= P(Z > \underline{\mathbf{0.70 \text{ to } 0.72}})$	A1		AWFW; ignore sign (0.71224)
	$= \underline{\mathbf{0.235 \text{ to } 0.242}}$	A1	**(4)**	AWFW (0.23816)
			5	
Notes	**1** Do **not** give BOD for unclear/dubious/questionable identifications of (A) & (B) **2** If answers to (A) & (B) are not identified, then mark as (A) followed by (B) **3** If answers to (A) & (B) are switched, then 0/5 marks **4** In (B), award of B0 $\Rightarrow$ 0/4 marks **5** In (B), cubing (0.235 to 0.242) $\Rightarrow$ B1 M1 A1 A0 (ie not ISW) **6** In (B), for information, use of (5.1 to 7.9) $\Rightarrow z = (0.548 \text{ to } 0.849) \Rightarrow p = (0.197 \text{ to } 0.292)$			
SC	**1** Use of distribution of total in (B): **B1** for $Sd = (5.1 \text{ to } 7.9)\sqrt{3}$ (OE); **M1** for $P(Z > (487.5 - 480)/((5.1 \text{ to } 7.9)\sqrt{3}))$ (OE); **A1** for (0.70 to 0.72) **A1** for 0.235 to 0.242 (AWFW); award of B0 $\Rightarrow$ 0/4 marks			
		Total	**16**	

Q	Solution	Marks	Total	Comments
6	**Accept the equivalent percentage answers with %-sign (see GN5)**			
(a) (i)	$P(A_1 \cap A_2 \cap A_3) = 0.85^3$ $= \underline{\mathbf{0.614}}$	B1	**(1)**	AWRT (0.614125)
(ii)	$P(A_1 \cap A_2 \cap B) = 0.85^2 \times 0.10$ **or** (0.0722 to 0.0723) **or** 289/4000 $\underline{\times \mathbf{3}}$ $= \underline{\mathbf{0.216 \text{ to } 0.217}}$	M1 A1 A1	**(3)**	OE; do **not** accept additional terms (0.07225) OE AWFW (0.21675)
(iii)	$P(A \cap B \cap C) = 0.85 \times 0.10 \times 0.05$ **or** (0.0042 to 0.0043) **or** 17/4000 $\underline{\times \mathbf{6}}$ $= \underline{\mathbf{0.025 \text{ to } 0.026}}$	M1 A1 A1	**(3)**	OE; do **not** accept additional terms (0.00425) OE AWFW (0.0255)
Notes	**1** Deduct 1 mark for at least one fractional final answer of (i) 4913/8000; (ii) 867/4000; (iii) 51/2000 **2** Award A0 for each alternative fractional final answer [eg (ii) 4335/20000]			
	Part (a)	**Total**	**7**	

Q	Solution	Marks	Total	Comments
6	**Accept the equivalent percentage answers with %-sign (see GN5)**			
	Part(a)	**Total**	**7**	
(b)				
(i)	**(α)** P(OD′) = $0.10 \times 0.75 + 0.05 \times 0.10$	M1		
	PLUS $0.85\ (\times 1)$	A1		CAO
	$= 0.85 + 0.075 + 0.005 =$ **0.93**	A1		CAO
	or			
	(β) P(OD) = $0.10 \times 0.25 + 0.05 \times 0.90 + 0.85 \times 0$	(M1)		See SC 3 below
	$= 0.025 + 0.045 =$ **0.07**	(A1)		CAO
	P(OD′) = $1 - 0.07$ = **0.93**	(A1)		CAO
	or			
	(γ)			Accept probabilities rather than percentages
	Side Effect: None / Slight / Severe / Total Change: 0 / 2.5 / 4.5 / 7.0 No change: 85 / 7.5 / 0.5 / 93.0 Total: 85 / 10.0 / 5.0 / 100.0	(B2)		(0, 2.5, 4.5) **or** (85, 7.5, 0.5) CAO
		(B1)		0.93 CAO
			(3)	
Note	**1** Accept fractional answers of 93/100 and 7/100			
SCs	**1** In **(α)**, P(OD′) = $0.10 \times 0.75 + 0.05 \times 0.10 + 0.15\ (\times 1) = 0.23$ ⇒ M1 A0 A0 (max 1 mark) **2** In **(β)**, P(OD) = $0.10 \times 0.25 + 0.05 \times 0.90 = 0.07$ ⇒ M1 A1 then P(OD′) = 0.93 ⇒ A1 (max 3 marks) **3** In **(β)**, P(OD) = $0.10 \times 0.25 + 0.05 \times 0.90 +$ (not 0.85) × (0) = 0.07 ⇒ M1 A0 then P(OD′) = 0.93 ⇒ A1 (max 2 marks) **4** In **(β)**, P(OD) = $0.10 \times 0.25 + 0.05 \times 0.90 +$ (non-zero term) ⇒ M1 A0 A0 (max 1 mark)			
(ii)	$P(OD \mid B \cup C) = \frac{1-0.93}{0.10+0.05}$ **or** $\frac{0.07}{0.10+0.05}$	M1 M1		Numerator; OE Denominator (See Notes 1 & 2 below)
	= **7/15 or 0.466 to 0.467 or 0.46̇**	A1		CAO/AWFW/CAO (0.46667)
	or			
	$P(OD \mid B \cup C) = \frac{2}{3} \times 0.25 + \frac{1}{3} \times 0.9$	(M1) (M1)		Either term (OE) **PLUS** other term (OE)
	= **7/15 or 0.466 to 0.467 or 0.46̇**	(A1)		CAO/AWFW/CAO (0.46667)
	or			
	From table, $P(OD \mid B \cup C)$			
	= **7/15 or 0.466 to 0.467 or 0.46̇**	(B3)		CAO/AWFW/CAO (0.46667)
			(3)	
Notes	**1** A mark of M1 may be available **in a fraction** even if the resultant probability answer is greater than 1 **2** Values of (1 – 0.93) or 0.07 or 0.15 seen but **not in a fraction** and with no correct answer ⇒ M0 M0 (A0)			
			6	
		Total	**13**	

Q	Solution	Marks	Total	Comments
7	**Accept 3 dp rounding of probabilities from tables**	**Accept the equivalent percentage answers with %-sign (see GN5)**		
(a) **(i)**	$P(\text{Blond} = 5) = \binom{30}{5}(0.25)^5(0.75)^{25}$ $= 142506 \times 0.00097656 \times 0.00075254$ **or** $= 0.2026 - 0.0979$	M1		Correct expression Can be implied by a **correct** answer Ignore additional expressions
	$= \underline{\mathbf{0.104 \text{ to } 0.105}}$	A1	**2**	AWFW (0.104728 / 0.1047)
(ii)	$P(\text{Blond} < 10) = \underline{\mathbf{0.803}}$	B1	**1**	AWRT (0.8034)
(iii)	$P(6 \leq \text{Blond} \leq 12) =$ 0.9784 **or** 0.9493 (p_1)	M1		Seen as **first** term in a **subtraction**
	MINUS 0.2026 **or** 0.3481 (p_2)	M1		Seen as **second** term in a **subtraction**
	$= \underline{\mathbf{0.775 \text{ to } 0.776}}$	A1	**3**	AWFW (0.7758)
Notes	**1** For no method **or** calculation of individual terms: award **B3** for 0.775 to 0.776 (AWFW); **B2** for 0.746 to 0.747 (AWFW); **B2** for 0.630 to 0.631 (AWFW); **B2** for 0.601 to 0.602 (AWFW); **B0** for anything else **2** Answers seen using [(0.7974 or 0.6519) – (0.0216 or 0.0507)] [ie $(1-p_2) - (1-p_1)$] $\Rightarrow$ M1 M1 A1 max **3** Answers seen using $[1 - (p_1 - p_2)]$ even after $(p_1 - p_2)$ [eg $1 - (0.9784 - 0.2026) =$ **0.2242**] $\Rightarrow$ 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 $\Rightarrow$ 0 marks			
(iv)	Mean $= np = 7.5 \Rightarrow P(\text{Blond} \geq 8)$ $= 1 - 0.5143$	M2		
	$= (1 - 0.6736)$ **or** 0.3264 **or** $= 0.5143$ **or** $= (1 - 0.3481)$ **or** 0.6519	(M1)		
	$= \underline{\mathbf{0.485 \text{ to } 0.486}}$	A1	**3**	AWFW (0.4857)
Note	**1** For calculation of individual terms or no method: award **B3** for 0.485 to 0.486 (AWFW); **B1** for 0.326 to 0.327 (AWFW); **B1** for 0.514 to 0.515 (AWFW); **B1** for 0.651 to 0.652 (AWFW); **B0** for anything else			
	Part(a)	**Total**	**9**	

Q	Solution	Marks	Total	Comments
7	**Accept 3 dp rounding of probabilities from tables**	**Accept the equivalent percentage answers with %-sign (see GN5)**		
	Part(a)	**Total**	**9**	
(b) **(i)**	Mean = $\underline{\boldsymbol{np = 16}}$	B1		Equating; seen or used
	$np(1-p)$ **or** npq **or** $\sqrt{np(1-p)}$ **or** $\sqrt{npq}$ $= 2.4^2$ **or** 5.76 **or** 2.4 **but not** $\sqrt{2.4}$	M1		Equating; seen or used
	$np(1-p)$ **or** $npq = 2.4^2$ **or** 5.76	A1		Equating; seen or used
	$p = \underline{\mathbf{0.64}}$ and $n = \underline{\mathbf{25}}$	A1 A1	**5**	Each CAO
Notes	**1** Equating npq to 2.4 (OE) then $\Rightarrow$ B1 M1 A0 A0 A0 (max) followed by M0 A0 in (ii) **2** For any method, answer of $p = 0.64$ (CAO) and $n = 25$ (CAO) $\Rightarrow$ 5 marks **3** For method of 'trial & improvement': B1 (equating/use of $np = 16$); M1 (at least one seen trial combination of **either** integer n **or** $0 < p < 1$); m1 (at least one seen attempt at evaluating npq with **both** integer n **and** $0 < p < 1$ but comparison with 5.76/2.4 **not** required); A1 ($p = 0.64$ CAO); A1 ($n = 25$ CAO)			
(ii)	$P(Y = 20) = \binom{25}{20}(0.64)^{20}(0.36)^5$ $= 53130 \times 0.00013292 \times 0.0060466$	M1		Correct expression Can be implied by a **correct** answer Do **not** ignore additional expressions
	$= \underline{\mathbf{0.0426 \text{ to } 0.0428}}$	A1	**2**	AWFW (0.042702)
		Total	**16**	