Mark Scheme (Results)

October 2022

Pearson Edexcel International Advanced Level In Statistics S2 (WST02) Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

PEARSON EDEXCEL IAL MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

'M' marks
These are marks given for a correct method or an attempt at a correct method. In Mechanics they are usually awarded for the application of some mechanical principle to produce an equation.
e.g. resolving in a particular direction, taking moments about a point, applying a suvat equation, applying the conservation of momentum principle etc.
The following criteria are usually applied to the equation.

To earn the M mark, the equation
(i) should have the correct number of terms
(ii) be dimensionally correct i.e. all the terms need to be dimensionally correct
e.g. in a moments equation, every term must be a 'force x distance' term or 'mass x distance', if we allow them to cancel 'g' s.
For a resolution, all terms that need to be resolved (multiplied by sin or cos) must be resolved to earn the M mark.

M marks are sometimes dependent (DM) on previous M marks having been earned.
e.g. when two simultaneous equations have been set up by, for example, resolving in two directions and there is then an M mark for solving the equations to find a particular quantity – this M mark is often dependent on the two previous M marks having been earned.

'A' marks
These are dependent accuracy (or sometimes answer) marks and can only be awarded if the previous M mark has been earned. E.g. M0 A1 is impossible.

'B' marks
These are independent accuracy marks where there is no method (e.g. often given for a comment or for a graph)

A few of the A and B marks may be f.t. – follow through – marks.

3. General Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- $*$ The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:

If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

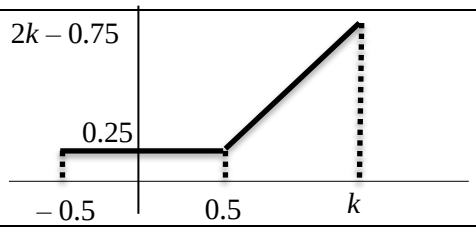
7. Ignore wrong working or incorrect statements following a correct answer.

Special notes for marking Statistics exams (for AAs only)

- Any correct method should gain credit. If you cannot see how to apply the mark scheme but believe the method to be correct then please send to review.
- For method marks, we generally allow or condone a slip or transcription error if these are seen in an expression. We do not, however, condone or allow these errors in accuracy marks.

Question Number	Scheme	Marks
1(a)(i)	$\left[\mathrm{P}\left(F<3 \middle\vert F \sim \mathrm{Po}(1.5)\right)=\right]0.8088$ awrt 0.809	B1
		(1)
(ii)	$\left[\mathrm{P}\left(F \ldots 6\right)=\right]1-\mathrm{P}\left(F \text{ „ } 5\right)$ or 1 – 0.9955	M1
	= 0.0045 awrt 0.0045	A1
		(2)
(b)	$R \sim \mathrm{Po}(10) \ \therefore\left[\mathrm{P}\left(R \text{„} 12\right)\right]=0.7916$ awrt 0.792	M1
	$X \sim \mathrm{B}(15, "0.7916")$	M1
	$\left[\mathrm{P}\left(X=10\right)=\right]{}^{15}C_{10}\left("0.7916"\right)^{10}\left(1-"0.7916"\right)^{5}$	M1
	= 0.11405… awrt 0.114	A1
		(4)
(c)	$H \sim \mathrm{Po}(0.4)$	M1
	$\left[\mathrm{P}\left(H=0\right)=\right]\mathrm{e}^{-0.4}$ [=0.6703…] **or** $\left[\mathrm{P}\left(H>0\right)=\right]1-\mathrm{e}^{-0.4}$ [= 0.32967…]	M1
	Profit = $2.4\times"0.6703..."-3\times"0.32967..."$	dM1
	= 0.6197 awrt 0.62	A1
		(4)

	Notes	Total 11
(a) (i)	**B1**	awrt 0.809
(ii)	**M1**	Writing or using $1-\mathrm{P}\left(F \text{ „ } 5\right)$
	A1	awrt 0.0045
(b)	**M1**	For 0.792 or better
	M1	For writing B(15, " their 0.7916") May be implied by a fully correct method for P(X = 10)
	M1	A correct method to find $\mathrm{P}\left(X=10\right)$ using a binomial distribution (implied by awrt 0.114)
	A1	awrt 0.114
(c)	**M1**	Writing or using Po(0.4) e.g. P(H = 1) = 0.268…
	M1	Correct method to find $\mathrm{P}\left(H=0\right)$ or $\mathrm{P}\left(H>0\right)$ May be implied by awrt 0.67 or 1 – awrt 0.67
	M1dep	Dependent on the previous method mark being awarded. Correct method to find the profit. Allow $7.4\times"0.6703..."+2\times"0.32967..."-5$
	A1	awrt 0.62 Allow 62 p

Question Number	Scheme	Marks
2 (a)		M1 A1
		(2)
(b)	Area = $\frac{1}{4}+\frac{1}{2}\left(\frac{1}{4}+2k-\frac{3}{4}\right)\left(k-\frac{1}{2}\right)=1$ **or** $\frac{1}{4}\left(k+\frac{1}{2}\right)+\frac{1}{2}(2k-1)\left(k-\frac{1}{2}\right)=1$ **or** $\frac{1}{4}+\left[\left(k^2-\frac{3}{4}k\right)-\left(\frac{1}{2}^2-\frac{3}{8}\right)\right]=1$	M1
	$8k^2-6k-5=0$ or $k^2-\frac{3}{4}k-\frac{5}{8}=0$ oe	A1
	$(4k-5)(2k+1)=0$ or $k=\frac{\frac{3}{4}\pm\sqrt{\left(-\frac{3}{4}\right)^2+4\times\left(\frac{5}{8}\right)}}{2}$ oe	M1
	$k = 1.25$*	A1 *
		(4)
(c)	$\left[\int_{-0.5}^{0.5}\frac{1}{4}x\,\mathrm{d}x\right]+\int_{0.5}^{1.25}2x^2-\frac{3}{4}x\,\mathrm{d}x=[0]+\left[\frac{2x^3}{3}-\frac{3}{8}x^2\right]_{0.5}^{1.25}$	M1A1
	$=\left(\frac{2\times1.25^3}{3}-\frac{3}{8}\times1.25^2\right)-\left(\frac{2\times0.5^3}{3}-\frac{3}{8}\times0.5^2\right)$	dM1
	$=\frac{93}{128}$ awrt 0.727	A1
		(4)
(d)	$[Q_1 =]$ 0.5	B1
	$Q_3^2-\frac{3}{4}Q_3+0.125=0.5$ or $Q_3^2-\frac{3}{4}Q_3-0.375=0$ oe	M1
	$Q_3=\frac{\frac{3}{4}\pm\sqrt{\left(-\frac{3}{4}\right)^2+4\times\left(\frac{1}{8}\right)}}{2}$	M1
	IQR ="1.093…" – 0.5	M1
	= 0.593… awrt 0.59	A1
		(5)

	Notes	Total 15
(a)	**M1**	A correct shape. Must not go below zero
	A1	A correct shape including labels. Allow 1.25 for k and 1.75 for $2k – 0.75$
(b)	**M1**	Equating area to 1 (0.75 if ¼ + is not present) A correct method to find the area - allow 1 sign error. May be implied by a correct 3 term quadratic. If using integration then must get to an equivalent equation as the main scheme
	A1	For a correct 3 term quadratic
	M1	A correct method to solve a 3 term quadratic (May be implied by 1.25 **and** –0.5) If the 3 term quadratic is incorrect then a correct method for solving their 3 term quadratic must be shown
	A1*	1.25 must be the only answer given. All previous marks must be awarded.
(c)	**M1**	$\int_{-0.5}^{0.5}\frac{1}{4}x\,\mathrm{d}x+\int_{0.5}^{1.25}2x^2-\frac{3}{4}x\,\mathrm{d}x$ or $\int_{0.5}^{1.25}2x^2-\frac{3}{4}x\,\mathrm{d}x$ on its own

	A1	Correct integration of $2x^2 - \frac{3}{4}x$
	dM1	Dep on previous M being awarded. Substituting in the correct limits (implied by $\frac{93}{128}$ or awrt 0.727 Condone 0.726) If the integration is incorrect, we must see the correct non simplified substitution into their integral. Ignore substitution into $\frac{1}{8}x^2$. Useful values to look for are $\frac{125}{96}, \frac{75}{128}, \frac{1}{12}$ and $\frac{3}{32}$ or $\frac{275}{384}$ and $\pm\frac{1}{96}$
	A1	For $\frac{93}{128}$ or awrt 0.727
(d)	**B1**	For 0.5 May be seen in their IQR
	M1	A correct equation for finding Q_3
	M1	A correct method to solve a 3 term quadratic (implied by $Q_3 = \frac{3+\sqrt{33}}{8}$ or $\frac{3-\sqrt{33}}{8}$ or awrt 1.093 or awrt – 0.343) If the 3 term quadratic is incorrect then a correct method for solving their 3 term quadratic must be shown. If using $Q_3^2 - \frac{3}{4}Q_3 - \frac{5}{8} = 0$ then M0
	M1	Correct method to find the IQR ft their Q_3 or implied by awrt 0.593
	A1	awrt 0.59 Allow $\frac{-1+\sqrt{33}}{8}$

Question Number	Scheme	Marks
3(a)	$H_0: p = 0.35$ $H_1: p \neq 0.35$	B1
	$P(X \leq 8) =$ awrt 0.0303 or $P(X \geq 21) =$ awrt 0.0173 or $P(X \leq 20) =$ awrt 0.9827	M1
	$[P(X \leq 8) =]$ awrt 0.0303 and $[P(X \geq 21) =]$ awrt 0.0173	A1
	CR $X \leq 8$ and $X \geq 21$	A1
		(4)
(b)	0.0476	B1ft
		(1)
(c)	$H_0: p = 0.028$ $H_1: p > 0.028$	B1
	$Y \sim B(250, 0.028) \Rightarrow Y \sim$ Po(7)	M1
	$P(Y \geq 11) = 1 - P(Y \leq 10)$ or $P(Y \geq 13) = 1 - 0.973$	M1
	$= 0.0985$ or Critical region $Y \geq 13$	A1
	There is insufficient evidence to suggest that the <u>proportion</u> of sunflower <u>seeds</u> that grow to a height of more than 3 metres is now <u>greater</u> than 0.028	A1
		(5)

	Notes	Total 10
(a)	**B1**	Both hypotheses in terms or p or π
	M1	One of the correct probability statements. Implied by a correct critical region
	A1	awrt 0.0303 and awrt 0.0173
	A1	Both parts of the critical region given. Allow alternative notation e.g. $X < 9$ and $X > 20$ Do not allow as probability statements.
(b)	**B1**	For 0.0476 Allow awrt 0.0475 (calculator) or ft their **two** critical regions provided probabilities are seen in part (a) Common ft is for $X \leq 7$ and $X \geq 21$ gives 0.0297
(c)	**B1**	Both hypotheses in terms or p or π – If already lost the mark in (a) for incorrect letter allow any letter
	M1	Po(7) written or used
	M1	Writing or using $1 - P(Y \leq 10)$ or $1 - 0.9015$ or $1 - 0.973$ (May be implied by 0.0985) or may be implied by $Y \geq 13$ provided Po(7) seen or used If using N(7, 6.804) or N(7, 7) allow use of $1 - P(Y \leq 10)$ or $1 - P(Y \leq 10.5)$ B(250, 0.028) gives 0.09549… and implies M1 N(7, 6.804) gives awrt 0.09 (Calc gives 0.08983…) or awrt 0.13 (Calc gives 0.125…) and implies M1 N(7, 7) gives awrt 0.09 (Calc gives 0.09293…) or awrt 0.13 (Calc gives 0.1284…) and implies M1
	A1	awrt 0.0985 or CR: $Y \geq 13$ provided Po(7) seen or used (Allow any letter for the CR)
	A1	Independent of the hypotheses but dependent on the previous M1A1 being awarded. A correct conclusion in context. Allow amount/number for proportion, sunflowers for seeds and increased oe for greater. Ignore any non-contextual statements

Question Number	Scheme	Marks
4(a)	$X \sim$ B(20, 0.4)	M1
	$P(5 \leqslant X < 8) = P(X \leqslant 7) - P(X \leqslant 4)$ or 0.4159 – 0.0510	M1
	= 0.3649 awrt 0.365	A1
		(3)
(b)	$Y \sim N(56, 33.6)$	M1A1
	$\frac{n - 0.5 - "56"}{\sqrt{"33.6"}} = -1.98$	M1M1 B1
	$n = 45$	A1cao
		(6)
	Notes	**Total 9**

(a)	**M1**	Writing or using B(20, 0.4)
	M1	For writing or using $P(X \leqslant 7) - P(X \leqslant 4)$ or P(X = 5) + P(X = 6) + P(X = 7)
	A1	awrt 0.365
(b)	**M1**	For writing or using N(56,…) (May be seen in a correct standardisation)
	A1	For writing or using N(56, 33.6) (May be seen in a correct standardisation)
	M1	For standardising (allow $\pm$) using any letter, their "56" and "33.6" and putting = to z value, where $1 < \|z\| < 2$ Condone missing ± 0.5 Condone 1 – standardisation, using any letter, their "56" and "33.6" and putting = to z value, where $1 < \|z\| < 2$
	M1	M1 for using a continuity correction -0.5 if using n or +0.5 if using $n - 1$. Either in their standardisation or after finding ***n*** (but not both) No need to put = to z value
	B1	For using $\pm$ 1.98 or better (calc gives) 1.97914…
	A1	45 – must see a correct continuity correction or an awrt 45.02 or awrt 45.03 45 from no working is 0/6

Question Number	Scheme	Marks
5(a)	$d = 7$	B1
	$\frac{c}{3} - \frac{7}{6} = 1 - \frac{1}{6}("7" - c)^2$	M1
	$\frac{c}{3} - \frac{7}{6} = 1 - \frac{1}{6}("49" - 2\times"7"c + c^2)$ oe or $c^2 - 12c + 36 = 0$ oe	dM1
	$(c-6)^2 = 0 \ \therefore c = 6$ *	A1*
		(4)
(b)	$P(X > 3.5) = 1 - \frac{1}{6}(3.5-3)^2$	M1
	$= \frac{23}{24}$ oe awrt 0.958	A1
		(2)
(c)	$P(3.5 < X < 5.5) = \left(\frac{5.5}{3} - \frac{7}{6}\right) - \left(\frac{1}{6}(3.5-3)^2\right) \left[= \frac{5}{8}\right]$ oe	M1
	$P(X > 4.5 \mid 3.5 < X < 5.5) = \frac{\left(\frac{5.5}{3} - \frac{7}{6}\right) - \left(\frac{4.5}{3} - \frac{7}{6}\right)}{"5/8"}$	M1
	$= \frac{8}{15}$ oe awrt 0.533	A1
		(3)

	Notes	Total 9
(a)	**B1**	realising $d = 7$
	M1	Forming an equation in c with their d or d
	dM1	Dependent on previous M1. Multiplying out brackets and would reduce to a 3 term quadratic correct for their d or d
	A1*	All previous marks must be awarded. For solving the correct 3TQ and statement
(b)	**M1**	Substitution of 3.5 into correct expression
	A1	Allow equivalent fractions or awrt 0.958
(c)	**M1**	Correct method to calculate $P(3.5 < X < 5.5)$ may use $1 - "\frac{23}{24}"$ for $\left(\frac{1}{6}(3.5-3)^2\right)$ Useful figures are $\left(\frac{5.5}{3} - \frac{7}{6}\right) = \frac{2}{3}$ and $\left(\frac{1}{6}(3.5-3)^2\right) = \frac{1}{24}$
	M1	Correct method using their 5/8 Useful figure is $\left(\frac{5.5}{3} - \frac{7}{6}\right) - \left(\frac{4.5}{3} - \frac{7}{6}\right) = \frac{1}{3}$
	A1	Allow equivalent fractions or awrt 0.533

Question Number	Scheme	Marks
6(a)	$\left(2\times\frac{a}{a+7}\times\frac{1}{4}\times\frac{3}{4}\right)+\left(\frac{a}{a+7}\times\frac{1}{4}\times\frac{1}{4}\right)=\frac{63}{256}$ or $\frac{a}{a+7}\times\left(1-\left(\frac{3}{4}\right)^2\right)=\frac{63}{256}$ or $\frac{a}{a+7}\times\left[\left(\frac{1}{4}\right)^2+2\times\frac{1}{4}\times\frac{3}{4}\right]=\frac{63}{256}$	M1 M1
	$\frac{a}{7+a}=\frac{63}{256}\div\frac{7}{16}$ or $\frac{a}{7+a}=\frac{9}{16}$ $\quad\therefore a=9$ *	A1*
		(3)
(b)	Range (R) 0, 5, 10 (and 15)	B1
	Bag: $\mathrm{P}(20)=\frac{9}{16}$ and $\mathrm{P}(5)=\frac{5}{16}$ and $\mathrm{P}(10)=\frac{2}{16}$	B1
	$\left[\mathrm{P}(R=0)=\right]\frac{5}{16}\times\frac{1}{4}\times\frac{1}{4}+\frac{2}{16}\times\frac{3}{4}\times\frac{3}{4}$	M1
	$\left[\mathrm{P}(R=5)=\right]2\times\frac{5}{16}\times\frac{1}{4}\times\frac{3}{4}+\frac{5}{16}\times\frac{3}{4}\times\frac{3}{4}+2\times\frac{2}{16}\times\frac{1}{4}\times\frac{3}{4}+\frac{2}{16}\times\frac{1}{4}\times\frac{1}{4}$	M1
	$\left[\mathrm{P}(R=10)=\right]\frac{9}{16}\times\frac{3}{4}\times\frac{3}{4}$	M1
	R: 0, 5, 10, 15 r: $\frac{23}{256}$, $\frac{89}{256}$, $\frac{81}{256}$, $\frac{63}{256}$	A1cao
		(6)

	Notes		Total 9
(a)	**M1**	For use of $\frac{a}{a+7}$ in an equation	
	M1	Setting up a correct equation to find the value of a	
	A1*	$a=9$ with at least one further correct line of working	
(b)	**B1**	For the 3 ranges 0, 5 and 10 and no extra incorrect ones or all extras have probability of 0	
	B1	For the correct 3 probabilities written or used for the bag $\frac{2}{16}$ and/or $\frac{5}{16}$ may be implied by a correct answer for $\mathrm{P}(R=0)$ or $\mathrm{P}(R=5)$ and $\frac{9}{16}$ may be implied by a correct answer for $\mathrm{P}(R=10)$	
		NB p and q must be consistent for the next 3 method marks	
	M1	A correct method to find one probability for $\mathrm{P}(R=0)$ or $\mathrm{P}(R=5)$ or $\mathrm{P}(R=10)$ allow $p\times q\times q+r\times(1-q)\times(1-q)$ or $2\times p\times q\times(1-q)+p\times(1-q)\times(1-q)+2\times r\times q\times(1-q)+r\times q\times q$ or $m\times(1-p)\times(1-p)$ where m, p, q and r are probabilities. (May be implied by $\frac{23}{256}$ or $\frac{89}{256}$ or $\frac{81}{256}$)	
	M1	A correct method to find two probabilities from $\mathrm{P}(R=0)$ or $\mathrm{P}(R=5)$ or $\mathrm{P}(R=10)$ allow $p\times q\times q+r\times(1-q)\times(1-q)$ or $2\times p\times q\times(1-q)+p\times(1-q)\times(1-q)+2\times r\times q\times(1-q)+r\times q\times q$ or $m\times(1-p)\times(1-p)$ where m, p, q and r are probabilities. (May be implied by 2 from $\frac{23}{256}$ or $\frac{89}{256}$ or $\frac{81}{256}$)	
	M1	A correct method to find all 3 probability for $\mathrm{P}(R=0)$ and $\mathrm{P}(R=5)$ and $\mathrm{P}(R=10)$ allow $p\times q\times q+r\times(1-q)\times(1-q)$ or $2\times p\times q\times(1-q)+p\times(1-q)\times(1-q)+2\times r\times q\times(1-q)+r\times q\times q$ or $m\times(1-p)\times(1-p)$ where m, p, q and r are probabilities. (May be implied by $\frac{23}{256}$ and $\frac{89}{256}$ and $\frac{81}{256}$) or these 3 probabilities that sum to $\frac{193}{256}$	

	A1	Correct ranges with correct associated probabilities attached. All extras must have an associated probability of 0 (Does not have to be seen in a table) **NB Allow decimal answers correct to 3 decimal places** $\frac{23}{256} = 0.090$ $\frac{89}{256} = 0.348$ $\frac{81}{256} = 0.316$ $\left[\frac{63}{256} = 0.246\right]$

Question Number	Scheme	Marks
7(i)	$\frac{a+b}{2}=9$ and $\frac{13-5}{b-a}=\frac{1}{5}$ or $a = -11$ and $b = 29$	M1
	$\mathrm{P}\left(X>\frac{"29"-"11"}{3}\right)\left[=\mathrm{P}(X>6)\right]$ or $\mathrm{P}\left(X>\frac{9\times 2}{3}\right)\left[=\mathrm{P}(X>6)\right]$ $=\frac{23}{40}$	M1A1
		(3)
(ii)	$\frac{1}{12}(c-1)^2=0.48 \Rightarrow c=3.4$	M1
	$\mathrm{E}(Y)=\frac{1+"3.4"}{2}$	M1
	$\mathrm{E}(Y^2)=0.48+"\left(\frac{1+3.4}{2}\right)"^2 = 5.32$	M1A1
		(4)
(iii)	$W \sim \mathrm{U}[0,20]$ $X \sim \mathrm{U}[10,20]$ $Y \sim \mathrm{U}[0,10]$	
	$W<6$ or $W>14$ or $X<12$ or $Y>8$ any letter, ignore distribution	M1
	$2\times\mathrm{P}(W<6)=2\times\frac{(6-0)}{20}$ or $2\times\mathrm{P}(W>14)=2\times\frac{(20-14)}{20}$ or $\mathrm{P}(W<6)=\frac{6-0}{20}$ **and** $\mathrm{P}(W>14)=\frac{20-14}{20}$ or $\mathrm{P}(X>14)=\frac{20-14}{10}$ or $\mathrm{P}(Y<6)=\frac{6-0}{10}$	M1
	$\mathrm{P}(8<W<12)=\frac{12-8}{20}$ or $\mathrm{P}(X<12)=\frac{12-10}{10}$ or $\mathrm{P}(Y>8)=\frac{10-8}{10}$	M1
	$\mathrm{P}(\text{ shortest side} < 6)="\frac{3}{10}"+"\frac{3}{10}"+"\frac{1}{5}"$ or $"\frac{1}{5}"+"\frac{3}{5}" = \frac{4}{5}$	dM1A1
		(5)
	Alternative 1	
	$6<W<8$ or $12<W<14$ any letter, ignore distribution	M1
	$\mathrm{P}(6<W<8)=\frac{8-6}{20}$ or $\mathrm{P}(12<W<14)=\frac{14-12}{20}$	M1
	$\mathrm{P}(6<W<8)=\frac{1}{10}$ and $\mathrm{P}(12<W<14)=\frac{1}{10}$ or $2\times\mathrm{P}(6<W<8)=2\times\frac{1}{10}$ or $2\times\mathrm{P}(12<W<14)=2\times\frac{1}{10}$	M1
	$\mathrm{P}(\text{shortest side} < 6)=1-"\frac{1}{10}"-"\frac{1}{10}"$ or $1-"\frac{2}{10}" = \frac{4}{5}$	dM1A1
		(5)
	Alternative 2	
	$W>10$ or $12<W<14$ or $6<W<8$ or $W<10$ any letter, ignore distribution	M1
	$\mathrm{P}(12<W<14)=\frac{14-12}{20}$ and $\mathrm{P}(W>10)=\frac{20-10}{20}$ or $\mathrm{P}(6<W<8)=\frac{8-6}{20}$ and $\mathrm{P}(W<10)=\frac{10-0}{20}$	M1
	$\mathrm{P}(12<W<14\mid W>10)=\frac{"1/10"}{"1/2"}\left[=\frac{1}{5}\right]$ or $\mathrm{P}(6<W<8\mid W<10)=\frac{"1/10"}{"1/2"}\left[=\frac{1}{5}\right]$	M1
	$\mathrm{P}(\text{ shortest side} < 6)=1-"\frac{1}{5}" = \frac{4}{5}$	dM1A1
		(5)
	NB Any answer of $\frac{4}{5}$ scores 5/5 provided it has not come from incorrect working	
		Total 12

M2 for $\mathrm{P}(12<X<14)=\frac{14-12}{10}$ or $\mathrm{P}(6<Y<8)=\frac{8-6}{10}$

	Notes	
	NB Allow any letter throughout the question	
(i)	**M1**	For setting up 2 correct equations May be implied correct answers for *a* and *b*
	M1	Realising the need to find P($X > 6$) or allow use of "their *a*" and " their *b*" or their "$\frac{a+b}{2}=9$"
	A1	23/40 oe or 0.575
(ii)	**M1**	Correct equation to find *c* with *c* = …
	M1	Correct method for finding E(*Y*) using "their *c*"
	M1	Correct method for finding E(Y^2) using "their E(Y)^2"
	A1	For 5.32 (Allow $\frac{133}{25}$)
(iii)	**M1**	For identifying a correct region required to answer the question. Allow any letter and ignore the distribution associated with the letter. May be implied by $W<6$ or $W>14$ or $X<12$ or $Y>8$
	M1	For a correct method to find a required probability. Allow any letter but the probability must be associated to the correct distribution. e.g. $2\times P(W<6)=2\times\frac{3}{10}$ or $2\times P(W>14)=2\times\frac{3}{10}$ or $P(W<6)=\frac{3}{10}$ **and** $P(W>14)=\frac{3}{10}$ or $P(X>14)=\frac{3}{5}$ or $P(Y<6)=\frac{3}{5}$
	M1	For a correct method to find a second required probability. Allow any letter but the probability must be associated to the correct distribution. e.g. $P(8<W<12)=\frac{1}{5}$ or $P(X<12)=\frac{1}{5}$ or $P(Y>8)=\frac{1}{5}$
	dM1	Dependent on previous 3 M marks. For $P(W<6)+P(W>14)+P(8<W<12)$ or $P(X>14)+P(X<12)$ or $P(Y<6)+P(Y>8)$ ft their probabilities
	A1	cao
Alternative 1		
(iii)	**M1**	For identifying a correct region required to answer the question. Allow any letter and ignore the distribution associated with the letter. May be implied by $6<W<8$ or $12<W<14$
	M1	For a correct method to find a required probability. Allow any letter but the probability must be associated to the correct distribution. e.g. $P(6<W<8)=\frac{1}{10}$ or $P(12<W<14)=\frac{1}{10}$
	M1	For a correct method to find a second required probability. Allow any letter but the probability must be associated to the correct distribution. e.g. $P(6<W<8)=\frac{1}{10}$ and $P(12<W<14)=\frac{1}{10}$ or $2\times P(6<W<8)=2\times\frac{1}{10}$ or $2\times P(12<W<14)=2\times\frac{1}{10}$
	dM1	Dependent on previous 3 M marks. For $1-"\frac{1}{10}"-"\frac{1}{10}"$ or $1-"\frac{2}{10}"$
	A1	cao
Alternative 2		
	M1	For identifying a correct region required to answer the question. Allow any letter and ignore the distribution associated with the letter. May be implied by $W>10$ or $12<W<14$ or $W<10$ or $6<W<8$
	M1	For a correct method to find both the required probabilities. Allow any letter but the probability must be associated to the correct distribution. e.g. $P(12<W<14)=\frac{1}{10}$ **and** $P(W>10)=\frac{1}{2}$ or $P(6<W<8)=\frac{1}{10}$ **and** $P(W<10)=\frac{1}{2}$
	M1	For correct use of conditional probability e.g. $\frac{"1/10"}{"1/2"}$
	dM1	Dependent on previous 3 M marks. For $1-"\frac{1}{5}"$
	A1	cao

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