S2_2020_10_MS

7

Question Number		Scheme	Marks	
1 (a)	$\int_{1}^{2} k \left(\frac{1}{2}x\right)$	$\int_{1}^{2} k \left(\frac{1}{2} x^{3} - 3x^{2} + ax + 1 \right) dx [= 1]$		
	$k\left[\frac{1}{8}x^{4} - x^{3} + \frac{1}{2}ax^{2} + x\right]_{1}^{2} \left[=1\right]$			
	k(2-8+	$-2a+2)-k\left(\frac{1}{8}-1+\frac{1}{2}a+1\right)=1$ or $k(2a-4)-k\left(\frac{1}{8}+\frac{1}{2}a\right)=1$	dM1	
	$-\frac{33}{8}k + \frac{33}{8}k + 3$	$\frac{3}{2}ka = 1$: $k(12a - 33) = 8*$	A1 *	
			(4)	
(b)	$\frac{\mathrm{d}\mathbf{f}(x)}{\mathrm{d}x} =$	$k\left(\frac{3}{2}x^2 - 6x + a\right)$	M1	
	$\frac{3}{2}x^2 - 6x + 5 = 0 \text{or} \frac{4}{9}x^2 - \frac{16}{9}x + \frac{40}{27} = 0$			
	$x = \frac{6 \pm \sqrt{6^2 - 4 \times 1.5 \times 5}}{3}$			
	x = 2 -	$x = 2 - \frac{\sqrt{6}}{3}$ oe or 1.183 awrt 1.18		
			(4)	
		Notes	Total 8	
1(a)	M1	Attempting to integrate $f(x)$, (at least one term $x^n \to x^{n+1}$). Ignore limits. No Need to a	equate to 1	
	A1	Fully correct integration. Allow not simplified. Ignore limits and accept any letters. Allow $+ C$ No Need to equate to 1		
	dM1	Dep on 1 st M1. Subst in correct limits, subtracting results and equate to 1 Allow if they have + C the use of F(2) = 1 and F(1) = 0 to form 2 equations and solve to eliminate + C		
	A1*	Answer is given. Correct solution only. At least one correct line of working required $k(2a-4)-k(\frac{1}{8}+\frac{1}{2}a)=1$ and the final given answer.	between	
(b)	M1	Attempting to differentiate $f(x)$, (at least one term $x^n \to x^{n-1}$). Condone missing k or incorrect value for k		
	dM1	Dependent on first Method mark being awarded. Putting their differential (or multiple May be implied by awrt 1.18 or awrt 2.82	$e of) = \overline{0}$	
	M1	Correct method for solving their 3 term quadratic equation. May be implied by awrt	1.18 or	
	awrt 2.82 Minimum for method if final answer is incorrect is of the form $\frac{6 \pm \sqrt{6}}{3}$			
		awrt 2.82 Minimum for method if final answer is incorrect is of the form $\frac{3}{3}$		

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Question		Scheme	Marks
INUITIOCI	1		
2(a)	f(w) =	$\frac{1}{8}$ -1.4 < w < 6.6	M1
		0 otherwise	Al
		×	(2)
(b)	E(W) =	2.6 oe	B1
			(1)
	$(1.6 - \alpha)$	$\times "\frac{1}{2}" = 0.35$	M1
(c)	(110 00)	8 12	
		$\alpha = -1.2$ oe	Alcso (2)
		1	(2)
(d)	P(1.2 <)	$W < 2.4) = (2.4 - 1.2) \times "\frac{1}{8}"$	M1
		$=\frac{3}{10}$ or 0.15 oc	Δ1ft
		20 01011000	AIIt
		1/	(2)
(e)	P(W > 2)	$2 \mid 1, 2 < W < 2, 4$ = $\frac{0.4 \times \frac{1}{8}}{8}$	M1
	1 (// 2 4	"0.15"	
		$=\frac{1}{2}$ awrt 0.333	A1
		3	(2)
	The rand	dom variable <i>Y</i> is the number of days the train is between 1.2 minutes and 2.4 minutes	(2)
(f)	late Y~	B(40, "0.15")	M1
	$P(Y \ge 10)$	$D = 1 - P(Y \le 9) \text{ or } 1 - 0.9328$	M1
		= 0.0672 awrt 0.0672	A1 (3)
L	1		
2()		Notes	Total 12
2(a)	M1	Notes pdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6 \\ pdf of the form [f(w)=] \end{cases}$ where p is a probability allow use of one/both \leq signs. Allow equivalent	Total 12 of \leq instead
2(a)	M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of p	Total 12 of \leq instead ent for the 0 letters
2(a)	M1 A1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of p	Total 12of \leq insteadent for the 0lettersconsistent.
2(a)	M1 A1 B1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of p is a probability allow use of \leq instead of one/both < signs. Allow any letter but must be otherwise. Allow any letter but must be otherwise. Allow any letter but must be otherwise.	Total 12 $f \leq instead$ ent for the 0 letters consistent.
2(a)	M1 A1 B1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of f	Total 12 $f \leq$ insteadent for the 0lettersconsistent.
2(a)	M1 A1 B1 M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of provide the signs. Allow any letter/mix of provide the signs. Allow any letter but must be a setting up equation $(1.6 - \alpha) \times$ " their p" = 0.35 with $0 or \frac{7}{20} = \frac{2.8}{8} and \alpha = 1.6 - 0 or F(1.6) - F(\alpha) = 0.35 using their F(w) in the form bw + c where 0 < b < 1$	Total 12 $f \leq$ insteadent for the 0lettersconsistent.
2(a) (b) (c)	M1 A1 B1 M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of p otherwise. Allow any letter/mix of p otherwise. Allow any letter but must be of the setting up equation $(1.6 - \alpha) \times$ " their p " = 0.35 with $0 or \frac{7}{20} = \frac{2.8}{8} and \alpha = 1.6 - 1.6 = 0.35 using their F(w) in the form bw + c where 0 < b < 1Allow for \int_{-1.6}^{1.6} "their f(w)"dw = 0.35 or with an attempt to integrate (at least one term of the set one term of the se$	Total 12 $f \leq instead$ ent for the 0 letters consistent. "2.8"
2(a) (b) (c)	M1 A1 B1 M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of f	Total 12 $f \leq$ insteadent for the 0lettersconsistent."2.8"correct).
2(a) (b) (c)	M1 A1 B1 M1 A1 cso	Notespdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6\\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct).
2(a) (b) (c)	M1 A1 B1 M1 A1 cso	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1	Total 12 $f \leq$ insteadent for the 0lettersconsistent."2.8"correct). p in the
2(a) (b) (c) (d)	M1 A1 B1 M1 A1 cso M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of p otherwise. Allow any letter/mix of p otherwise. Allow any letter but must be of 2.6 oe	Total 12 $f \leq$ insteadent for the 0lettersconsistent."2.8"correct). p in the
2(a) (b) (c) (d)	M1 A1 B1 M1 A1 cso M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of $1 = 1.6 - 1.6 $	Total 12 $f \leq instead$ ent for the 0lettersconsistent."2.8"correct). p in the
2(a) (b) (c) (d)	M1 A1 B1 M1 A1 cso M1 A1ft	Notespdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1	Total 12 $f \leq$ insteadent for the 0lettersconsistent."2.8"correct). p in the
2(a) (b) (c) (d)	M1 A1 B1 M1 A1 cso M1 A1 ft	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct).
2(a) (b) (c) (d)	M1 A1 B1 M1 A1 cso M1 A1 ft M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct). y) in the to integrate
2(a) (b) (c) (d) (e)	M1 A1 B1 M1 A1 cso M1 A1 ft M1	Notespdf of the form $[f(w) =] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct). y) in the to integrate
2(a) (b) (c) (d) (e)	M1 A1 B1 M1 A1 cso M1 A1 ft M1 A1	Notespdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of 1 fully correct allow use of \leq instead of one/both < signs. Allow any letter/mix of 2.6 oe	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct).) in the to integrate
2(a) (b) (c) (d) (e) (f)	M1 A1 B1 A1 A1 A1 A1 A1 A1 A1 A1 A1 ft M1 A1 A1 M1 A1 M1	Notespdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6\\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of $prodeconderwise$. Allow any letter but must be of $prodeconderwise$. Allow for $prodeconderwise$. The implementation of $prodeconderwise. The implementation of the form bw + c where 0 < b < 1Allow for \int_{1.2}^{1.6} "their f(w)"dw with an attempt to integrate (at least one term correct).Fit their prodeconderwise is a probability of prodeconderwise. The implementation of prodeconderwise is a probability\frac{0.4 \times "their \frac{1}{8}" or \frac{0.4}{1.2}" implied by \frac{1}{3} Allow for \int_{2}^{2.4} "their f(w)"dw with an attempt toprodeconderwise is a probability or prodeconderwise is a probability or prodeconderwise is a probability(at least one term correct) for numeratorAllow 0.3 or 0.33prodeconderwise is a prodeconderwise is a prodeconde$	Total 12 $f \leq instead$ $f \leq instead$ ent for the 0 letters consistent. "2.8" correct). p in the to integrate
2(a) (b) (c) (d) (e) (f)	M1 A1 B1 A1 CSO M1 A1ft M1 A1ft M1 A1	Notespdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of fully correct allow use of \leq instead of one/both < signs. Allow any letter but must be equivalent of the probability of the probability allow use of \leq instead of one/both < signs. Allow any letter but must be equivalent of 2.6 oesetting up equation $(1.6 - \alpha) \times$ "their p " = 0.35 with $0 or \frac{7}{20} = \frac{2.8}{8} and \alpha = 1.6 - or F(1.6) - F(\alpha) = 0.35 using their F(w) in the form bw + c where 0 < b < 1Allow for \int_{\alpha}^{1.6} "their f(w)"dw = 0.35 oe with an attempt to integrate (at least one term of fully for f_{\alpha}^{1.6} "their p" where "their \frac{1}{8}" is a probability or F(2.4) - F(1.2) using their F(w) form bw + c where 0 < b < 1 Implied by 0.15Allow for \int_{12}^{2.4} "their f(w)"dw with an attempt to integrate (at least one term correct).Ft their p as long as the answer is a probability\frac{0.4 \times "their \frac{1}{8}"}{"their (d)"} or \frac{0.4}{"1.2"} implied by \frac{1}{3} Allow for \int_{2}^{2.4} "their f(w)"dw with an attempt to integrate (at least one term correct).Releast one term correct) for numeratorAllow 0.3 or 0.33Writing or using B(40, "their 0.15") Implied by mean of 40 \times "their (d)"Writing or using B(40, "their 0.15") Implied by mean of 40 \times "their mean")$	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct). ") in the to integrate
2(a) (b) (c) (d) (e) (f)	M1 A1 B1 A1 cso A1 cso M1 A1 ft M1 A1 ft M1 A1 M1 M1	Notespdf of the form $[f(w)=] \begin{cases} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{cases}$ where p is a probability allow use of of one/both < signs. Allow equivale otherwise. Allow any letter/mix of for for the form $[f(w)=] \begin{pmatrix} p & -1.4 < w < 6.6 \\ 0 & otherwise \end{pmatrix}$ where p is a probability allow use of of one/both < signs. Allow any letter/mix of for for for the form $f(w) = 0.35$ with $0 or \frac{7}{20} = \frac{2.8}{8} and \alpha = 1.6 - 0 or F(1.6) - F(\alpha) = 0.35 using their F(w) in the form bw + c where 0 < b < 1Allow for \int_{\alpha}^{1.6} "their f(w)"dw = 0.35 oe with an attempt to integrate (at least one term of fusion f_{\alpha}^{1.6} "their f(w)"dw = 0.35 or with an attempt to integrate (at least one term of form bw + c where 0 < b < 1If using F(1.6) - F(\alpha) = 0.35 then F(w) must be correct. Allow different letters(2.4 - 1.2) \times "their p" where "their \frac{1}{8}" is a probability or F(2.4) - F(1.2) using their F(w) form bw + c where 0 < b < 1 Implied by 0.15Allow for \int_{1.2}^{2.4} "their f(w)"dw with an attempt to integrate (at least one term correct).Ft their p as long as the answer is a probability\frac{0.4 \times "their \frac{1}{8}" or \frac{0.4}{"1.2"} implied by \frac{1}{3} Allow for \int_{2}^{2.4} "their f(w)"dw with an attempt to integrate (at least one term correct).If their or using B(40, "their 0.15") Implied by mean of 40 \times "their (d)"Writing or using 1 - P(Y \le 9) Allow for 1 - P\left(z \le \frac{9.5 \text{ or } 9 - "their mean"} "their sd"$	Total 12 f ≤ instead ent for the 0 letters consistent. "2.8" correct). p) in the to integrate

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Question		Scheme	Marks
3(a)(i)	$X \sim B(1)$	0, 0.45)	M1
5(u)(l)	P(X < 1)	P(X < 1) = 0.0233 awrt 0.0233	
	$I(X \leq I)$	awit 0.0255	AI
(ii)	$P(X \ge 6) = 1 - P(X \le 5) \text{ or } 1 - 0.7384$		M1
		= 0.2616 awrt 0.262	A1
(b)	<i>F</i> ~N(54, 29.7)		
	$\frac{c+0.5-54}{2} \le -1.6449$ or $\frac{d-0.5-54}{2} \ge 1.6449$		
	$\sqrt{29.7}$ $\sqrt{29.7}$ $\sqrt{29.7}$ $\sqrt{29.7}$		
	c = 44 an	ad $d = 64$	Alcso
			(7)
(c)	$H_0: p = 0$	$H_1: p < 0.45$ $H_1: p < 0.45$ $H_2: p < 0.45$	Bl
	$Y \sim B(30)$	$(1,0.45)$ therefore $P(Y \le 8) = 0.03$ or CR $Y \le 8$	Bl
	8 is in the	e critical region or Reject H_0 oe or significant	dMl
	therefore	the data collected supports the manufacturer's claim .	AI (4)
		Notos	(4) Total 15
(a)(i)	M1	Writing or using $B(10, 0.45)$ in (i) or (ii) implied by a correct answer to (i) or	
(<i>a</i>)(1)	A1	awrt 0.0233	(11)
(ii)	M1	For writing or using $1 - P(X \le 5)$ oe	
(11)	A1	awrt 0.262	
(b)	M1	For writing or using N(54,)	
	A1	For writing or using N(54, 29.7)	
	MI	For standardising (allow \pm) using their "54" and "29.7" and putting = to z val	ue where
	NI I	$1 < z < 2$ Condone missing ± 0.5	
	M1	M1 for using a continuity correction ± 0.5 in standardisation. No need to put =	to <i>z</i> value
	D1	For using 1.6449 or better (calc gives) 1.64485 Allow if written then gone of	on to use
	BI	1.65 or 1.64 or better in equation	
	A1	One correct inequality. Allow written as an equation. Allow with 1.65/1.64 or	better
	Alcso	All previous marks awarded. Both <i>c</i> and <i>d</i> correct integers	
	NB: <i>c</i> and <i>d</i> correct with no working can be awarded full marks		
(c)	B1 Both hypotheses correct in terms of p or π Must be attached to H ₀ and H ₁		
	BI	0.03 or better (0.03120) or CR stated as $Y \le 8$ oe do not accept $P(Y \le 8) = .$	for CR
	Condone 0.97 or better (0.96879)		
	alvii	Dep on 2 ⁴⁶ B1 A correct statement – need not be contextual but do not allow	
		Allow opposite conclusion if 2-tail hypotheses given	
	A1	Correct conclusion for their H_1 . If H_1 is 2- tail the opposite conclusion must be	e given. No
		hypotheses or H ₁ $p > 0.45$ is A0. Allow belief instead of claim. Allow the dat	a collected
		supports that the proportion/percentage/probability/number/amount oe of	flawed
		plates has decreased/reduced/is not 0.45/has changed oe	

Question		Scheme	Marks
4(a)	Common	Spotted-orchids occur singly/randomly/independently	B1
.()			(1)
(b)(i)	$S \sim Po(4.5)$	5)	
	P(S=6) =	$=\frac{e^{-4.5}4.5^6}{6!} \text{ or } P(S \le 6) - P(S \le 5)$	M1
	=	= 0.1281 awrt 0.128	A1
(ii)	P(4 < S <	$10) = P(S \le 9) - P(S \le 4)$ or $0.9829 - 0.5321$	M1
		= 0.4508 awrt 0.451	A1
			(4)
(c)	$H_0: \lambda = 9$	$\frac{\partial H_1: \lambda > 9}{\partial \lambda} = \frac{\partial (\lambda + 10)}{\partial \lambda} = \frac{\partial (\lambda + 10)}{\partial \lambda} = \frac{\partial (\lambda + 10)}{\partial \lambda}$	B1
	$M \sim \text{Po}($	9) $P(M \ge 11) = 1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$	M1
		$= 0.294 \qquad \text{or } CR M \ge 15$	Al
	Accept H	or insignificant or 11 does not lie in the critical region	
		isumetent evidence to support Juan's bene r	(5)
(d)	$T \sim N(90,$	90)	B1
	P(T < 70)	0) = P $\left(Z < \pm \left(\frac{69.5 - 90}{\sqrt{90}}\right)\right)$ or P(Z < ± 2.160) awrt 2.16	M1
		= 0.0154 awrt 0.0154	A1
	IZ D (O)	$\mathbf{D}(\mathbf{A}, \mathbf{A}, \mathbf{D}, \mathbf{A}) = \mathbf{D}_{\mathbf{A}} (\mathbf{A}, \mathbf{A})$	(3)
(e)	$V \sim Po(20)$	$O(0 \times 0.012) = Po(2.4) V \sim = Po(2.4)$	M1
	P(V=0)	$+ P(V = 1) = e^{-2.4}(1 + 2.4)$	dM1
		= 0.30844 awrt 0.308	A1
			(2)
		Notos	(3) Total 16
4(a)	B1	Notes One of the given reasons. No context needed	(3) Total 16
4(a) (b)(i)	B1 M1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$	(3) Total 16
4(a) (b)(i)	B1 M1 A1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128	(3) Total 16
4(a) (b)(i) (ii)	B1 M1 A1 M1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$	(3) Total 16
4(a) (b)(i) (ii)	B1 M1 A1 M1 A1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451	(3) Total 16
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5	(3) Total 16 instead of 9.
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr	(3) Total 16 instead of 9. ect CR or
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corrawrt 0.3 or 0.29 or better (0.2940)Output Descent to $M \ge 15$ or $M \ge 15$ or $M \ge 15$ or $M \ge 15$ or $M \ge 15$	(3) Total 16 instead of 9. rect CR or
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1 A1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corrawrt 0.3 or 0.29 or better (0.2940)0.3 or 0.29 or better (0.2940) or $M \ge 15$ oeSC: Condenge $P(X \le 10) = 0.7$ or better (0.705082) for M1A1	(3) Total 16 instead of 9. ect CR or
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1 A1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corrawrt 0.3 or 0.29 or better (0.2940)0.3 or 0.29 or better (0.2940)O.7 or better (0.705988) for M1A1Description: Mit All Action of Action of the formula of the f	(3) Total 16 instead of 9. rect CR or
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1 A1 A1 dM1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corrawrt 0.3 or 0.29 or better (0.2940)0.3 or 0.29 or better (0.2940)Or or better (0.2940)Or or better (0.705988) for M1A1Dep on M1 A1. A correct statement- no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given.	(3) Total 16 instead of 9. rect CR or
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1 A1 dM1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corrawrt 0.3 or 0.29 or better (0.2940)0.3 or 0.29 or better (0.2940) or $M \ge 15$ oeSC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1Dep on M1 A1. A correct statement- no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given.Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 0$ or to A 0. Allow along instand of holiof. Alternative: There is insufficient avide	(3) Total 16 instead of 9. rect CR or ng non eses or H ₀ na to
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradicting contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted-orchids has increased//is not 9/has characterized.	(3) Total 16 instead of 9. ect CR or ng non eses or H ₀ nce to anged oe
4(a) (b)(i) (ii) (c)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted- orchids has increased // is not 9/has cha (with the bold words included).	(3) Total 16 instead of 9. rect CR or ng non eses or H ₀ nce to anged oe
4(a) (b)(i) (ii) (c) (d)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1 A1 B1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted-orchids has increased//is not 9/has cha (with the bold words included). Writing or using N(90, 90)	(3) Total 16 instead of 9. ect CR or ng non eses or H ₀ nce to anged oe
4(a) (b)(i) (ii) (c) (d)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1 B1 B1 M1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted- orchids has increased // is not 9/has ch (with the bold words included). Writing or using N(90, 90) Standardising with 68.5 or 69.5 or 70.5 and their mean and sd	(3) Total 16 instead of 9. rect CR or ng non eses or H ₀ nce to anged oe
4(a) (b)(i) (ii) (c) (d)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1 B1 M1 A1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradicting contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothed $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted- orchids has increased // is not 9/has cha (with the bold words included). Writing or using N(90, 90) Standardising with 68.5 or 69.5 or 70.5 and their mean and sd awrt 0.0154 NB Poisson gives 0.01275	(3) Total 16 instead of 9. ect CR or ng non eses or H ₀ nce to anged oe
4(a) (b)(i) (ii) (c) (d) (e)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1 B1 M1 A1 M1 A1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H ₀ and H ₁ in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H ₀ is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted- orchids has increased // is not 9/has ch (with the bold words included). Writing or using N(90, 90) Standardising with 68.5 or 69.5 or 70.5 and their mean and sd awrt 0.0154 NB Poisson gives 0.01275 Writing or using Po(200 × 0.012) Allow Po(200 × "their d")	(3) Total 16 instead of 9. rect CR or ng non eses or H ₀ nce to anged oe
4(a) (b)(i) (ii) (c) (d) (e)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1 B1 M1 A1 M1 A1 M1 dM1	Notes One of the given reasons. No context needed For $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128 Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451 Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5 Writing or using Po(9) and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corr awrt 0.3 or 0.29 or better (0.2940) 0.3 or 0.29 or better (0.2940) or $M \ge 15$ oe SC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1 Dep on M1 A1. A correct statement– no context needed but do not allow contradictir contextual comments. Allow opposite conclusion if 2-tail hypotheses given. Correct conclusion. If H_0 is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted- orchids has increased // is not 9/has ch (with the bold words included). Writing or using N(90, 90) Standardising with 68.5 or 69.5 or 70.5 and their mean and sd awrt 0.0154 NB Poisson gives 0.01275 Writing or using Po(200 × 0.012) Allow Po(200 × "their d") Dependent on using Poison. For using / writing $P(V = 0) + P(V = 1)$ or $e^{-\lambda}(1 + \lambda)$ or	(3) Total 16 instead of 9. ect CR or ang non eses or H_0 nce to anged oe $r P(V \leq 1)$ oe
4(a) (b)(i) (ii) (c) (d) (e)	B1 M1 A1 M1 A1 B1 M1 A1 dM1 A1 B1 M1 A1 M1 dM1 A1	NotesOne of the given reasons. No context neededFor $\frac{e^{-\lambda}\lambda^6}{6!}$ with any value for λ or writing or using $P(S \le 6) - P(S \le 5)$ awrt 0.128Writing or using $P(S \le 9) - P(S \le 4)$ awrt 0.451Both hypotheses correct. Must be attached to H_0 and H_1 in terms of λ or μ . Allow 4.5Writing or using $P(9)$ and $1 - P(M \le 10)$ or $P(M \ge 15) = 0.0415$ oe Implied by corrawrt 0.3 or 0.29 or better (0.2940)0.3 or 0.29 or better (0.2940) or $M \ge 15$ oeSC: Condone $P(X \le 10) = 0.7$ or better (0.705988) for M1A1Dep on M1 A1. A correct statement – no context needed but do not allow contradicting contextual comments. Allow opposite conclusion if 2-tail hypotheses given.Correct conclusion. If H_0 is 2- tail the opposite conclusion must be given. No hypothe $\lambda < 9$ gets A0. Allow claim instead of belief. Alternative: There is insufficient evide support hat the number of Common Spotted-orchids has increased / is not 9/has chailed (with the bold words included).Writing or using N(90, 90)Standardising with 68.5 or 69.5 or 70.5 and their mean and sd awrt 0.0154NB Poisson gives 0.01275Writing or using Po(200 × 0.012) Allow Po(200 × "their d")Dependent on using Poison. For using / writing $P(V = 0) + P(V = 1)$ or $e^{-\lambda}(1 + \lambda)$ or awrt 0.308NB Binomial gives 0.3066	(3) Total 16 instead of 9. ect CR or ng non eses or H_0 nce to anged oe r $P(V \leq 1)$ oe

S2 2020 10 MS

Question Number		Scheme	Marks		
5(a)	$\mathrm{E}(T^2)$	$= \int_{0}^{3} \frac{1}{50} \left(18t^{2} - 2t^{3} \right) dt + \int_{3}^{5} \frac{1}{20} t^{2} dt$	M1		
	$= \left[\frac{1}{50}\left(6t^{3} - \frac{t^{4}}{2}\right)\right]_{0}^{3} + \left[\frac{t^{3}}{60}\right]_{3}^{5} \text{ or } = \left[\frac{3}{25}t^{3} - \frac{t^{4}}{100}\right]_{0}^{3} + \left[\frac{t^{3}}{60}\right]_{3}^{5} \text{ oe}$				
	$= \frac{1}{50} \left(6 \times 3^3 - \frac{3^4}{2} \right) + \left(\frac{125}{60} - \frac{27}{60} \right) \text{ or } = \frac{1}{50} \left(162 - \frac{81}{2} \right) + \left(\frac{25}{12} - \frac{9}{20} \right) \text{ oe}$				
	$=\frac{1219}{300}=4.063$				
	Var(7	$T = "4.063" - (1.66)^2$	M1		
	````	= 1.3077 awrt 1.31	A1		
			(5)		
(b)	$\int_{3}^{t} \frac{1}{20} dx$	$c + C$ where $C = 0.9$ or $\int_{0}^{3} \frac{1}{50} (18 - 2t) dt$ or using F(5) =1 to find C	M1		
		$\int 0   t < 0$	B1		
		$\left[ F(t) - \right] < \frac{1}{50} \left( 18t - t^2 \right) \text{ or } 1.62 - \frac{\left(18 - 2t\right)^2}{200} \qquad 0 \le t \le 3$	A1		
		$\frac{1}{20}t + 0.75 \qquad 3 < t \le 5$	A1		
		1 <i>t</i> > 5	(4)		
(c)	P( <i>T</i> >	$(-2) = 1 - \left(\frac{1}{50} \left(18 \times 2 - 2^2\right)\right)$ or $1 - \int_0^2 \frac{1}{50} \left(18 - 2t\right) dt$	M1		
		$=\frac{9}{25}$ or 0.36	A1		
			(2)		
(d)	P(0 <	T < 3.66) = F(3.66)	Ml		
		= 0.933	Al (2)		
		Notes	(2) Total 13		
(a)	M1	Intention to find $E(T^2)$ correctly. They must add the 2 integrals and attempt to integrate	(at least		
		one term $x^n \to x^{n+1}$ ). Algebraic integration must be seen. Ignore limits. Allow as part of condone " (1.66) ² " occurring twice. If no algebraic integration shown it is M0.	Var(T)		
	A1	Correct integration			
	M1d	dep on previous M being awarded for correct limits and attempt to substitute. If no work An attempt may be implied by a correct answer <b>or</b> 1219/300 <b>or</b> 243/100 <b>or</b> 49\30 oe	ing shown		
	M1	For their $E(T^2) - 1.66^2$			
	A1	awrt 1.31 Allow 2452/1875 oe			
(b)	M1	For a correct method to find the $3^{rd}$ line including limits unless using $F(5) = 1$ method.			
	<b>B</b> 1	2 nd line correct – any letter. Ignore missing inequality			
	Al	3 rd line correct– any letter. Ignore missing inequality	1 :		
	AI	Fully correct CDF All in terms of the same letter (Ignore LHS). Allow < instead of $\leq$ and versa Allow "otherwise" for the range on the 1 st or last line but not both	nd vice		
(c)	M1	For finding $1 - F(2)$ using their second line or starting again. Must subst in 2			
	A1	cao			
(d)	M1	For realising they need F(3.66) Allow F(3.66) $[-F(0)]$ allow F("their mean +2") $[-F(0)]$	]		
	A1	Cao allow answer as a fraction			

## S2_2020_10_MS

Question Number		Scheme	Marks
6(a)	A sampli probabil or the pr	ing distribution is <u>all</u> the <u>values</u> of a <u>statistic</u> and the associated <u>lities</u> <u>cobability distribution</u> of the <u>statistic</u> .	B1
(1,-)	D(amo11()	(40) = 0.5 $P(modium(80)) = 0.2$ $P(lorgo(150)) = 0.2$	(1) D1
(0)	Range (k	(40) = 0.3, P(medium(80)) = 0.3, P(large(150)) = 0.2	BI R1
	$\sum D(D - 0)$	$) - \frac{1}{2} - $	
	$\sum_{k=0}^{k} \left( \frac{1}{k} - 0 \right)$	(10, 0.5) + 0.5 + 0.2 = 0.10	IMI I
	(40,40,80	0) (40,80,80)	D1
	(80,80,1)	50) (40 80 150) (40 150 150)	DI
	$[P(R = 40) = ]3 \times ("0.5" \times "0.3"^{2}) + 3 \times ("0.5"^{2} \times "0.3")$		
	$\begin{bmatrix} P(R = 70) = ]_{3 \times ("0, 3"^{2} \times "0, 2")} + 2 \times ("0, 3" \times "0, 2"^{2}) = 0.00 \end{bmatrix}$		
	$\frac{\left[ \Gamma \left( \Lambda - 70 \right) - J \right] 5 \times \left( 0.5 \times 0.27 \right) + 5 \times \left( 0.5 \times 0.27 \right) = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J = 0.09}{\left[ \Gamma \left( 1 - 2 \right) - J \right] 5 \times \left[ \Gamma \left( 1 - 2 \right) - J = 0.0}{\left[ \Gamma \left( 1 - 2 \right$		
	P(R=1)	$10) = \int 3 \times ("0.5"^2 \times "0.2") + 3 \times ("0.5" + "0.2"^2) + 6 \times ("0.5" \times "0.3" \times "0.2") = 0.39$	
	R	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Alcao
	/	0.10 0.30 0.09 0.39	(7)
(c)	(1-"0.09	$(9'')^n < 0.2$ or $((0.91'')^n < 0.2$	M1
	[n >]17.0	065	M1
	n = 18		Al
			(3)
		Notes	Total 11
6(a)	B1	A correct explanation with the words in bold. Allow equivalent words eg outo values	comes for
(b)	B1	Correct probabilities – may be seen in an equation or implied by a correct prob	oability
		for $R = 0$ or for 2 correct probabilities from those for $R = 40, R = 70, R = 110$	-
	B1	All four ranges correct with no extra.	
	MI	Correct method for finding $P(R = 0)$	~+
		required but no incorrect combinations must be seen (may use bag size rather t	n than
	B1	numbers in bag) May be implied by a correct probability for $P(R = 40)$ , $P(R =$	70) and
		P(R = 110) or by correct working seen for each of the 7 combinations (no need	d for the
		number of ways of arranging ie $3 \times \text{or } 6 \times$ ) eg $(40,40,80) = 0.5^2 \times 0.3$	
	<u>M1</u>	Correct method for one of the probabilities for $P(R = 40)$ , $P(R = 70)$ , $P(R = 110)$	0)
	M1	Correct method for a second probability for $P(R = 40)$ , $P(R = 70)$ , $P(R = 110)$ probabilities add up to 1.	or the 4
	A1	Correct answer only. Allow answers as a fraction. Need not be in a table but	
		probabilities must be attached to the correct range	
(c)	M1	Setting up a correct inequality using their 0.09 Allow written as an equation.	
		For 17.1 or better allow $\frac{\log 0.2}{\log^{-0.91^{\circ}} 0.2}$ or $\log_{-0.91^{\circ}} 0.2$ oe If inequality/equation is	incorrect
	M1	but of the form $(n)^n < 0.2$ $(n)^n = 0.2$ where $0 < n < 1$ this mark can be award	led if
		but of the form $(p) < 0.2$ $(p) = 0.2$ where $0  this mark can be award working is shown$	
	A1	18 do not accept $n > 18$ or $n < 18$ if final answer	