1	$\lambda = (1.2 + 2.3) \div 2$ $= 1.75$ $e^{-1.75}\left(\frac{1.75^2}{2} + \frac{1.75^3}{3!}\right)$ $= 0.421$ (3 sf)	**M1** **A1** **M1** **A1** [4]	Attempt combined mean, allow 1.2 + 2.3 Correct mean Allow incorrect mean. Allow end errors (1 and/or 4)
		Total: 4	
2 (i)	$\frac{6}{\sqrt{120}}$ oe seen $\frac{30-29}{\left(\frac{6}{\sqrt{120}}\right)}$ (= 1.826) $P(z > '1.826') = 1 - \Phi('1.826')$ $= 0.034$ (2 sf)	**B1** **M1** **M1** **A1** [4]	Or $6^2/120$ oe seen ± Allow without √120. No sd/var mix Correct tail consistent with their working 0.0339
(ii)	No *n* is large (⩾30) Sample mean is (appr) normally distrib or The CLT applies oe	B1 B1 [2]	1st B1 for either comment 2nd B1 for'No'with 2nd comment (No mark for 'No' alone)
		Total: 6	
3 (i)	$\frac{3420}{60}(= 57)$ $\frac{60}{59}\left(\frac{195200}{60} - '57'^2\right)$ (= 4.40678) = 4.41 (3 sf)	**B1** **M1** **A1** [3]	 Oe As final answer
(ii)	$'57' \pm z\sqrt{\frac{'4.40678'}{60}}$ $z = 2.326$ [56.4 to 57.6] (3 sf)	**M1** **B1** **A1** [3]	 2.326 – 2.329 (accept 2.33 if no better seen) NB: use of biased variance in (ii) can score in full
		Total: 6	

4 (i)	$k\int_1^2(3-x)dx=1$	**M1**	Attempt $\int f(x) = 1$, ignore limits or $\frac{k}{2}(h_1 + h_2) = 1$
	$k\left[3x-\frac{x^2}{2}\right]_1^2=1$	**A1**	Correct integration & limits or $\frac{k}{2}(2 + 1) = 1$
	$(k(6 - 2 - (3 - 0.5)) = 1)$		
	$k \times 1.5 = 1$ or $k \times \frac{3}{2} = 1$ or $k = \frac{1}{1.5}$ oe		
	$k = \frac{2}{3}$ **AG**	**A1** [3]	No errors seen
(ii)	$\frac{2}{3}\int_1^m(3-x)dx = 0.5$ oe $\int$ from m to 2	**M1***	Attempt Int f(x) = 0.5, ignore limits oe Or use of area of trapezium
	$\left(\frac{2}{3}\left[3x-\frac{x^2}{2}\right]_1^m=0.5\right)$		
	$\frac{2}{3}\left[3m-\frac{m^2}{2}-2.5\right]=0.5$	**dep M1***	Sub of correct limits into their integral. Or trapezium using 1 and m/m and 2 Any correct 3-term QE = 0 or $(m-3)^2 = 2.5$
	$m^2 - 6m + 6.5 = 0$ oe	**A1**	
	$\left(m=\frac{6\pm\sqrt{36-4\times6.5}}{2}=1.42 \text{ or } 4.58\right)$		
	$m = 1.42$ (3 sf)	**A1** [4]	or $\frac{6-\sqrt{10}}{2}$ oe; single correct ans
		Total: 7	

5	**(i)**	Po(1.6) stated or implied	**M1**	
		$P(X > 3) = 1 - e^{-1.6}\left(1 + 1.6 + \frac{1.6^2}{2} + \frac{1.6^3}{3!}\right)$	**M1**	Allow M1 for 1 – P($X \leqslant 3$), incorrect λ and allow one end error
		= 0.0788 (3 sf)	**A1** [3]	SR Use of Bin scores B1 only for 0.0788
	(ii)	$\lambda = \frac{n}{2500}$	**B1**	or $e^{-\mu} < 0.05$ M1
		$e^{-\frac{n}{2500}} < 0.05$ Allow = Allow incorrect λ	**M1**	or $\frac{2499}{2500}$ B1 $\left(\frac{2499}{2500}\right)^n < 0.05$ M1
		$-\frac{n}{2500} < \ln 0.05$ Attempt ln bs	**M1**	$-\mu < \ln 0.05$ M1 ($\mu > 2.9957$) $n = \mu \times 2500$ B1
		$n > 7489.3$ (1 dp) Smallest $n = 7490$	**A1** [4]	$n\ln\frac{2499}{2500} < \ln 0.05$ M1 Smallest $n = 7488$ A1 Smallest $n = 7490$ A1
			Total: 7	
6	**(i)**	E(T) = 9 × 78 + 7 × 66 (= 1164)	**B1**	Or 9 × 78 + 7 × 66 – 1200
		Var(T) = 9 × 7² + 7 × 5² (= 616)	**B1**	
		$\frac{1200 - '1164'}{\sqrt{'616'}}$ (= 1.450)	**M1**	± Allow without √
		P(z < 1.450) = Φ (1.450) = 0.927 (3 sf)	**M1** **A1** [5]	Correct tail consistent with their mean
	(ii)	E(D) = 66 – 78 (= –12)	**B1**	Both needed
		Var(D) = 7² + 5² (= 74)		
		$\frac{0 - ('-12')}{\sqrt{74}}$ (= 1.395)	**M1**	± Allow without √
		P(D > 0) = 1 – Φ ('1.395') 0.0815 (3 sf)	**M1** **A1** [4]	Correct tail consistent with their mean Similar scheme for P(M – W) < 0
			Total: 9	

7 (i)	Prob could be different later in day or on a different day oe	**B1** [1]	or any explanation why not random or "Not random" or "Not representative"
(ii)	Looking for decrease (or improvement) H_0: P(not arrive) = 0.2 H_1: P(not arrive) < 0.2	**B1** **B1** [2]	oe Allow "$p = 0.2$"
(iii)	Concluding that prob has <u>decreased</u> (or publicity has worked) when it hasn't oe	**B1** [1]	In context
(iv)	P($X = 0$) and P($X = 1$) attempted P($X \leqslant 2$) = $0.8^{30} + 30 \times 0.8^{29} \times 0.2 +$ $^{30}C_2 \times 0.8^{28} \times 0.2^2$ (= 0.0442) P($X \leqslant 3$) = $0.8^{30} + 30 \times 0.8^{29} \times 0.2 +$ $^{30}C_2 \times 0.8^{28} \times 0.2^2 + {}^{30}C_3 \times 0.8^{27} \times 0.2^3$ = 0.123 cr is $X \leqslant 2$ P(Type I) = 0.0442 (3 sf)	**M1** **M1** **B1** **A1** **A1** [5]	B(30, 0.2) Not nec'y added May be implied by calc P($X \leqslant 2$) or P($X \leqslant 3$) Attempt P($X \leqslant 2$) Or '0.0442' + $^{30}C_3 \times 0.8^{27} \times 0.2^3 = 0.123$
(v)	3 is outside cr No evidence that p has decreased (or that publicity has worked)	**M1** **A1** √ [2]	Comparison of 3 with their cr or P($X \leqslant 3$) = 0.123 which is > 0.05 Correct conclusion. No contradictions
		Total: 11	
		Total for paper: 50	