Mark Scheme 4733
June 2006

1		$\mu = \frac{3}{37}\int_3^4 x^3 dx = \frac{3}{37}\left[\frac{x^4}{4}\right]_3^4$ [= $3\frac{81}{148}$] $\frac{3}{37}\int_3^4 x^4 dx = \frac{3}{37}\left[\frac{x^5}{5}\right]_3^4$ = $12\frac{123}{185}$ or 12.665 $\sigma^2 = 12\frac{123}{185} - 3\frac{81}{148}^2$ = **0.0815**	M1 M1 A1 A1 M1 A1 **6**	Integrate xf(x), limits 3 & 4 *[can be implied]* [$\frac{525}{148}$ or 3.547] Attempt to integrate x^2f(x), limits 3 & 4 Correct indefinite integral, any form $\frac{2343}{185}$ or in range [12.6, 12.7] *[can be implied]* Subtract their μ^2 Answer, in range [0.0575, 0.084]
2	(i)	Find P($R \geq 6$) or P($R < 6$) = 0.0083 or 0.9917 Compare with 0.025 [can be from N] [0.05 if "empty LH tail stated] Reject H_0	M1 A1 B1 **4** A1√	Find P(= 6) from tables/calc, OR RH critical region P(≥ 6) in range [0.008, 0.0083] or P(< 6) = 0.9917 OR CR is 6 with probability 0.0083/0.9917 Explicitly compare with 0.025 [or 0.975 if consistent] OR state that result is in critical region Correct comparison and conclusion, √ on their *p*
	(ii)	$n = 9$, P(≤ 1) = 0.0385 [> 0.025] $n = 10$, P(≤ 1) = 0.0233 [< 0.025] Therefore n = **9**	M1 A1 B1 **3**	At least one, or n = 8, P(≤ 1) = 0.0632 Both of these probabilities seen, don't need 0.025 Answer n = 9 only, indep't of M1A1, *not* from P(= 1)
3	(i)	$(140 - \mu)/\sigma = -2.326$ $(300 - \mu)/\sigma = 0.842$ Solve to obtain: μ = **257.49** σ = **50.51**	M1 B1 A1√ M1 A1 A1 **6**	One standardisation equated to Φ^{-1}, allow "1–", σ^2 Both 2.33 and 0.84 at least, ignore signs Both equations completely correct, √ on their z Solve two simultaneous equations to find one variable μ value, in range [257, 258] σ in range [50.4, 50.55]
	(ii)	Higher as there is positive skew	B1 B1 **2**	"Higher" or equivalent stated Plausible reason, allow from normal calculations
4	(i)	Each element equally likely to be selected (and all selections independent) OR each possible sample equally likely	B1 **1**	One of these two. "Selections independent" alone is insufficient, but don't need this. An example is insufficient.
	(ii)	B(6, 5/8) ${}^6C_4\, p^4\, (1 - p)^2$ = **0.32187**	M1 M1 A1√ **3**	B(6, 5/8) stated or implied, allow e.g. 499/799 Correct formula, any p Answer, a.r.t. 0.322, can allow from wrong p
	(iii)	N(37.5, 225/16) $\frac{39.5 - 37.5}{3.75}$ = 0.5333 $1 - \Phi(0.5333)$ = **0.297**	B1 B1 M1 dep A1 dep M1 A1 **6**	Normal, mean 37.5, or 37.47 from 499/799, 499/800 14.0625 or 3.75 seen, allow 14.07/14.1 or 3.75 Standardise, wrong or no cc, np, npq, no $\sqrt{n}$ Correct cc, $\sqrt{npq}$, signs can be reversed Tables used, answer < 0.5, p = 5/8 Answer, a.r.t. 0.297 SR: np < 5: Po(np) stated or implied, B1

5	(i)	B(303, 0.01) ≈ Po(3.03)	B1 B1 **2**	B(303, 0.01) stated, allow p = 0.99 or 0.1 Allow Bin implied clearly by parameters Po(3.03) stated or implied, can be recovered from (ii)
	(ii)	$e^{-3.03}(1+3.03+\frac{3.03^2}{2})$ = 0.4165 **AG**	M1 A1 **2**	Correct formula, ± 1 term or "1 – " or both Convincingly obtain 0.4165(02542) [Exact: 0.41535]
	(iii)	302 seats ⇒ μ = 3.02 $e^{-3.02}(1+3.02)$ = 0.1962 0.196 < 0.2 So **302** seats.	M1 M1 A1 A1 A1 **5**	Try smaller value of μ Formula, at least one correct term Correct number of terms for their μ 0.1962 [or 0.1947 from exact] Answer 302 only
	SR: SR: SR:	B(303, 0.99): B1B0; M0; M1 then N(298.98,2.9898) or equiv, standardise: M1A1 total 4/9 p = 0.1: B(303, 0.1), N(30.3, 27.27) B1B0; Standardise 2 with np & $\sqrt{npq}$, M1A0; N(0.1n, 0.09n); standardise with np & $\sqrt{npq}$; solve quadratic for $\sqrt{n}$; n = 339: M1M1M1A1, total 6/9 B(303, 0.01) ≈ N(3.03, 2.9997): B1B0; M0A0; M1A0		
6	(i)	Customers arrive independently	B1 **1**	Valid reason in context, allow "random"
	(ii)	1 – 0.9921 = **0.0079**	M1 A1 **2**	Poisson tables, "1 –", or correct formula ± 1 term Answer, a.r.t. 0.008 [1 – 0.9384 = 0.0606: M1A0]
	(iii)	N(48, 48) $z = \frac{55.5-48}{\sqrt{48}}$ = 1.0825 1 – Φ(1.0825) = **0.1394**	B1 B1√ M1 dep A1 dep M1 A1 **6**	Normal, mean 48 Variance or SD same as mean√ Standardise, wrong or no cc, μ = λ Correct cc, √λ Use tables, answer < 0.5 Answer in range [0.139, 0.14]
	(iv)	$e^{-\lambda}$ < 0.02 λ > –ln 0.02 = 3.912 0.4t = 3.912: t = 9.78 minutes t = 9 minutes 47 seconds	M1 M1 A1 M1 A1 **5**	Correct formula for P(0), OR P(0 | λ = 4) at least ln used OR λ = 3.9 at least by T & I 3.91(2) seen OR λ = 3.91 at least by T & I Divide λ by 0.4 or multiply by 150, any distribution 587 seconds ± 1 sec *[inequalities not needed]*

7	(i)	$\frac{c - 4000}{60 / \sqrt{50}} = 1.645$ Solve c = 4014 [4013.958] Critical region is **> 4014**	M1 B1 A1√ M1 A1 A1√ **6**	Standardise unknown with √50 or 50 *[ignore RHS]* z = 1.645 or –1.645 seen Wholly correct eqn, √ on their z [1 – 1.645: M1B1A0] Solve to find c Value of c, a.r.t. 4014 Answer "> 4014", allow ≥, √ on their c, needs M1M1
	(ii)	Use "Type II is: accept when H_0 false" $\frac{4020 - 4014}{60 / \sqrt{50}}$ = 0.7071 [0.712 from 4013.958] 1 – Φ(0.7071) = **0.240** [0.238 from 4013.958]	M1dep depM1 A1√ A1 M1 A1 **6**	Standardise 4020 and 4014√ , allow 60^2, cc With √50 or 50 Completely correct LHS, √ on their c z-value in range [0.707, 0.712] Normal tables, answer < 0.5 Answer in range [0.2375, 0.2405]
	(iii)	Smaller Smaller cv, better test etc	B1 B1 **2**	"Smaller" stated, no invalidating reason Plausible reason
	(iv)	Smaller Smaller cv, larger prob of Type I etc	B1 B1 **2**	"Smaller" stated, no invalidating reason Plausible reason
	(v)	No, parent distribution known to be normal	B2 **2**	"No" stated, convincing reason SR: If B0, "No", reason that is not invalidating: B1