Mark Scheme 4733
January 2007

For over-specified answers (> 6SF where inappropriate) deduct 1 mark, no more than once in paper.

1	$\frac{22-\mu}{5} = -\Phi^{-1}(0.242)$ $= -0.7$ $\mu =$ **25.5**	M1 A1 B1 A1	 **4**	Standardise with Φ^{-1}, allow +, "1 –" errors, cc, $\sqrt{5}$ or 5^2 Correct equation including signs, no cc, can be wrong Φ^{-1} 0.7 correct to 3 SF, can be + Answer 25.5 correct to 3 SF
2	(i) 900 ÷ 12 = **75**	B1	**1**	75 only
	(ii) (a) True, first choice is random (b) False, chosen by pattern	B1 B1	**1** **1**	True stated with reason based on first choice False stated, with any non-invalidating reason
	(iii) Not equally likely e.g. P(1) = 0, or triangular	M1 A1	 **2**	"Not equally likely", or "Biased" stated Non-invalidating reason
3	Let R be the number of 1s $R \sim B(90, 1/6)$ $\approx N(15, 12.5)$ $\frac{13.5-15}{\sqrt{12.5}}$ [= –0.424] **0.6643**	B1 B1 B1 M1 A1 A1	 **6**	B(90, 1/6) stated or implied, e.g. Po(15) Normal, $\mu = 15$ stated or implied 12.5 or $\sqrt{12.5}$ or 12.5^2 seen Standardise, *np* and *npq*, allow errors in √ or cc or both √ and cc both right Final answer, a.r.t. 0.664. [Po(15): 1/6]
4	(i) $\overline{w} = 100.8 \div 14 = 7.2$ $\frac{938.70}{14} - \overline{w}^2$ [= 15.21] $\times 14/13$ = **16.38**	B1 M1 M1 A1	 **4**	7.2 seen or implied Use Σw^2 – their $\overline{w}^2$ Multiply by $n/(n-1)$ Answer, a.r.t. 16.4
	(ii) N(7.2, 16.38 ÷ 70) [= N(7.2, 0.234)]	B1 B1√ B1√	 **3**	Normal stated Mean their $\overline{w}$ √ Variance [their (i)√ ÷ 70], allow arithmetic slip
5	(i) $\lambda = 1.2$ Tables or formula used **0.6626**	B1 M1 A1	 **3**	Mean 1.2 stated or implied Tables or formula [allow ± 1 term, or "1 –"] correctly used Answer in range [0.662, 0.663] [.3012, .6990, .6268 or .8795: B1M1A0]
	(ii) B(20, 0.6626√) $^{20}C_{13}\ 0.6626^{13} \times 0.3374^7$ **0.183**	M1 M1 A1	 **3**	B(20, *p*), *p* from (i), stated or implied Correct formula for their *p* Answer, a.r.t. 0.183
	(iii) Let S be the number of stars $S \sim Po(24)$ $\approx N(24, 24)$ $\frac{29.5-24}{\sqrt{24}}$ [= 1.1227] **0.8692**	B1 B1 B1√ M1 A1 A1	 **6**	Po(24) stated or implied Normal, mean 24 Variance 24 or 24^2 or $\sqrt{24}$, √ if 24 wrong Standardise with λ, λ, allow errors in cc or √ or both √λ and cc both correct Answer, in range [0.868, 0.8694]

6	(i)	$\left[ax+\frac{bx^2}{2}\right]_0^2=1$ $2a + 2b = 1$ **AG**	M1 B1 A1 **3**	Use total area = 1 Correct indefinite integral, or convincing area method Given answer correctly obtained, "1" appearing before last line [if + c, must see it eliminated]
	(ii)	$\left[\frac{ax^2}{2}+\frac{bx^3}{3}\right]_0^2=\frac{11}{9}$ $2a+\frac{8b}{3}=\frac{11}{9}$ Solve simultaneously $a=\frac{1}{6}$, $b=\frac{1}{3}$	M1 B1 A1 M1 A1 A1 **6**	Use $\int xf(x)dx$ = 11/9, limits 0, 2 Correct indefinite integral Correct equation obtained, a.e.f. Obtain one unknown by correct simultaneous method a correct, 1/6 or a.r.t 0.167 b correct, 1/3 or a.r.t. 0.333
	(iii)	e.g. P(< 11/9) = 0.453, *or* $\left[ax+\frac{bx^2}{2}\right]_0^m=0.5, m=1.303 \text{ or } \frac{\sqrt{13}-1}{2}$ Hence median > mean	M1 M1 A1 A1√ **4**	Use P(x < 11/9), *or* integrate to find median m Substitute into $\int f(x)dx$, √ on a, b, limits 0 and 11/9 or m [if finding m, need to solve 3-term quadratic] Correct numerical answer for probability or m Correct conclusion, cwo ["Negative skew", M2; median > mean, A2]
7	(i) α: β:	$H_0: p = 0.35$ [*or* $p \geq 0.35$] $H_1: p < 0.35$ B(14, 0.35) P(≤ 2) = 0.0839 > 0.025 CR ≤ 1, probability 0.0205 Do not reject H_0. Insufficient evidence that proportion that can receive Channel C is less than 35%	B1 B1 M1 A1 B1 M1 A1√ **7**	Each hypothesis correct, B1+B1, allow $p \geq .35$ if .35 used [Wrong or no symbol, B1, but r or x or $\bar{x}$: B0] Correct distribution stated or implied, can be implied by N(4.9, …), but *not* Po(4.9) 0.0839 seen, *or* P(≤ 1) = 0.0205 if clearly using CR Compare binomial tail with 0.025, *or* R = 2 binomial CR Do not reject H_0, √ on their probability, *not* from N or Po or P(< 2); Contextualised conclusion √
	(ii)	B(8, 0.35): P(0) = 0.0319 B(9, 0.35): P(0) = 0.0207 Hence largest value of n is **8**	M1 A1 A1 A1 **4**	Attempt to find P(0) from B(n, 0.35) One correct probability [P(≤ 2) = .0236, n = 18: M1A1] Both probabilities correct Answer 8 or ≤ 8 only, needs minimum M1A1
	or	$0.65^n > 0.025$; $n \ln 0.65 > \ln 0.025$ 8.56; largest value of n = 8	M1M1 A1A1	$p^n > 0.025$, any relevant p; take ln, *or* T&I to get 1 SF In range [8.5, 8.6]; answer 8 or ≤ 8 only
8	(i) α:	$\frac{100.7-102}{5.6/\sqrt{80}}=-2.076$ Compare with –2.576	M1 A1 B1 **3**	Standardise 100.7 with √80 or 80 a.r.t. –2.08 obtained, must be –, *not* from μ = 100.7 –2.576 or –2.58 seen and compare z, allow both +
	or β:	Φ(–2.076) = 0.0189 [or Φ(2.076) = 0.981] and compare with 0.005 [or 0.995]	M1 A1 B1 (3)	Standardise 100.7 with √80 or 80 a.r.t. 0.019, allow 0.981 only if compared with 0.995 Compare correct tail with 0.005 or 0.995
	or γ:	$102-\frac{k\times 5.6}{\sqrt{80}}$ k = 2.576, compare 100.7 100.39	M1 B1 A1 (3)	This formula, allow +, 80, wrong SD, any k from Φ^{-1} k = 2.576/2.58, – sign, and compare 100.7 with CV CV a.r.t. 100.4
		Do not reject H_0 Insufficient evidence that quantity of SiO_2 is less than 102	M1 A1 **2**	Reject/Do not reject, √, needs normal, 80 or √80, Φ^{-1} or equivalent, correct comparison, *not* if clearly μ = 100.7 Correct contextualised conclusion
	(ii) (a)	$\frac{c-102}{5.6/\sqrt{n}}=-2.326$ $102-c=\frac{13.0256}{\sqrt{n}}$ **AG**	M1 B1 A1 **3**	One equation for c and n, equated to Φ^{-1}, allow cc, wrong sign, σ^2; 2.326 or 2.33 Correctly obtain given equation, needs in principle to have started from c – 102, –2.326
	(b)	$\frac{c-100}{5.6/\sqrt{n}}=1.645$ or $c-100=\frac{9.212}{\sqrt{n}}$	M1 A1 **2**	Second equation, as before Completely correct, aef
	(c)	Solve simultaneous equations $\sqrt{n}$ =11.12 n_{min} = **124** c = **100.83**	M1 A1 A1 A1 **4**	Correct method for simultaneous equations, find c or $\sqrt{n}$ $\sqrt{n}$ correct to 3 SF n_{min} = 124 only Critical value correct, 100.8 or better