1 (i)	X ~ B(18, 0.1) (***A***) P(2 faulty tiles) $= \binom{18}{2} \times 0.1^2 \times 0.9^{16} = 0.2835$ OR from tables $0.7338 - 0.4503 = 0.2835$	M1 $0.1^2 \times 0.9^{16}$ M1 $\binom{18}{2} \times p^2 q^{16}$ A1 CAO OR: M2 for 0.7338 – 0.4503 A1 CAO	**3**
	(***B***) P(More than 2 faulty tiles) $= 1 - 0.7338 = 0.2662$	M1 P(X≤2) M1 *dep* for 1-P(X≤2) A1 CAO	**3**
	(***C***) E(X) = np = 18 × 0.1 = 1.8	M1 for product 18 × 0.1 A1 CAO	**2**
(ii)	(A) Let p = probability that a randomly selected tile is faulty H_0: $p = 0.1$ H_1: $p > 0.1$	B1 for definition of p in context B1 for H_0 B1 for H_1	**3**
	(B) $_1$ has this form as the manufacturer believes that the number of faulty tiles may <u>increase</u>.	E1	**1**
(iii)	Let X ~ B(18, 0.1) P($X \geq 4$) = 1 – P($X \leq 3$) = 1 – 0.9018 = 0.0982 > 5% P($X \geq 5$) = 1 – P($X \leq 4$) = 1 – 0.9718 = 0.0282 < 5% So critical region is {5,6,7,8,9,10,11,12,13,14,15,16,17,18}	B1 for 0.0982 B1 for 0.0282 M1 for at least one comparison with 5% A1 CAO for critical region *dep* on M1 and at least one B1	**4**
(iv)	4 does not lie in the critical region, (so there is insufficient evidence to reject the null hypothesis and we conclude that there is not enough evidence to suggest that the number of faulty tiles has increased.	M1 for comparison A1 for conclusion **in context**	**2**
		TOTAL	**18**

2	**(i)**	P(20 correct) = $\binom{30}{20} \times 0.6^{20} \times 0.4^{10} = 0.1152$	M1 $0.6^{20} \times 0.4^{10}$ M1 $\binom{30}{20} \times p^{20} q^{10}$ A1 CAO	**[3]**
	(ii)	Expected number = 100 × 0.1152 = 11.52	M1 A1 FT (Must not round to whole number)	**[2]**
			TOTAL	**[5]**

3 **(i)**	Median = 3370 $Q_1 = 3050 \quad Q_3 = 3700$ Inter-quartile range = 3700 – 3050 = 650	B1 B1 for Q_3 or Q_1 B1 for IQR	**3**
(ii)	Lower limit 3050 – 1.5 × 650 = 2075 Upper limit 3700 + 1.5 × 650 = 4675 Approx 40 babies below 2075 and 5 above 4675 so total 45	B1 B1 M1 (for either) A1	**4**
(iii)	Decision based on convincing argument: eg 'no, because there is nothing to suggest that they are not genuine data items and these data may influence health care provision'	E2 for convincing argument	**2**
(iv)	All babies below 2600 grams in weight	B2 CAO	**2**
(v)	(*A*) $X \sim B(17, 0.12)$ $P(X = 2) = \binom{17}{2} \times 0.12^2 \times 0.88^{15} = 0.2878$ (*B*) $P(X > 2)$ $= 1 - (0.2878 + \binom{17}{1} \times 0.12 \times 0.88^{16} + 0.8\ ^{17})$ $= 1 - (0.2878 + 0.2638 + 0.1138) = 0.335$	M1 $\binom{17}{2} \times p^2 \times q^{15}$ M1 indep $0.12^2 \times 0.88^{15}$ A1 CAO M1 for $P(X=1) + P(X=0)$ M1 for $1 - P(X \le 2)$ A1 CAO	**3** **3**
(vi)	Expected number of occasions is 33.5	B1 FT	**1**
		TOTAL	**18**

4 **(i)**	(*A*) P(both) = $\left(\frac{2}{3}\right)^2 = \frac{4}{9}$ (*B*) P(one) = $2\times\frac{2}{3}\times\frac{1}{3}=\frac{4}{9}$ (*C*) P(neither) = $\left(\frac{1}{3}\right)^2 = \frac{1}{9}$	B1 CAO B1 CAO B1 CAO	**3**
(ii)	Independence necessary because otherwise, the probability of one seed germinating would change according to whether or not the other one germinates. May not be valid as the two seeds would have similar growing conditions eg temperature, moisture, etc. *NB Allow valid alternatives*	E1 E1	**2**
(iii)	Expected number = 2 × $\frac{2}{3}=\frac{4}{3}$ (= 1.33) E(X^2) = $0\times\frac{1}{9}+1\times\frac{4}{9}+4\times\frac{4}{9}=\frac{20}{9}$ Var(X) = $\frac{20}{9}-\left(\frac{4}{3}\right)^2=\frac{4}{9}$ = 0.444 *NB use of npq scores M1 for product, A1CAO*	B1 FT M1 for E(X^2) A1 CAO	**3**
(iv)	Expect $200\times\frac{8}{9}=177.8$ plants So expect 0.85 × 177.8 = 151 onions	M1 for 200 × $\frac{8}{9}$ M1 dep for × 0.85 A1 CAO	**3**
(v)	Let X ~ B(18, p) Let p = probability of germination (for population) H_0: p = 0.90 H_1: p < 0.90 P($X \leq 14$) = 0.0982 > 5% So not enough evidence to reject H_0 Conclude that there is not enough evidence to indicate that the germination rate is below 90%. Note: use of critical region method scores M1 for region {0,1,2,…, 13} M1 for 14 does not lie in critical region then A1 E1 as per scheme	B1 for definition of p B1 for H_0 B1 for H_1 M1 for probability M1 dep for comparison A1 E1 for conclusion in context	**7**
		TOTAL	**18**