Statistics 1 Binomial Answers

6(a)(i)	B(50, 0.2)	M1		Use of in (a)
	$P(R \leq 15) = 0.969$ to 0.97	A1	2	AWFW 0.9692
(ii)	$P(R = 10) = P(R \leq 10) - P(R \leq 9)$			Stated or implied
	or	M1		
	$P(R = 10) = \binom{50}{10}(0.2)^{10}(0.8)^{40}$			Stated or implied
	$= 0.5836 - 0.4437 = 0.139$ to 0.141	A1	2	AWFW 0.1399
(iii)	$P(5 < R < 15) =$			
	$P(R \leq 14$ or $15) = 0.9393$ or 0.9692	M1		Accept values to 3 dp
	minus $P(R \leq 5$ or $4) = 0.0480$ or 0.0185	M1		Accept values to 3 dp
	$= 0.89$ to 0.893	A1		AWFW 0.8913
	or			
	B(50, 0.2) expressions stated for at least 3 of $5 \leq R \leq 15$	(M1)		Or implied by a correct answer
	Answer	(A2)	3	

(b)	Mean, $\mu = np = 50 \times 0.2 = 10$	B1		Either; CAO
	or			
	Estimate of p, $\hat{p} = 0.21$			
	Variance, $\sigma^2 = np(1-p) = 10 \times 0.8 = 8$	B1		CAO
	Mean or **Estimate of p** **is similar** to that expected			10.5 and 10 or 0.21 and 0.2
	but **Variance** (standard deviation) **is different** from that expected	B1		Either point 20.41 and 8 or 4.5 and 2.8
	Reason to **doubt validity** of Sly's claim	B1	4	Must be based on both 10 or 0.2 and 8 or on both 10 or 0.2 and 2.8 correctly
	Total		**11**	

5(a)	B(15, 0.3)	M1		use of in (a)
(i)	$P(K = 5) = P(K \le 5) - P(K \le 4)$			
	$P(K = 5) = \binom{15}{5}(0.3)^5(0.7)^{10}$	M1		may be implied
	$= 0.7216 - 0.5155 = 0.2055$ to 0.2065	A1	3	AWFW (0.2061)
(ii)	(Fewer than) half $\Rightarrow$ 7 or 7½ or 8	B1		stated or implied
	Thus require $P(K \le 7$ or $< 8)$	M1		used or implied by correct answer
	$= 0.9495$ to 0.9505	A1	3	AWFW (0.9500)
(iii)	$P(2 < K < 7) =$ 0.8689 or 0.9500	M1		
	minus 0.1268 or 0.2969	M1		
	$= 0.7415$ to 0.7425	A1	3	AWFW (0.7421)
	or			
	B(15, 0.3) expressions stated for at least 3 terms within $2 \le K \le 7$	M1		or implied by a correct answer
	Answer	A2		

2(a)	Use of binomial in (a), (b) or (c)	M1		Can be implied
	$P(E = 5) = \binom{16}{5}(p)^5(1-p)^{11}$	M1		Allow $p = 0.45, 0.25, 0.30$ or $\frac{1}{3}$
	$= 0.112$	A1	3	AWRT (0.1123)
(b)(i)	B(50, 0.25)	B1		Used; can be implied
	$P(C \le 12) = 0.511$	B1	2	AWRT (0.5110)
(ii)	$P(10 < B' < 20) =$ 0.9152 or 0.9522	M1		Allow 3 dp accuracy
	minus 0.0789 or 0.1390	M1		Allow 3 dp accuracy
	$= 0.836$	A1	3	AWRT (0.8363)
	or			
	B(50, 0.30) expressions stated for **at least 3** terms within $10 \le B' \le 20$	(M1)		Or implied by a correct answer
	Answer = 0.836	(A2)		AWRT
(c)	$n = 40$, $p = 0.7$	B1		Both used; can be implied
	Mean $\mu = np = 28$	B1√		CAO; √ on p only
	Variance $\sigma^2 = np(1-p) = 8.4$	M1		Use of $np(1-p)$ even if SD
	Standard deviation $= \sqrt{8.4}$ or $= 2.89$ to 2.9	A1	4	CAO; AWFW
	Total		**12**	

6(a)	Use of binomial in (a) or (b)(i)	M1		PI
(i)	$P(T_{10} \leq 3) = 0.38$ to 0.383	B1	2	AWFW (0.3823)
(ii)	$P(10 < T_{40} < 20) =$ 0.8702 or 0.9256	M1		Allow 3 dp accuracy
	minus 0.0352 or 0.0156	M1		Allow 3 dp accuracy
	= 0.83 to 0.84	A1		AWFW (0.835)
	OR			
	B(40, 0.40) expressions stated for at least 3 terms within $10 \leq T_{40} \leq 20$	(M1)		Or implied by a correct answer
	Answer = 0.83 to 0.84	(A2)	3	AWFW

(b)(i)	$n = 5 \quad p = 0.4$			
	Mean, $\mu = np = 2$	B1		CAO
	Variance, $\sigma^2 = np(1-p) = 1.2$	M1		Use of $np(1-p)$ even if SD
	Standard deviation $= \sqrt{1.2}$ or $= 1.09$ to 1.1	A1	3	CAO AWFW
(ii)	Mean $(\bar{x}) = 2$	B1		CAO $\sum x = 26$
	Standard Deviation $(s_n,\ s_{n-1})$ $= 1.1$ to 1.16	B2		$\sum x^2 = 68$ AWFW (1.1094 or 1.1547)
	If neither correct but use of mean $(\bar{x}) = \frac{\sum x}{13}$	(M1)	3	
(iii)	Means are same and SDs are similar/same Means are same but SDs are different so Trina's claims appear valid / invalid	B1 ↑Dep↑ B1	2	Must have scored full marks in (b)(i) and (b)(ii)
	Total		**13**	