AS and A level Mathematics Practice Paper – Statistics – Mark scheme

Section B – Binomial distribution and hypothesis testing (50 marks)		
1(a)	$X \sim \mathrm{B}(25, 0.2)$ $20, 0.25)$ $X \geq 10) = 1 - 0.9861 = 0.0139$ $[\mathrm{P}(X \geq 9) =]0.0468$ $X \leq 1) = 0.0243$ $[\mathrm{P}(X \leq 1) =]0.0274$ $X = [0 \leq]\ X \leq 1$ $9 \leq X\ [\leq 25]$	M1 A1 A1 A1d **(4)**
1(b)	$\mathrm{H_0}$: $p = 0.2$ $p = 0.25$ $\mathrm{H_1}$: $p < 0.2$ $p < 0.25$ $\mathrm{P}(X \leq 6) = 0.1034$ or CR $X \leq 5$ Insufficient evidence to reject $\mathrm{H_0}$, Accept $\mathrm{H_0}$, Not significant. 6 does not lie in the Critical region. No evidence that increasing the batch size has **reduced** the **percentage** of broken **pots (oe)** **or** evidence that there is **no change** in the **percentage** of broken **pots (oe)**	B1 M1 A1 M1d A1cso **(5)**
		(9 marks)
2	$\mathrm{H_0} : p = 0.2$ $\mathrm{H_1} : p < 0.2$ $[X \sim \mathrm{B}(40, 0.2)]$ $\mathrm{P}(X \leq 3) = 0.0285$ or CR of $X \leq 3$ [0.0285 < 0.05] significant, reject $\mathrm{H_0}$ There is evidence to support the supplier's **<u>claim</u>** or The probability of a **<u>ball</u>** failing the bounce **<u>test</u>** is **<u>less</u>** than **<u>0.2</u>**	B1 M1A1 M1dep A1cso
		(5 marks)
3(a)	$X \sim \mathrm{B}(25, 0.5)$ may be implied by calculations in part a or b $\mathrm{P}(X \leq 7) = 0.0216$ $\mathrm{P}(X \geq 18) = 0.0216$ CR $X \leq 7$; $\cup$ $X \geq 18$	M1 A1A1 **(3)**
3(b)	P(rejecting $\mathrm{H_0}$) = 0.0216 + 0.0216	M1

	$= 0.0432$ awrt 0.0432/0.0433	A1 **(2)**
		(5 marks)
4	$H_0 : p = 0.5$ $H_1 : p > 0.5$ X~B(30,0.5) Using correct Bin $P(X \geq 21) = 1 - P(X \leq 20)$ or $P(X \leq 19) = 0.9506$ $P(X \geq 20) = 0.0494$ $= 1 - 0.9786$ $= 0.0214$ CR $X \geq 20$ so significant/reject H_0 /in Critical region Evidence to suggest **<u>David's claim is incorrect</u>** or The weather **<u>forecast</u>** produced by the local **<u>radio</u>** is better than those achieved by **<u>tossing/flipping a coin</u>**	B1 B1 M1 M1 A1 M1 dep A1
		(7 marks)
5	$H_0 : p = 0.2$ $H_1 : p > 0.2$ Under H_0, $X \sim$ Bin (10, 0.2) $P(X \geq 4) = 1 - P(X \leq 3)$ OR $P(X \leq 4) = 0.9672$ $= 1 - 0.8791$ $P(X \geq 5) = 0.0328$ $= 0.1209$ CR $X \geq 5$ $0.1209 > 0.05$ Insufficient evidence to reject H_0 so teacher's claim is supported	B1 B1 M1 A1 M1A1ft
		(6 marks)
6(a)	$X \sim B(30, 0.25)$ $P(X \leq 10) - P(X \leq 4) = 0.8943 - 0.0979$ $= 0.7964$	B1 M1 A1 **(3)**
6(b)	$H_0 : p = 0.25$ $H_1 : p < 0.25$ B(15, 0.25) $P(X \leq 1) = 0.0802$ Reject H_0 or Significant or 1 1ies in the critical region There is evidence that the radio **<u>company's</u>** claim is true. **Or** The new transmitter will reduce the proportion of houses unable to receive **<u>radio</u>**	B1 M1 A1 dM1 A1 cso **(5)**
		(8 marks)

7(a)	$X \sim B(20, 0.25)$ $P(X \geq 10) = 1 - 0.9861 = 0.0139$ $X \leq 1) = 0.0243$ $P(X \leq 1) = 0.0243$ $(0 \leq)\, X \leq 1 \;\cup\; 10 \leq X\, (\leq 20)$	M1 A1 A1 A1A1 **(5)**
7(b)	H_0: $p = 0.25$ H_1: $p < 0.25$ $X \sim B(20, 0.25)$ $P(X \leq 3) = 0.2252$ or CR $X \leq 1$ Insufficient evidence to reject H_0, Accept H_0, Not significant. 3 does not lie in the Critical region. No evidence that the **changes** to the process have **reduced** the **percentage** of **defective articles (oe)**	 B1 M1A1 M1d A1cso **(5)**
		(10 marks)