Binomial Distribution 1

1	**(i** $0.24 + 0.35 + 2k + k + 0.05 = 1$ $k = 0.12$	M1 A1	**2**	Summing probs = 1 Correct answer
	(ii) model number is 1	B1	**1**	
	(iii) mean = $1 \times 0.35 + 2 \times 0.24 + 3 \times 0.12 + 4 \times 0.05$ P(>1.39) = P(2, 3, 4) = 0.41	B1 M1 B1	**3**	1.39 seen Finding P(X > their mean) Correct ans following mean or mode only
2	**(i** $1.2 = 15p$ p = 0.08 Var = $npq = 15 \times 0.08 \times 0.92 = 1.104$ **AG**	M1 A1	**2**	Attempt to find p using $1.2 = 15p$ Correct answer
	(ii) $P(0, 1, 2) = (0.92)^{15} + {}^{15}C_1(0.08)(0.92)^{14} + {}^{15}C_2(0.08)^2(0.92)^{13}$ $= 0.887$	M1 M1 A1	**3**	Binomial expression ${}^{15}C_x p^x(1-p)^{15-x}$ $0 < p < 1$ Correct unsimplified expression for P(0, 1, 2) Correct answer
	(iii) P(at least 1 faulty screw) = 1 – P(0) = $1 - (0.92^{15}$ = 0.7137… P(at least 1 faulty screw in 7 packets) = ${}^8C_7(0.713\ldots)^7(0.2863\ldots)$ = 0.216	M1 A1 M1 A1	**4**	Attempt at P(0) or 1 – P(0) Rounding to 0.71 Binomial expression ${}^8C_7 p^7(1-p)$ $0 < p < 1$ Correct answer
3	**(i** max = 12 $P(12) = (0.7)^{12} = 0.0138$	B1 B1	**2**	(Implied by P(12) with power 12) Accept 0.014
	(ii) P(fewer than 10) = 1– P (10, 11, 12) $= 1 - {}^{12}C_{10} \times (0.7)^{10}(0.3)^2 - 12 \times (0.7)^{11}(0.3) - (0.7^{12}$ = 1 – 0.2528 = 0.747	M1 A1 A1	**3**	Binomial term ${}^{12}C_r(0.7)^r(0.3)^{12-r}$ or ${}^{12}C_r(p)^r(q)^{12-r}$, $0.99 \leqslant p + q \leqslant 1.00$ Correct unsimplified expression oe Correct answer
4	**(i)** $P(> 1) = 1 - (0.95)^{20} - (0.95)^{19}(0.05)^1{}_{20}C_1$ = 0.264	M1 M1 A1	[3]	Binomial term $20Cx(0.05)^x(0.95)^{20-x}$ Correct unsimplified expression Correct answer
	(ii) Profit 19 or 20 work = 450 × 10 – 480 = 4020 Profit < 19 work = – 480 Expected profit = $4020 \times (1 - 0.264) - 480 \times 0.264$ = \$2830 (\$2832) Or –480 + 4500 (1 – 0.264) = 2830	B1 M1 M1 A1	[4]	4020 seen Multiplying 4020 by their **(i)** or their (1 – **(i)**) Multiplying 480 by [1 – their **(i)**] and subtracting Rounding to correct answer

5	**(i**	P(0, 1, 2) $=(0.85)^6 + (0.15)(0.85)^5{}_6C_1 +$ $(0.15)^2(0.85)^4{}_6C_2$ $= 0.953$	B1 M1 A1	[3]	0.15 and 0.85 seen Any binomial expression Σpowers = 6, Σ p = 1 Correct answer
	(ii)	$P(D) = 0.6 \times 0.1 + 0.4 \times 0.55 = 0.28$ $P(B\|D) = \frac{P(B \cap D)}{P(D)}$ $0.06/0.28 = 0.2143$ $P(> 1) = 1 - P(0)$ $= 1 - (0.7857)^5$ $= 1 - 0.7078$ $= 0.701$	M1 A1 M1 A1 M1 A1	[6]	Attempt to find P(D) 0.28 seen Using cond prob formula to find P($B\|D$) Correct unsimplified answer Binomial expression 1 –P(0) or 1 –P(0, 1) Σ p = Correct answer accept 0.700

6	**(i**	P(3m) = 4/5 (0.8) P(5m) = 1/5 (0.2) E(X) = 17/5 (3.4) Var(X) = 16/25 (0.64)	B1 B1 M1 A1	[4]	P(3m) = 4/5 or P(5m) = 1/5 seen or implied Correct E(X) Subtract their mean^2 numerically from Σx^2p, no extra dividing Correct answer
	(ii)	P(3, 5) + P(5, 3) = 0.8 × 0.2 +0.2 × 0.8 = 8/25 (0.32)	M1 A1√	[2]	Summing two 2-factor terms Correct answer, ft on 2 × p × (1 − p), their p
	(iii)	P(11) = P(3, 3, 5) + P(3, 5, 3) + P(5, 3, 3) = (4/5 × 4/5 × 1/5) × 3 = 48/125 (0.384)	M1 M1 A1	[3]	Mult 2 probs for 3 with 1 prob for 5 Multiplying probs for 11 by 3 or summing 3 options Correct final answer