Discrete Random Variables 2 MS

Q1.

6 **(i)**	$(0.75)^n < 0.06$	M1*	Equation or inequality with 0.75^n and 0.06 or 0.94 seen
	$n > 9.78$	M1dep*	Attempt at solving by trial and error (can be implied) or using logarithms correctly
	$n = 10$	A1 **[3]**	Correct answer
(ii)	$E(X) = 14 \times 0.75$ or 10.5 Try $P(10) = {}^{14}C_{10}(0.75)^{10}(0.25)^4 = 0.220$	M1	Evaluating binomial probability for an integer value directly above or below their mean
	$P(11) = {}^{14}C_{11}(0.75)^{11}(0.25)^3 = 0.240$	M1	Evaluating the other binomial probability
	(mode is) 11	A1 **[3]**	Correct answer
	OR	M1	Evaluating binomial $P(n)$ and $P(n+1)$
		M1	Evaluating binomial P(10), P(11) and P(12)
		A1	Correct answer
(iii)	$P(> 11)$ $= {}^{14}C_{12}(0.75)^{12}(0.25)^2 + {}^{14}C_{13}(0.75)^{13}(0.25)^1 + (0.75)^{14}$	M1	A binomial term of the form ${}^{14}C_n p^n(1-p)^{14-n}$ seen, $n \neq 0$ or 14
		M1	Summing binomial P(12, 13, 14) or P(11, 12, 13, 14,)
	$= 0.281$	A1	Correct answer 0.280 – 0.282
	$P(3) = {}^5C_3\,(0.2811)^3(0.7189)^2$	M1	A binomial term of the form ${}^5C_3 p^3(1-p)^2$ seen, any p
	$= 0.115$	A1 **[5]**	Correct answer

Q2.

3 **(i)**	$P(X = 1) = P(GBBB)\ 4 \times C_1$	M1	Considering values of X of 1, 2, 3, 4
	$= 5/8 \times 3/7 \times 2/6 \times 1/5 \times 4 = 1/14$	M1	Attempting to find the probability of at least 2 values of X
	$P(X = 2) = P(GGBB) \times {}_4C_2 = 3/7$		
	$P(X = 3) = P(GGGB) \times {}_4C_3 = 3/7$	A1	One correct probability
	$P(X = 4) = P(GGGG) \times {}_4C_4 = 1/14$	A1	All correct
	OR		
	$P(1) = {}_5C_1 / {}_8C_4 = 1/14$	M1	Considering values of X of 1, 2, 3, 4
	$P(2) = {}_3C_2 \times {}_5C_2 / {}_8C_4 = 3/7$	M1	Dividing by ${}_8C_4$
	$P(3) = {}_3C_1 \times {}_5C_3 / {}_8C_4 = 3/7$	A1	One correct probability
	$P(4) = {}_5C_4 / {}_8C_4 = 1/14$	A1 [4]	All correct
(ii)	$Var(X) = 1/14 + 12/7 + 27/7 + 16/14 - (5/2)^2$	M1	Using a variance formula correctly with mean^2 subtracted numerically, no extra division
	$= 15/28$ (0.536)	A1 [2]	Correct final answer

Discrete Random Variables 2 MS

Q3.

5	**(i)** $4p + p + 3p = 1$ so P(blue) = 1/8 AG	B1	[1]	Must show something
	(ii) P(R) = ½, P(B) = 1/8, P(G) = 3/8 P(all different) = ½ × 1/8 × 3/8 × 3! =9/64 (0.141)	M1 M1 A1	[3]	Multiplying P (R, B, G) together Mult by 3! Correct answer

	(iii) mean = 136 × 1/8 = 17, var = 14.875 $P(<20) = P\left(z < \frac{19.5-17}{\sqrt{14.875}}\right)$ = Φ(0.648) = 0.742	B1 M1 M1 M1 A1	 [5]	Unsimplified mean and variance correct Standardising, need sq rt Cont correction 19.5 or 20.5 Correct area, > 0.5 legit Correct answer

Q4.

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

Q5.

3	**(i)** $p = 0.1$	B1	**[1]**	
	(ii) **(a)** P(X = 1, Y = 3) = 0.3 × 0.2 = 0.06 P(X = 2, Y = 2) = 0.15 × 0.5 = 0.075 P(X = 3, Y = 1) = 0.3 × 0.3 = 0.09 P(sum is 4) = 0.225	M1 B1 A1	 **[3]**	Summing 2 or 3 options One option correct unsimplified correct final answer
	(b) P(X = 1, Y = anything) = 0.3 P(X = 2, Y = anything) = 0.15 P(X = 3, Y = 1, 2) = 0.3 × 0.8 = 0.24 P(X = 4, Y = 1) = 0.2 × 0.3 = 0.06 P(X = 5, Y = 1) = 0.05 × 0.3 = 0.015 P(product < 8) = 0.765	M1 B1 A1	 **[3]**	Σ 3 or more two-factor options Two correct options Correct answer
	OR P(Y = 1, X = anything) = 0.3 P(Y = 2, X =1, 2, 3) = 0.5 × 0.75 = 0.375 P(Y = 3, X =1, 2) = 0.2 × 0.45 = 0.09 P(product < 8) = 0.765	M1 B1 A1		

Discrete Random Variables 2 MS

Q6.

4 **(i)**	$P(X < 5) = 1 - P(5, 6, 7)$ $= 1 - (0.21)^5(0.79)^2\ {}_7C_5 - (0.21)^6(0.79)^1{}_7C_6 - (0.21)^7$ $= 0.994$	M1 A1 A1 **[3]**	Binomial expression with powers Σ 7 and probs Σ = 1, and ${}_7C_r$ Correct unsimplified expression Correct answer
(ii)	$P(\text{at least 1}) = 1 - P(0) = 1 - (0.79)^7$ $= 0.808$ $P(\text{exactly 3 weeks}) = (0.808)^3(0.192)_4C_3$ $= 0.405$	M1 A1 M1 A1 **[4]**	Attempt to find P(at least 1) or 1– P(0 and 1) Rounding to correct answer Bin expression with powers Σ 4 and their 0.808 etc. and ${}_4C_3$ Correct answer

Q7.

2 **(i)**	y: 0, 2, 4 $P(Y = y)$: 0.42, 0.48, 0.1	B1 M1 A1 A1 [4]	0, 2, 4 only seen for Y no probs needed. Accept other vals if P(value) = 0 seen in table, allow 0002244 with probs Summing two or more 2-factor probs (can be implied) One correct prob Correct table or list
(ii)	$0.96 + 0.4 = 1.36$	B1ft [1]	Ft their table for Y or X $\Sigma p = 1$

Q8.

4 **(i)**	mean = 11/6 $(1\frac{5}{6}, 1.83)$	B1	correct answer
	$sd = \sqrt{(1+1+1+4+9+9)/6 - (11/6)^2}$ $= \sqrt{29}/6$ (0.898)	M1 A1 **[3]**	numerical use of a correct sd/variance formula correct answer
(ii)	x: 2, 3, 4, 5, 6 Pr: 9/36, 6/36, 13/36, 4/36, 4/36	B1 B1 M1 A1 **[4]**	all correct x values P(2) and P(6) correct considering more than 1 case for a sum of 3 or 4 or 5 P(3), P(4) and P(5) correct
(iii)	$p = 1/3$ $np = 8 \quad n = 24$ Var = $24 \times 1/3 \times 2/3 = 16/3$ (5.33)	B1 M1 A1ft **[3]**	correct p using $np = 8$ to find n or $8(1 - p)$ to find var, $0<p<1$ correct answer, ft their p

Discrete Random Variables 2 MS

Q9.

3	(i)	$z = -1.036 = \frac{73-75}{\sigma}$ $\sigma = 1.93$	B1 M1 A1 [3]	$\pm$ correct z value accept ± 1.037 Equation with 73, 75, σ and a z value Rounding to correct answer
	(ii)	$P(> 77) = 0.15$ $P(< 3) = P(0, 1, 2)$ $= (0.85)^8 + {}_8C_1(0.15)(0.85)^7 + {}_8C_2(0.15)^2(0.85)^6$ $= 0.895$	M1 M1 A1 [3]	Prob rounding to 0.15 and 0.85 ${}_8C_x p^x(1-p)^{8-x}$ seen any p, $0<p<1$ Correct answer