Discrete Random Variables 1 MS

Q1.

1	$a + b = 0.45$ $-3a - b + 1.6 = 0.75$ $a = 0.2 \quad b = 0.25$	B1 M1 A1 A1 **[4]**	Correct sum probs = 1 o.e. Attempt at $\Sigma xp = 0.75$ Correct a Correct b

Q2.

6	**(i)** <table><tr><td>x</td><td>0</td><td>1</td><td>2</td></tr><tr><td>$P(X = x)$</td><td>1/7</td><td>4/7</td><td>2/7</td></tr></table>	B1 B1 B1 **[3]**	0, 1, 2 only in table or listed with some prob 3, 4… if in table must have blank or 0 for prob One correct probability All correct
	(ii) $E(X) = 8/7$ (1.14) AG $Var(X) = 12/7 - (8/7)^2$ $= 20/49$ (0.408)	B1 M1 A1 **[3]**	Legitimate correct given answer rounding to 1.14 Correct method with mean^2 subt numerically no dividing by anything Correct final answer
	(iii) $P(G \mid NA) = \dfrac{P(G \cap NA)}{P(NA)}$ $= \dfrac{2/5 \times 1/4}{2/5 \times 1/4 + 3/5 \times 9/10}$ $= \dfrac{5}{32}$ (0.156)	M1 M1 A1 A1 **[4]**	Attempt at $P(G \cap NA)$ or $P(G \cap A)$ as numerator of a fraction Attempt at P(NA) or P(A) in form of summing two 2-factor products, seen anywhere Correct unsimplified denominator of a fraction Correct answer

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Q3.

5	**(i)** P(2) = P(0,2) + P(2,0) = 6/10 × 3/7 + 3/10 × 4/7 = 30/70 = 3/7 AG	M1 A1 [2]	Summing two 2-factor probabilities Correct answer legit obtained
	(ii) x | 0 | 2 | 4 | 6 P($X = x$) | 24/70 | 30/70 | 13/70 | 3/70	B1 B1 [2]	Correct values for rv X Correct probs
	(iii) E(X) = 13/7 Var(X) = 120/70 + 208/70 + 108/70 – $(13/7)^2$ = 2.78	B1ft M1 A1 [3]	 Using variance formula correctly with mean^2 subtracted numerically, no extra division Correct final answer
	(iv) $P(A2 \mid \text{Sum } 2) = \frac{3/10 \times 4/7}{30/70}$ = 0.4	M1 A1 [2]	Correct numerator with a 0 < denom < 1 Correct answer

Q4.

7	**(i)** If y = P(odd number) then P(even number) = $2y$ $3y + 6y = 1$ so $y = 1/9$ oe. OR prob = 1/3	M1 A1 [2]	2P(Odd) shown = P(Even) and summed to 1 correct answer accept either
	(ii) Score of 8 means throwing a 6 6 is even so P(8) = 2/9 (AG)	B1 B1 [2]	 legit justification of use of 2/9
	(iii) Var(X) = (48 + 36 + 98 + 128 + 100)/9 – $(58/9)^2$ = 4.02 accept 4.025 (326/81)	M1 A1 [2]	Correct method no dividings, 6.44 squared subt numerically Correct answer
	(iv) P(score 6,10) + P(score 10,6) + P(score 8,8) = 1/81 + 1/81 + 4/81 = 6/81 (2/27) (0.0741)	M1 A1 [2]	Summing two different 2-factor probabilities Correct answer
	(v) P(score 6, 10) = 1/81 P(1st score 6 given total 16) = (1/81) ÷ (6/81) = 1/6	B1 M1 A1 [3]	1/81 seen in numerator Dividing by their **(iv)** Correct answer

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Q5.

1	$4p + 5p^2 + 1.5p + 2.5p + 1.5p = 1$ $10p^2 + 19p - 2 = 0$	M1	Summing 5 probs to = 1 can be implied
	$p = 0.1$ or -2	A1	For 0.1 seen with or without –2
	$p = 0.1$	A1 [3]	Choosing 0.1 must be by rejecting –2

Q6.

6	**(i)** constant/given prob, independent trials, fixed/given no. of trials, only two outcomes	B1 B1 [2]	One option correct Three options correct
	(ii) P(8, 9, 0, 1) =	M1	One term seen involving $(0.3)^x(0.7)^{9-x}({}^9C_x)$
	${}^9C_8(0.3)^8(0.7) + (0.3)^9 + (0.7)^9 + {}^9C_1(0.3)(0.7)^8$	A1	Correct unsimplified expression
	$= 0.196$	A1 [3]	Correct answer
	(iii) mean = $90 \times 0.3 = 27$ var = 18.9	B1	Expressions for 27 and 18.9 (4.347) seen
	$P(X > 35) = 1 - \Phi\left(\frac{35.5 - 27}{\sqrt{18.9}}\right)$	M1	Standardising one expression, must have sq rt in denom, cc not necessary
	$= 1 - \Phi(1.955) = 0.0253$	M1	Continuity correction applied at least once
	$P(X < 27) = \Phi\left(\frac{26.5 - 27}{\sqrt{18.9}}\right) = 1 - \Phi(0.115)$	M1	$(1 - \Phi_1) + (1 - \Phi_2)$ accept (0.0329 + 0.5) if no cc
	$= 0.4542$ Total prob = 0.480 accept 0.48	A1 [5]	Rounding to correct answer

Q7.

2	**(i)** x | 1 | 2 | 3 | 4 | 5 Prob | k | $2k$ | $3k$ | $4k$ | $5k$	M1	1, 2, 3, 4, 5 seen, together with some probabilities involving k but not x
	$15k = 1$ $k = 1/15$ (0.0667)	M1 A1 [3]	summing probs involving k to 1 correct answer
	(ii) E(X) $= k + 4k + 9k + 16k + 25k$ $= 55k = 11/3$ (3.67)	M1 A1ft [2]	using Σpx no dividing correct answer, ft on $55k$, $0 < k < 1$

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Q8.

3 **(i)**	P(any other number) = 9/70 $P(X < 2) = 27/70 + 1/10$ = 34/70 (17/35) (0.486)	B1 B1ft **[2]**	9/70 Seen Ft their probs if < 1
(ii)	E(X) = 108/70 (54/35) (1.543) $\text{Var}(X) = ((-2)^2 + \ldots + 5^2) \times 9 / 70 - (54/35)^2$ = 5.33	M1 M1 A1 **[3]**	Valid attempt at E(X) (needn't be accurate) Using a variance formula correctly with mean^2 subtracted numerically, no extra division Correct final answer
(iii)	$a = 1$	B1 **[1]**	

Q9.

1 $20p = 4.8$ $p = 0.24$ or 4.8/20 $P(0, 1, 2) = (0.76)^{20} + {}^{20}C_1(0.24)^1(0.76)^{19}$ $+ {}^{20}C_2(0.25)^2(0.76)^{18}$ = 0.109 SR max 3 out of 4	B1 M1 A1 A1 **[4]** B1 M1 A1	Correct value for p Summing 2 or 3 binomial probs o.e., any p, $n = 5$ or 20 Correct unsimplified answer Correct answer As above Using N(4.8, 3.648) with cc 2.5 or 3.5 0.114 seen

Q10.

7 **(i)**	P(6) = P(3, 9) + P(9, 3) = 2/25 = 0.08 AG	B1 **[1]**	Accept 2/25 seen
(ii)	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Prob</td><td>0.2</td><td>0.24</td><td>0.08</td><td>0.08</td><td>0.16</td><td>0.16</td><td>0.08</td></tr></table>	M1 A1 **[2]**	Values 0 – 6 seen could be in list All correct
(iii)	Mean = Σxp = 2.56 (64/25)	B1 **[1]**	
(iv)	P(4, 5, 6) = 0.4(10/25) or 0.16 + 0.16 + 0.08 = P(draw) × 0.4 = 0.2 × 0.4 = 0.08 (2/25)	B1 ft M1 A1ft **[3]**	ft their P(4, 5, 6) providing $p < 1$ Multiplying by their P(draw) providing $p < 1$ Correct answer
(v)	P(J wins on nth go) $= (0.2)^{n-1} \times 0.4$ oe	M1 A1ft **[2]**	Mult by any p^n or p^{n-1}, $p < 1$ ft their probs