Ques	Solution	Mark	Notes
1(a)	EITHER $P(A\cap B) = P(A) + P(B) - P(A\cup B)$ $= 0.2$	**M1** **A1**	Award M1 for using formula
	This is not equal to P(A) × P(B) therefore not independent.	**A1**	
	OR Assume A,B are independent so that $P(A\cap B) = P(A) + P(B) - P(A)P(B)$ $= 0.58$	**M1** **A1**	Award M1 for using formula
	Since $P(A\cup B) \neq 0.58$, A,B are not independent.	**A1**	
(b)	$P(A\mid B') = \dfrac{P(A\cap B')}{P(B')}$	**M1**	Award M1 for using formula
	$= \dfrac{0.3-0.2}{0.6}$	**A1**	FT their P(A∩B) if independence not assumed
	$= \dfrac{1}{6}$	**A1**	Accept Venn diagram
2	$np = 0.9,\ \ npq = 0.81$ Dividing, $q = 0.9$, $p = 0.1$ $n = 9$	**B1B1** **M1A1** **A1**	
3(a)	P(1 of each) = $\dfrac{3}{9}\times\dfrac{3}{8}\times\dfrac{3}{7}\times 6$ or $\dbinom{3}{1}\times\dbinom{3}{1}\times\dbinom{3}{1}\div\dbinom{9}{3}$	**M1A1**	M1A0 if 6 omitted
	$= \dfrac{9}{28}$	**A1**	
(b)	P(2 particular colour and 1 different) = $\dfrac{3}{9}\times\dfrac{2}{8}\times\dfrac{6}{7}\times 3$ or $\dbinom{3}{2}\times\dbinom{6}{1}\div\dbinom{9}{3}$	**M1A1**	M1A0 if 3 omitted
	$= \dfrac{3}{14}$	**A1**	Allow 3/28
	P(2 of any colour and 1 different) = $\dfrac{9}{14}$	**B1**	FT previous line
4(a)	Let X denote the number of goals scored in the first 15 minutes so that X is Po(1.5) si	**B1**	
	$P(X = 2) = \dfrac{e^{-1.5}\times 1.5^2}{2!}$ $= 0.251$	**M1** **A1**	Award M0 if no working seen
(b)	$P(X > 2) = 1 - e^{-1.5}\left(1 + 1.5 + \dfrac{1.5^2}{2!}\right)$	**M1A1**	
	$= 0.191$	**A1**	

Ques	Solution	Mark	Notes
5(a) (i)	Let X = number of female dogs so X is B(20,0.55) $P(X=12)=\binom{20}{12}\times 0.55^{12}\times 0.45^{8}$ $=0.162$	B1 M1 A1	si Accept 0.4143 – 0.2520 or 0.7480 – 0.5857
(ii)	Let Y = number of male dogs so Y is B(20,0.45) $P(8 \le X \le 16) = P(4 \le Y \le 12)$ $= 0.9420 - 0.0049$ or $0.9951 - 0.0580$ $= 0.9371$	M1 A1 A1A1 A1	Award M0 if no working seen
(b)	Let U = number of yellow dogs so U is B(60,0.05) ≈ Po(3) $P(U < 5) = 0.8153$	 M1 m1A1	
6(a)	P(head) = $\frac{3}{4}\times\frac{1}{2}+\frac{1}{4}\times 1$ $=\frac{5}{8}$	M1A1 A1	M1 Use of Law of Total Prob (Accept tree diagram)
(b)(i)	P(DH|head) = $\frac{1/4}{5/8}$ $=\frac{2}{5}$ cao	B1B1 B1	B1 num, B1 denom FT denominator from (a)
(ii)	EITHER P(head) = $\frac{3}{5}\times\frac{1}{2}+\frac{2}{5}\times 1$ $=\frac{7}{10}$ OR P(Head) $=\dfrac{\frac{3}{4}\times\frac{1}{2}\times\frac{1}{2}+\frac{1}{4}\times 1}{\frac{5}{8}}$ $=\frac{7}{10}$	 M1A1 A1 B1B1 B1	 M1 Use of Law of Total Prob (Accept tree diagram) B1 num, B1 denom FT denominator from (a)

Ques	Solution	Mark	Notes
7(a)	[0,0.4]	**B1**	Allow(0,0.4)
(b)	$E(X) = 0.1 + 0.6 + 3\theta + 0.8 + 5(0.4 - \theta)$	**M1**	
	$= 3.5 - 2\theta$	**A1**	
	The range is [2.7,3.5]	**A1**	FT the range from (a)
(c)	$E(X^2) = 0.1 + 1.2 + 9\theta + 3.2 + 25(0.4 - \theta)$	**M1A1**	Must be in terms of θ
	Var(X) = $0.1 + 1.2 + 9\theta + 3.2 + 25(0.4 - \theta) - (3.5 - 2\theta)^2$	**M1**	
	$= 2.25 - 2\theta - 4\theta^2$	**A1**	
	Var(X) = 1.5 gives	**M1**	
	$4\theta^2 + 2\theta - 0.75 = 0$	**A1**	
	$16\theta^2 + 8\theta - 3 = 0$		
	$(4\theta + 3)(4\theta - 1) = 0$	**M1**	Allow use of formula
	$\theta = 0.25$	**A1**	
8(a)	EITHER the sample space contains 64 pairs of which 8 are equal OR whatever number one of them obtains, 1 number out of 8 obtained by the other one gives equality.	**M1**	
	P(equal numbers) = $\frac{1}{8}$	**A1**	
(b)	The possible pairs are (4,8);(5,7);(6,6);(7,5);(8,4)	**B1**	
	EITHER the sample space contains 64 pairs of which 5 give a sum of 12 OR each pair has probability 1/64.	**M1**	
	P(sum = 12) = $\frac{5}{64}$	**A1**	
(c)	EITHER reduce the sample space to (4,8);(5,7);(6,6);(7,5);(8,4) OR $P(\text{equal numbers}) = \frac{P(6,6)}{P(\text{sum} = 12)} = \frac{1/64}{5/64}$	**M1**	
	Therefore P(equal numbers) = $\frac{1}{5}$	**A1**	

Ques	Solution	Mark	Notes
9(a)(i)	$P(0.4 \le X \le 0.6) = F(0.6) - F(0.4)$	M1	
	$= 0.261$	A1	
(ii)	The median m satisfies		
	$2m^3 - m^6 = 0.5$	B1	
	$2m^6 - 4m^3 + 1 = 0$		
	$m^3 = \dfrac{4 \pm \sqrt{8}}{4}$ (0.293)	M1A1	Award M1 for a valid attempt to solve the equation
	$m = 0.664$	A1	Do not award A1 if both roots given
(b)(i)	Attempting to differentiate $F(x)$	M1	
	$f(x) = 6x^2 - 6x^5$	A1	
(ii)	$E(X^3) = \int_0^1 x^3(6x^2 - 6x^5)\mathrm{d}x$	M1A1	M1 for the integral of $x^3 f(x)$ A1 for completely correct although limits may be left until 2nd line.
	$= \left[\dfrac{6x^6}{6} - \dfrac{6x^9}{9}\right]_0^1$	A1	FT their $f(x)$ if M1 awarded in (i)
	$= 1/3$	A1	