

S1

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
(b)	This is not equal to $P(A) \times P(B)$ therefore not independent. OR Assume A,B are independent so that $P(A \cap B) = P(A) + P(B) - P(A)P(B)$ $= 0.58$ Since $P(A \cup B) \neq 0.58$, A,B are not independent.	A1 M1 A1 A1	Award M1 for using formula
	$P(A B') = \frac{P(A \cap B')}{P(B')}$ $= \frac{0.3 - 0.2}{0.6}$ $= \frac{1}{6}$	M1 A1 A1	Award M1 for using formula FT their $P(A \cap B)$ if independence not assumed 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) = $\frac{3}{9} \times \frac{3}{8} \times \frac{3}{7} \times 6 \text{ or } \binom{3}{1} \times \binom{3}{1} \times \binom{3}{1} \div \binom{9}{3}$ $= \frac{9}{28}$	M1A1 A1	M1A0 if 6 omitted
(b)	P(2 particular colour and 1 different) = $\frac{3}{9} \times \frac{2}{8} \times \frac{6}{7} \times 3 \text{ or } \binom{3}{2} \times \binom{6}{1} \div \binom{9}{3}$ $= \frac{3}{14}$ P(2 of any colour and 1 different) = $\frac{9}{14}$	M1A1 A1 B1	M1A0 if 3 omitted Allow 3/28 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 $P(X = 2) = \frac{e^{-1.5} \times 1.5^2}{2!}$ $= 0.251$	B1 M1 A1	Award M0 if no working seen
(b)	$P(X > 2) = 1 - e^{-1.5} \left(1 + 1.5 + \frac{1.5^2}{2!} \right)$ $= 0.191$	M1A1 A1	

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5(a)	Let X = number of female dogs so X is $B(20,0.55)$	B1	si
(i)	$P(X = 12) = \binom{20}{12} \times 0.55^{12} \times 0.45^8$ $= 0.162$	M1 A1	Accept 0.4143 – 0.2520 or 0.7480 – 0.5857
(ii)	Let Y = number of male dogs so Y is $B(20,0.45)$ $P(8 \leq X \leq 16) = P(4 \leq Y \leq 12)$ $= 0.9420 - 0.0049$ 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 $B(60,0.05) \approx Po(3)$ $P(U < 5) = 0.8153$	M1 m1A1	
6(a)	$P(\text{head}) = \frac{3}{4} \times \frac{1}{2} + \frac{1}{4} \times 1$ $= \frac{5}{8}$	M1A1 A1	M1 Use of Law of Total Prob (Accept tree diagram)
(b)(i)	$P(DH \text{head}) = \frac{1/4}{5/8}$ $= \frac{2}{5} \text{ cao}$	B1B1 B1	B1 num, B1 denom FT denominator from (a)
(ii)	EITHER $P(\text{head}) = \frac{3}{5} \times \frac{1}{2} + \frac{2}{5} \times 1$ $= \frac{7}{10}$ OR $P(\text{Head}) = \frac{\frac{3}{4} \times \frac{1}{2} \times \frac{1}{2} + \frac{1}{4} \times 1}{\frac{5}{8}}$ $= \frac{7}{10}$	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)	$E(X) = 0.1 + 0.6 + 3\theta + 0.8 + 5(0.4 - \theta)$ $= 3.5 - 2\theta$ The range is [2.7,3.5]	M1 A1 A1	FT the range from (a)
(c)	$E(X^2) = 0.1 + 1.2 + 9\theta + 3.2 + 25(0.4 - \theta)$ $\text{Var}(X) = 0.1 + 1.2 + 9\theta + 3.2 + 25(0.4 - \theta)$ $- (3.5 - 2\theta)^2$ $= 2.25 - 2\theta - 4\theta^2$ Var(X) = 1.5 gives $4\theta^2 + 2\theta - 0.75 = 0$ $16\theta^2 + 8\theta - 3 = 0$ $(4\theta + 3)(4\theta - 1) = 0$ $\theta = 0.25$	M1A1 M1 A1 M1 A1 M1 A1	Must be in terms of θ Allow use of formula
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. $P(\text{equal numbers}) = \frac{1}{8}$	M1 A1	
(b)	The possible pairs are (4,8);(5,7);(6,6);(7,5);(8,4) EITHER the sample space contains 64 pairs of which 5 give a sum of 12 OR each pair has probability 1/64. $P(\text{sum} = 12) = \frac{5}{64}$	B1 M1 A1	
(c)	EITHER reduce the sample space to (4,8);(5,7);(6,6);(7,5);(8,4) OR $P(\text{equal numbers}) = \frac{P(6,6)}{P(\text{sum}=12)} = \frac{1/64}{5/64}$ Therefore $P(\text{equal numbers}) = \frac{1}{5}$	M1 A1	

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