S1

Ques	Solution	Mark	Notes
1(a)(i)	P(A∪B) = P(A) + P(B)	M1	Award M1 for using formula
	= 0.8	A1	
(ii)	P(A∩B) = P(A)P(B) = 0.5 × 0.3	B1	
	P(A∪B) = P(A) + P(B) – P(A∩B)	M1	Award M1 for using formula
	= 0.5 + 0.3 – 0.5 × 0.3 = 0.65	A1	
(b)	P(A∩B) = P(A) + P(B) – P(A∪B) = 0.1	B1	
	P(B|A) = $\frac{P(A\cap B)}{P(A)}$	M1	Award M1 for using formula
	= 0.2	A1	
2(a)	$E(X^2) = \text{Var}(X) + [E(X)]^2$	M1	Award M1 for using formula
	= 66	A1	
(b)	$E(Y) =$ 3E(X) + 4	M1	Award M1 for using formula
	= 28	A1	
	Var(Y) = $3^2\text{Var}(X)$	M1	Award M1 for using formula
	= 18	A1	
3(a)	P(no white) = $\frac{4}{9}\times\frac{3}{8}\times\frac{2}{7}$ or $\binom{4}{3}\div\binom{9}{3}$	M1	
	= $\frac{1}{21}$	A1	
(b)	P(2 white) = $\frac{5}{9}\times\frac{4}{8}\times\frac{4}{7}\times 3$ or $\binom{5}{2}\times\binom{4}{1}\div\binom{9}{3}$	M1	M0 if 3 omitted.
	= $\frac{10}{21}$	A1	
(c)	EITHER		
	P(2 blue) = $\frac{3}{9}\times\frac{2}{8}\times\frac{6}{7}\times 3$ or $\binom{3}{2}\times\binom{6}{1}\div\binom{9}{3}$	M1A1	M0 if 3 omitted
	= $\left(\frac{3}{14}\right)$		
	P(2 the same) = $\frac{10}{21}+\frac{3}{14}$		
	= $\frac{29}{42}$ cao	A1	
	OR		
	P(2 the same) = $\frac{5}{9}\times\frac{4}{8}\times\frac{1}{7}\times 3+\frac{5}{9}\times\frac{4}{8}\times\frac{3}{7}\times 3 + \frac{3}{9}\times\frac{2}{8}\times\frac{1}{7}\times 3+\frac{3}{9}\times\frac{2}{8}\times\frac{5}{7}\times 3$	M1A1	M0 if 3 omitted Accept $\binom{5}{2}\times\binom{1}{1}\div\binom{9}{3}+\binom{5}{2}\times\binom{3}{1}\div\binom{9}{3}$ $+\binom{3}{2}\times\binom{1}{1}\div\binom{9}{3}+\binom{3}{2}\times\binom{5}{1}\div\binom{9}{3}$
	= $\frac{29}{42}$ cao	A1	

4(a)(i)	$P(X = 4) = \binom{10}{4} \times 0.75^4 \times 0.25^6$	**M1**	Accept 0.9965 – 0.9803 or 0.0197 – 0.0035
	$= 0.0162$	**A1**	
(ii)	Let Y denote the number of games won by Dave so that Y is B(10,0.25). si	**M1**	
	We require $P(Y \le 4)$	**m1**	
	$= 0.9219$	**A1**	
(b)	The number of games lasting less than 1 hr, G, is B(45,0.08) ≈ Poi(3.6). si	**B1**	Award M1A0 for use of adjacent row or column.
	$P(G > 6) = 0.0733$	**M1A1**	FT their mean
5(a)	$P(CB) = \frac{6}{10} \times \frac{8}{100} + \frac{4}{10} \times \frac{3}{100}$	**M1A1**	M1 Use of Law of Total Prob (Accept tree diagram)
	$= 0.06$	**A1**	
(b)	$P(F\|CB) = \frac{12/1000}{0.06}$	**B1B1**	FT denominator from (a) B1 num, B1 denom
	$= 0.2$ cao	**B1**	
6(a)	$\frac{1}{6}$	**B1**	
(b)	$\frac{5}{6} \times \frac{5}{6} \times \frac{1}{6} = \frac{25}{216}$	**M1A1**	
(c)	$\frac{1}{6}, \frac{25}{216}$ and $\frac{5}{6} \times \frac{5}{6} \times \frac{5}{6} \times \frac{5}{6} \times \frac{1}{6} \left(\frac{625}{7776}\right)$	**M1A1**	Award M1A1 if only 3rd term given.
(d)	$\text{Prob} = \frac{1/6}{1 - 25/36}$	**M1**	FT their answer to (a)
	$= \frac{6}{11}$	**A1**	
7(a)(i)	$P(X = 10) = \frac{e^{-12} \times 12^{10}}{10!}$	**M1**	Working must be shown.
	$= 0.105$	**A1**	Accept 0.3472 – 0.2424 or 0.7576 – 0.6528
(ii)	$P(X > 10) = 1 - 0.3472 = 0.6528$	**M1A1**	Award M1 for adjacent row/col
(b)	Using tables, we see that $P(X \le 18) = 0.9626$	**M1**	Award M1A0 for 17 or 19
	He needs to take 18 jars.	**A1**	

8(a)	$0 \le \theta \le 0.3$	**B1B1**	Accept use of <.
(b)	$E(X) = 2(0.3-\theta) + 3\times 2\theta + 4(0.7-\theta)$	**M1**	Use of $\Sigma x p_x$ with θ.
	$= 3.4$	**A1**	
	E(X) is therefore independent of θ		Need not be seen
(c)(i)	$E(X^2) = 4(0.3-\theta) + 9\times 2\theta + 16(0.7-\theta)$.	**M1**	Must include θ
	$= 12.4 - 2\theta$	**A1**	
	Var(X) $= 12.4 - 2\theta - 3.4^2$	**M1**	FT their $E(X)$ if possible
	$= 0.84 - 2\theta$	**A1**	
	$0.84 - 2\theta = 0.8^2$		
	$\theta = 0.1$ cao	**A1**	
(ii)			
	Possibilities are 3,3; 4,2 si	**B1**	
	P(Sum = 6) = 0.2×0.6×2 + 0.2×0.2	**M1**	Award M1A0 if 2 is missing in 1st term or present in 2nd term
	= 0.28	**A1**	FT their value of θ if sensible
9(a)(i)	E(X) = $\frac{1}{10}\int_1^2 x(2x+3x^2)\,dx$	**M1A1**	M1 for the integral of $xf(x)$, A1 for completely correct although limits may be left until 2nd line.
	$= \frac{1}{10}\left[\frac{2x^3}{3} + \frac{3x^4}{4}\right]_1^2$	**A1**	For evaluating the integral
	= 1.59	**A1**	
(ii)	$E(X^2) = \frac{1}{10}\int_1^2 x^2(2x+3x^2)\,dx$	**B1**	Integral and limits
	$= \frac{1}{10}\left[\frac{2x^4}{4} + \frac{3x^5}{5}\right]_1^2$	**B1**	Correct evaluation of integral
	= 2.61		
	Var(X) = 2.61 – 1.59^2 = 0.08	**M1A1**	FT their $E(X)$
(b)(i)	$F(x) = \int_1^x \frac{1}{10}(2t+3t^2)\,dt$	**M1**	Limits may be left until 2nd line
	$= \frac{1}{10}\left[t^2 + t^3\right]_1^x$	**A1**	
	$= \frac{1}{10}(x^2 + x^3 - 2)$ cao	**A1**	
(ii)	$P(X \le 1.4) = F(1.4)$	**M1**	FT their $F(x)$ if possible
	= 0.27	**A1**	
(iii)	The lower quartile is less than 1.4	**B1**	FT their answer to (a)(ii)
	since $F(1.4)$ is more than 0.25.	**B1**	