

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

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

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