Ques	Solution	Mark	Notes
1(a)	P(A∪B) = P(A) + P(B)	**M1**	Award M1 for using formula
	P(B) = 0.4 – 0.25 = 0.15	**A1**	
(b)	P(A∪B) = P(A) + P(B) – P(A)P(B)	**M1**	Award M1 for using formula
	0.4 = 0.25 + P(B) – 0.25P(B)	**A1**	
	P(B) = 0.15/0.75 = 0.2	**A1**	
2(a)	P(1 of each) =		
	$\frac{5}{10}\times\frac{3}{9}\times\frac{2}{8}\times 6$ or $\binom{5}{1}\times\binom{3}{1}\times\binom{2}{1}\div\binom{10}{3}$	**M1A1**	M1A0A0 if 6 omitted Special case : if they use an incorrect total, eg 9 or 11, FT their incorrect total but subtract 2 marks at the end
	$= \frac{1}{4}$	**A1**	
(b)	P(3 war) = $\frac{5}{10}\times\frac{4}{9}\times\frac{3}{8}$ or $\binom{5}{3}\div\binom{10}{3}$	**M1**	
	$= \frac{1}{12}$	**A1**	
(c)	P(3 cowboy) = $\frac{3}{10}\times\frac{2}{9}\times\frac{1}{8}$ or $\binom{3}{3}\div\binom{10}{3}$		
	$= \frac{1}{120}$	**B1**	
	P(3 the same) = $\frac{1}{12}+\frac{1}{120}=\frac{11}{120}$	**M1A1**	FT previous values
3	$E(X) = 20$	**B1**	
	Var(X) = 4 (SD = 2)	**B1**	
	$E(Y) = 20a + b = 65$	**B1**	
	Var(Y) = $4a^2 = 36$	**B1**	Accept SD(Y) = 2a = 6
	$a = 3$	**B1**	Must be justified by solving the two equations
	$b = 5$	**B1**	
4(a)(i)	B(20,0.25)	**B1**	B must be mentioned and the parameters n and p must be seen or implied somewhere in the question
(ii)	P(3 ≤ X ≤ 9) = 0.9087 – 0.0139 or 0.9861 – 0.0913	**B1B1**	
	= 0.8948	**B1**	
(iii)	P(X = 6) = $\binom{20}{6}\times 0.25^6\times 0.75^{14}$	**M1**	FT an incorrect p except for the last three marks
	= 0.169	**A1**	M0 if no working seen
(b)(i)	Let Y denote the number of throws giving '8'		
	Then Y is B(160,0.0625) ≈ Poi(10).	**B1**	
	P(Y = 12) = $e^{-10}\times\frac{10^{12}}{12!}$	**M1**	M0 if no working seen
	= 0.0948	**A1**	Accept the use of tables
(ii)	P(6≤Y≤14) = 0.9165 – 0.0671 or 0.9329 – 0.0835	**B1B1**	Correct values only (no FT)
	= 0.8494 cao	**B1**	

5(a)	P(1) = $\frac{1}{3}\times\frac{1}{4}+\frac{1}{3}\times\frac{1}{3}+\frac{1}{3}\times\frac{1}{2}$	**M1A1**	M1 Use of Law of Total Prob (Accept tree diagram)
	$=\frac{13}{36}$ (0.361)	**A1**	
(b)	P(A|1) = $\frac{1/12}{13/36}$	**B1B1**	FT denominator from (a) B1 num, B1 denom
	$=\frac{3}{13}$ cao (0.231)	**B1**	
6(a)	The sequence is MMMH si	**B1**	
	Prob = 0.3×0.3×0.3×0.7 = 0.0189	**M1A1**	
(b)	The sequence is MHH or HMH si	**B1**	
	Prob = 0.3×0.7×0.7 + 0.7×0.3×0.7 = 0.294	**M1A1**	Award B1 for 0.147
7(a)	$\sum p_x = k\left(1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}\right) = 1$	**M1**	
	$k\left(\frac{8+4+2+1}{8}\right)=1 \rightarrow k=\frac{8}{15}$	**A1**	Convincing
(b)	$E(X)=\frac{8}{15}\times1+\frac{4}{15}\times2+\frac{2}{15}\times4+\frac{1}{15}\times8$	**M1**	
	$=\frac{32}{15}$ (2.13)	**A1**	
	$E(X^2)=\frac{8}{15}\times1+\frac{4}{15}\times4+\frac{2}{15}\times16+\frac{1}{15}\times64$ (8)	**M1A1**	
	Var(X) = $8-\left(\frac{32}{15}\right)^2=3.45$ (776/225)	**A1**	Accept 3.46
(c)(i)	The possibilities are (1,1); (2,2); (4,4); (8,8) si	**B1**	
	$P(X_1=X_2)=\left(\frac{8}{15}\right)^2+\left(\frac{4}{15}\right)^2+\left(\frac{2}{15}\right)^2+\left(\frac{1}{15}\right)^2$	**M1**	
	$=\frac{17}{45}$ (0.378)	**A1**	
(ii)	It follows that $P(X_1\neq X_2)=\frac{28}{45}$	**M1**	FT their answer from (c)(i)
	And therefore by symmetry $P(X_1>X_2)=\frac{14}{45}$	**A1**	Do not accept any other method.

8(a)	Let X denote the number of calls between 9am and 10 am so that X is Po(5)	**B1**	
	$P(X=7) = \dfrac{e^{-5}\times 5^7}{7!}$	**M1**	M0 no working
	$= 0.104$	**A1**	
(b)	We require P(calls betw 9 and 10=7|calls betw 9 and 11=10)		
	$= \dfrac{P(\text{c b 9 and 10} = 7 \text{ AND c b 9 and 11} = 10)}{P(\text{calls between 9 and 11} = 10)}$	**M1**	
	$= \dfrac{P(\text{c b 9 and 10} = 7)\times \text{P(c b 10 and 11} = 3)}{P(\text{calls between 9 and 11} = 10)}$	**A1**	
	$= \dfrac{e^{-5}\times 5^7}{7!}\times\dfrac{e^{-5}\times 5^3}{3!}\div\dfrac{e^{-10}\times 10^{10}}{10!}$ (denom = 0.125)	**A1A1**	A1 numerator, A1 denominator The denominator A1 can be awarded if the M1 is awarded
	$= 0.117$	**A1**	
9(a)	$\int_0^2 k\left(1-\dfrac{x^2}{4}\right)dx = 1$	**M1**	M1 for $\int f(x)dx$, limits not required until next line
	$k\left[x-\dfrac{x^3}{12}\right]_0^2 = 1$	**A1**	
	$k\left(2-\dfrac{8}{12}\right) = 1$	**A1**	
	$k = \dfrac{3}{4}$		
(b)	$E(X) = \int_0^2 x\left(\dfrac{3}{4}-\dfrac{3x^2}{16}\right)dx$	**M1A1**	M1 for the integral of $xf(x)$, A1 for completely correct although limits may be left until 2nd line.
	$= \left[\dfrac{3x^2}{8}-\dfrac{3x^4}{64}\right]_0^2$	**A1**	
	$= 0.75$	**A1**	
(c)(i)	$F(x) = \int_0^x \left(\dfrac{3}{4}-\dfrac{3t^2}{16}\right)dt$	**M1**	M1 for $\int f(x)dx$
	$= \left[\dfrac{3t}{4}-\dfrac{t^3}{16}\right]_0^x$	**A1**	A1 for performing the integration
	$= \dfrac{3x}{4}-\dfrac{x^3}{16}$	**A1**	A1 for dealing with the limits
(ii)	$P(0.5 \le X \le 1.5) = F(1.5) - F(0.5)$	**M1**	FT their F(x)
	$= 0.547$	**A1**	