

## Topic Y2 Counting principles & probability distributions (Post-TT B) [50] MS

1.

3(i)	$\frac{7!}{3! \times 2!}$ = 420	M1M1 A1	3	M1: 7!/(a factorial); or ... ÷ (3! x 2!)) M1: all correct
(ii)	$\frac{5!}{2!}$ = 60	M1 A1	2	M1: 5! seen (not part of a C) or 5 x 4! or 120 seen or ... ÷ 2! alone
(iii)	$1 - {}^4/7x^3/6$ or $1 - {}^4C_2 / {}^7C_2$ or $1 - {}^4P_2 / {}^7P_2$ or ${}^3/7x^2/6 + {}^3/7x^4/6 + {}^4/7x^3/6$ oe or ${}^3C_2 / {}^7C_2 + {}^3C_1x^4C_1 / {}^7C_2$  = ${}^5/7$ or 0.714 (3 sfs)	M1M1  A1	  3	M1: 1- prod or 1-.../{}^7C_2 or 1-{}^4C_2 / .. (or Ps) or add 3 prods or add 2 correct prods or ${}^3C_2 / {}^7C_2$ or ${}^3C_1x^4C_1 / {}^7C_2$ or add ≥ 5 out of 7 correct prods M1: all correct
<b>Total</b>		<b>8</b>		

2.

3(i)(a)	0.9368 or 0.937	B1	1	
(b)	$0.7799 - 0.5230$ or ${}^8C_5 \times 0.45^3 \times 0.55^5$ = 0.2569 or 0.2568 or 0.257	M1 A1	2	Allow 0.9368 - 0.7799
(c)	0.7799 seen - 0.0885 (not 1 - 0.0885) = 0.691 (3 sfs)	M1 M1 A1	3	${}^8C_5 \times 0.45^3 \times 0.55^5 + {}^8C_4 \times 0.45^4 \times 0.55^4 + {}^8C_3 \times 0.45^5 \times 0.55^3$ : M2 1 term omitted or wrong or extra: M1
(ii)(a)	${}^{10}C_2 \times ({}^7/12)^8 \times ({}^7/12)^2$ seen = 0.105 (3 sfs)	M1 A1	2	or 0.105 seen, but not ISW for A1
(b)	$2^{31/72}$ or ${}^{175/72}$ or 2.43 (3 sfs)	B1	1	NB ${}^{12/5} = 2.4$ : B0
<b>Total</b>		<b>9</b>		

3.

(i) (a) Geo(0.14) stated in (a) or (b)  $(0.86)^4 \times 0.14$ = 0.0766 (3 sfs)	B1 M1 A1	3	or $0.86^n \times 0.14$ or $0.14^n \times 0.86$ in (a) or $\geq$ M1 in (b) or Geo(0.86) stated in (a) or (b)  No wking: 0.077: B1M1A0
(b) $1 - 0.86^7$ or $0.14 + 0.86 \times 0.14 \dots + 0.86^6 \times 0.14$ = 0.652 (3 sfs)	M2 A1	3	$1 - 0.86^8$ : M1 +8 <sup>th</sup> term (r = 7 or 0) or 1 missing term: M1
(ii) $1/0.14$ = ${}^{50/7}$ or 7.14 (3 sfs)	M1 A1	2	
<b>Total</b>	<b>8</b>		

4.

2(i)	$\frac{{}^2C_2 \times {}^8C_3}{{}^{15}C_5}$  = ${}^{56/143}$ or ${}^{1176/3003}$ or 0.392 (3 sfs)	M1 M1  A1	3	${}^7C_2 \times {}^8C_3$ or 1176 : M1 (Any C or P)/ ${}^{15}C_5$ : M1 (dep < 1)  or $\frac{7}{15} \times \frac{6}{14} \times \frac{8}{13} \times \frac{7}{12} \times \frac{6}{11}$ or 0.0392: M1 $\times {}^5C_2$ or $\times 10$ : M1 (dep ≥ 4 probs mult)  if 2 ↔ 3, treat as MR max M1M1
(ii)	$3! \times 2!$ or ${}^3P_3 \times {}^2P_2$ not in denom = 12	M1 A1	2	BABAB seen: M1  120-12: M1A0 NB ${}^4/2!$ = 12: M0A0
<b>Total</b>		<b>5</b>		

5.

(i)	Bricks scattered at constant average rate & independently of one another	B1 B1 2	B1 for each of 2 different reasons, in context. (Treat “randomly” ≡ “singly” ≡ “independently”)
(ii)	Po(12) $P(\leq 14) - P(\leq 7) [= .7720 - .0895]$ [or $P(8) + P(9) + \dots + P(14)$ ]  $= 0.6825$	B1 M1  A1 3	Po(12) stated or implied Allow one out at either end or both, eg 0.617, or wrong column, but <i>not</i> from Po(3) nor, eg, .9105 – .7720 Answer in range [0.682, 0.683]
(iii)	$e^{-\lambda} = 0.4$ $\lambda = -\ln(0.4)$ $= 0.9163$ Volume = $0.9163 \div 3 = 0.305$	B1 M1 A1 M1 4	This equation, aef, can be implied by, eg 0.9 Take ln, or 0.91 by T & I $\lambda$ art 0.916 or 0.92, can be implied Divide their $\lambda$ value by 3 [SR: Tables, eg 0.9÷3: B1 M0 A0 M1]

6.

7(a)	$-4 = 2 - 5E(X)$	M1	3.1a
	$E(X) = 1.2$		
	$-1 \times c + 0 \times a + 1 \times a + 2 \times b + 3 \times c = 1.2$	M1	1.1b
	$a + 2b + 2c = 1.2$ [1]		
	$P(Y \geq -3) = 0.45$ gives $P(2 - 5X \geq -3) = 0.45$ i.e. $P(X \leq 1) = 0.45$	M1	2.1
	$2a + c = 0.45$ [2]		
	$2a + b + 2c = 1$ [3]	M1	1.1b
	$\begin{pmatrix} 1 & 2 & 2 \\ 2 & 0 & 1 \\ 2 & 1 & 2 \end{pmatrix} \begin{pmatrix} a \\ b \\ c \end{pmatrix} = \begin{pmatrix} 1.2 \\ 0.45 \\ 1 \end{pmatrix} \Rightarrow \begin{pmatrix} a \\ b \\ c \end{pmatrix} = \begin{pmatrix} 1 & 2 & -2 \\ 2 & 2 & -3 \\ -2 & -3 & 4 \end{pmatrix} \begin{pmatrix} 1.2 \\ 0.45 \\ 1 \end{pmatrix}$ or	M1	1.1b
	e.g. [3] - [2] $\Rightarrow b + c = 0.55$ sub. $2(b + c)$ into [1] $\Rightarrow a = 0.1$ etc		
$a = 0.1 \quad b = 0.3 \quad c = 0.25$	A1 A1	1.1b 1.1b	
	(7)		
(b)	$\text{Var}(Y) = 75 - (-4)^2$ or 59	M1	1.1a
	[ $\text{Var}(Y) = 5^2 \text{Var}(X)$ implies] $\text{Var}(X) = 2.36$	A1	1.2
		(2)	
(c)	$P(Y > X) = P(2 - 5X > X) \rightarrow P(X < \frac{1}{3})$	M1	3.1a
	$P(X < \frac{1}{3}) = a + c = 0.35$	A1ft	1.1b
		(2)	

(11 marks)