Topic Y2 Counting principles & probability distributions (Pre-TT A) [49] MS

1.

If P used instead of C consistently in all parts attempted (at least two parts attempted), max marks: (i) B0 (ii) M1A0 (iii) M1M1A0 Answers: (i) 427518000 (ii) 550368 (iii) 7338240					
i		593775	B1 [1]	or 594000 (3 sf)	
ii		$^{14}C_2 \times {}^{9}C_2 \times {}^{7}C_2$ alone = 68796	M1 A1 [2]	 or 68800 (3 sf)	MR: $\div {}^{30}C_6$ $(=\frac{84}{725}$ or 0.116) M1A0
iii		14 (or $^{14}C_1$) × $^{16}C_5$ or 14 × 4368 alone = 61152	M2 A1 [3]	or M1 for either $^{16}C_5$ or 4368 seen or 14 (or $^{14}C_1$) × any no. seen or 61200 (3 sf)	$14\times({}^{9}C_5+{}^{9}C_4\times 7+{}^{9}C_3\times{}^{7}C_2+{}^{9}C_2\times{}^{7}C_3+9\times{}^{7}C_4+{}^{7}C_5)$ M2 NOT 14 + ... : M0M0 MR: $\div {}^{30}C_6$ $(=\frac{224}{2175}$ or 0.103) M2A0

2.

(i)	(a)	Geo(0.05) $(19/20)^5(1/20)$ = 0.0387	M1 M1 A1 3	Geo(0.05) or 0.95 stated or implied q^5p attempted Answer, a.r.t. 0.0387 ISW	
	(b)	$(19/20)^{10}$ = 0.599	M1 M1 A1 3	q^{10} or $1-p-pq\ \ldots-pq^9$ [q^9 or q^{11}, or one wrong term: M1M0] Answer, a.r.t. 0.599 $1-(^{19}/_{20})^{10}$: M0M0A0	
(ii)		Mean = $1/p$ = 20	M1 A1 2	 20, cao	

3.

(a)	$\mathbf{P}(X=4)=\frac{7}{10}\times\frac{6}{9}\times\frac{5}{8}$	M1	2.1
	$=\frac{210}{720}=\frac{7}{24}$ *	A1*	1.1b
(b)	$\mathbf{E}(X)=1\times\frac{3}{10}+2\times\frac{7}{30}+3\times\frac{7}{40}+4\times\frac{7}{24}=$ $\frac{59}{24}=2.458\dot{3}$ $\mathbf{E}(X^2)=1^2\times\frac{3}{10}+2^2\times\frac{7}{30}+3^2\times\frac{7}{40}+4^2\times\frac{7}{24}=$ $\frac{299}{40}=7.475$	M1 A1	3.1b 1.1b
	$\mathrm{Var}(X)=\frac{299}{40}-\left(\frac{59}{24}\right)^2=1.43159\ldots$ awrt 1.43	M1 A1	1.1b 1.1b
(c)	Let rv $T=$ number of tokens drawn $T\sim\mathrm{Geo}(0.3)$	B1	3.3
	$Y=T-1$	B1	3.1b
	$\mathrm{Var}(Y)=\mathrm{Var}(T)$	M1	3.4
	$\mathrm{Var}(Y)=\frac{1-p}{p^2}=\frac{0.7}{0.3^2}=\frac{70}{9}=7.\dot{7}$	A1	1.1b

4.

(i)	$^{5!}/_{2}$ $= 60$	M1 A1 2	Allow 5P3
(ii)	$4!$ $= 24$	M1 A1 2	Allow $2\times4!$
(iii)	$^{2}/_{5} \times {}^{3}/_{4}$ or $3/5\times2/4$ $\times 2$ $= {}^{3}/_{5}$ oe	M1 M1 A1 3	allow M1 for $^{2}/_{5} \times {}^{3}/_{5} \times 2$ or $^{12}/_{25}$ or $(6\times3!)\div$**(i)** M2 or $3!\div$**(i)**,$6\div$**(i)**,$(6+6)\div$**(i)**,$6k\div$**(i)** or 6×6 or 36 or 1-correct answer M1 (k,integer ≤ 5)
Total		[7]	

5.

ia	0.299 (3 sf)	B1 1	
ib	$0.2991 - 0.1040$ $= 0.195$ (3 sf) or $\frac{1280}{6561}$ oe	M1 A1 2	Must subtract correct pair from table
iia	$^{15}C_4\times(1-0.22)^{11}\times0.22^4$ $= 0.208$ (3 sf)	M1 A1 2	Allow M1 for $^{15}C_4\times0.88^{11}\times0.22^4$
iib	$(15 \times 0.22 =) 3.3$ $15\times0.22\times(1-0.22)$ or '3.3'$\times(1-0.22)$ $= 2.57$ (3 sf)	B1 M1 A1 3	Allow M1 for $15 \times 0.22 \times 0.88$
Total		**8**	

6.

Question	Scheme	Marks	AOs
8(a)	$X \sim$ Po(2.6) $Y \sim$ Po(1.2)		
	P(each hire 2 in 1 hour) $=$ P(X=2) $\times$ P(Y=2) = 0.25104…$\times$ 0.21685…	M1	3.3
	$=$ 0.05444… awrt **0.0544**	A1	1.1b
		(2)	
(b)	$W = X + Y \rightarrow W \sim$ Po(3.8)	M1	3.4
	P(W = 3) = 0.20458…. awrt **0.205**	A1	1.1b
		(2)	
(c)	$T \sim$ Po((2.6+1.2)×2)	M1	3.3
	P(T < 9) = 0.64819… awrt **0.648**	A1	1.1b
		(2)	
(d)	**(i)** Mean = np = **2.4**	B1	1.1b
	(ii) Variance = $np(1-p)$ = 2.3904 awrt **2.39**	B1	1.1b
		(2)	
(e)	**(i)** [$D \sim$ Po(2.4) P($D \leqslant 4$)] = 0.9041… awrt **0.904**	B1	1.1b
	(ii) Since n is large and p is small/mean is approximately equal to variance	B1	2.4
		(2)	
			(10 marks)