Topic Y2 Counting principles & probability distributions (Pre-TT B) [47] MS

1.

3i	${}^{15}C_7$ or ${}^{15!}/_{7!8!}$ 6435	M1 A1 2	
ii	${}^{6}C_3 \times {}^{9}C_4$ or ${}^{6!}/_{3!3!} \times {}^{9!}/_{4!5!}$ 2520	M1 A1 2	Alone except allow $\div {}^{15}C_7$ Or ${}^{6}P_3 \times {}^{9}P_4$ or ${}^{6!}/_{3!} \times {}^{9!}/_{5!}$ Allow $\div {}^{15}P_7$ NB not ${}^{6!}/_{3!} \times {}^{9!}/_{4!}$ 362880
Total		**4**	

2.

			Q1: if consistent "0.8" incorrect or ${}^{1}/_{8}$, ${}^{7}/_{8}$ or 0.02 allow M marks in ii , iii & 1st M1 in i
i	Binomial stated $0.9437 - 0.7969$ or ${}^{8}C_3 \times 0.2^3 \times 0.8^5$ $= 0.147$ (3 sfs)	M1 M1 A1 3	or implied by use of tables or ${}^{8}C_3$ or $0.2^a \times 0.8^b$ $(a+b = 8)$
ii	$1 - 0.7969$ $= 0.203$ (3 sf)	M1 A1 2	allow $1 - 0.9437$ or 0.056(3) or equiv using formula
iii	8×0.2 oe 1.6	M1 A1 2	$8 \times 0.2 = 2$ M1A0 $1.6 \div 8$ or ${}^{1}/_{1.6}$ M0A0

3.

Uses sum of probs = 1	AO1.2	M1	$0.4 + b + c = 1$ $b + c = 0.6$
Uses formula for E(R)	AO1.1a	M1	E $(R) = 0.2 \Rightarrow$ $(-2 \times 0.3) + (0 \times b) + (a \times c) + (4 \times 0.1) = 0.2$ $ac = 0.4$
Uses formula for variance $E(X^2) - (E(X))^2$	AO1.1a	M1	$E(X^2) - (E(X))^2 = (4 \times 0.3) + (0 \times b) + (a^2 \times c) + (16 \times 0.1) - (0.2)^2 = 3.56$ $a^2c = 0.8$
Obtains a, b and c CAO	AO1.1b	A1	From (2) and (3) $a = 2$ Hence $c = 0.2$ and $b = 0.4$

4.

8(i)	Geometric. Each attempt (or result or try) indep	B1 B1	2	In context. Not "events,. trials, outcomes" . Ignore extra
(ii)(a)	$(^2/_3)^3 \times {}^1/_3$ $= {}^8/_{81}$ or 0.0988 (3 sfs)	M2 A1	3	$(^2/_3)^2 x^1/_3$ or $(^2/_3)^4 \times {}^1/_3$: allow other numerical "p" ($0<p<1$):M1
(b)	$(^2/_3)^3$ $1-(^2/_3)^3$ $= {}^{19}/_{27}$ or 0.704 (3sfs)	M1 M1 A1	3	not $(^2/_3)^3$ x …. or $^1/_3 + {}^2/_3 x^1/_3 + (^2/_3)^2 x^1/_3$ M2 $1-(^2/_3)^4$ or $1-$("q")^4 M1 or 3 terms, with 2 correct M1 or 3 correct terms + 1 extra M1 or "p" + "qp" + "q^2p" M1 or 1 – sum of 3 correct terms M1 "p" means num value, not $^1/_3$
(iii)	3	B1f	1	or $^1/_{\text{"}p\text{"}}$
(iv)	$1-{}^{19}/_{27}$ | (1 – 0.7037) or 0.2963 $(^8/_{27})^2 \times {}^{19}/_{27}$ | $0.2963^2 \times 0.7037$ $= {}^{1216}/_{19683}$ | = 0.0618 (3 sfs)	M1 M1 A1	3	ft (b) for M1M1 must see method if ft Allow figs rounded to 2 sfs for M1M1 cao. allow art 0.0618 or 0.0617
Total		**12**		

5.

(a)	States mean = 40 hours	AO1.2	B1	Mean $= \dfrac{1}{\lambda} = 40$ hours
(b)	Obtains correct probability	AO1.1b	B1	$P(\text{time} < 12) = 1 - e^{-12\times0.025}$ $= 1 - e^{-0.3} = 0.259$
(c)	Uses 'no memory' property PI	AO3.4	M1	Exponential distribution has no memory
	Obtains probability	AO1.1b	A1	$P(\text{time} > 30) = e^{-30\times0.025} = e^{-0.75}$ $= 0.472$

(d)	States or uses new mean (or uses $e^{-0.3}$)	AO3.4	B1	4 consecutive shifts gives $4 \times 12 = 48$ hours
	Finds probability P (time > 48) (or uses $(e^{-0.3})^4$)	AO1.1a	M1	P(time > 48) = $e^{-48\times0.025} = e^{-1.2}$
	Obtains correct probability	AO1.1b	A1	$= 0.301$
(e)(i)	States Poisson for model of situation given	AO3.3	B1	Poisson identified
	States value for λ (= 0.025 per hour) for model	AO3.3	B1	Po (0.025) per hour
e (ii)	Uses 60 x 'their' λ for 'their' Po model Or Uses exponential model to find P(Time > 60)	AO3.4	M1F	For **60** hours of process $\lambda = 60 \times 0.025 = 1.5$
	Obtains correct probability using Poisson or exponential model	AO1.1b	A1	$P(X = 0) = \frac{1.5^0 \times e^{-1.5}}{0!} = e^{-1.5} = 0.223$

6.

ia	5040	B1 1		
b	6! or 5!×6 or 720	M1	$^1/_7 \times ^1/_6$ M1*	NOT 6! in denom
	÷ 7! or ÷ "5040" or 1440 or (5! or 6!) × 2	M1	Any ÷ 7! or "5040" but NOT any × 2 × 6 or × 2 M1 dep*	eg $^{6!}/_{5040}$ or $^1/_7$ or 0.143 or $^1/_{21}$ (3 sfs): M1M1A0
	$= ^2/_7$ oe or 0.286 (3 sf)	A1 3		
iia	3! × 4! alone or 144	M1	$^4/_7 \times ^3/_6 \times ^3/_5 \times ^2/_4 \times ^2/_3 \times ^1/_2$ oe or $\frac{1}{7C3 \text{ or } 7C4}$	Not 3! × 4! ×… (eg not 3! × 4! × 5) not $\frac{1}{31\times4!}$, not $\frac{1}{144}$
	(÷ 7! or "5040") $= ^1/_{35}$ oe or 0.0286 (3sf)	A1 2		NB no mark for ÷ 7! or "5040" in this part
b	5 seen or 5! seen	M1		or GGGBBBB, BGGGBBB, BBGGGBB, BBBGGGB, BBBBGGG
	3! × 4! × 5 or 5! × 3! or 720 or 5 × 144	M1	or $5 \times ^3/_7 \times ^2/_6 \times ^1/_5 (\times ^4/_4 \times ^3/_3 \times ^2/_2)$ oe: M2 or $5 \times \frac{1}{7C3 \text{ or } 7C4}$: M2 or 5 × "(iia)": M2	NB no mark for ÷ 7! or "5040" in this part
	(÷7! or "5040") $= ^1/_7$ oe or 0.143 (3 sf)	A1 3		
Total		**9**		