

Probability Mark Scheme

1.

(i)	$\frac{3}{4} + \frac{1}{4} \times \frac{3}{8}$ $+ \frac{1}{4} \times \frac{5}{8} \times \frac{3}{16}$ $= \frac{447}{512}$ or 0.873 (3 sf)	M1 M1 A1 [3]	$\frac{1}{4} \times \frac{5}{8} \times \frac{13}{16}$ (= $\frac{65}{512}$ or 0.127) $1 - \frac{1}{4} \times \frac{5}{8} \times \frac{13}{16}$	
(ii)	0.6p or equiv seen $0.4 + 0.6p = 0.58$ $p = 0.3$	B1 M1 A1 [3]	Tree diag alone insufficient for mark. Or $0.6p = 0.18$. "0.18" alone insufficient	NB $0.6 \times 0.3 = 0.18$ seen at the end is probably a check, not an answer. But if 0.3 seen and 0.18 is very clearly indicated as the ans then B1M1A0

2.

(i)	Top: 2 branches $\frac{4}{5}, \frac{1}{5}$ & R, B shown Bottom: 1 st branch: prob = 1 or $\frac{5}{5}$, & R shown no 2 nd branch OR branch with prob = 0 or $\frac{0}{5}$	B1 B1 [2]	consistent allow eg $\frac{4}{4}$ ignore any 3 rd layer branches	Any missing label(s) on first three branches, subtr B1 once No label needed on zero branch, if drawn.
(ii)	$\frac{5}{6} \times \frac{1}{5}$ or $\frac{1}{6}(\times 1)$ or $\frac{1}{6}$ seen $\frac{5}{6} \times \frac{1}{5} + \frac{1}{6}(\times 1)$ $= \frac{1}{3}$ oe	M1 M1 A1 [3]	all correct cao	or $1 - \frac{5}{6} \times \frac{4}{5}$ or $1 - \frac{2}{3}$ M2 ft incorrect tree dep probs ≤ 1 if 3 rd tree prob = 1, (ii)M1M1A0 if 3 rd tree prob $\neq 1$, (ii)M1M0A0 NB!! $2 \times \frac{5}{6} \times \frac{1}{5} = \frac{1}{3}$ M1M0A0
(iii)	$\frac{4}{5} \times \frac{3}{4} + \frac{1}{5}(\times 1)$ or $1 - \frac{4}{5} \times \frac{1}{4}$ or $1 - 0.2$ all correct $= \frac{4}{5}$ or 0.8 oe	M1 A1 [2]	or $(\frac{5}{6} \times \frac{4}{5} \times \frac{3}{4} + \frac{5}{6} \times \frac{1}{5}) \div \frac{5}{6}$ all correct May be seen without working M1A1 cao	but $\frac{5}{6} \times (\frac{4}{5} \times \frac{3}{4} + \frac{1}{5})$ M0 ft incorrect tree: (iii) M1A0

3.

0.4×0.7 $0.6 + 0.4 \times 0.7$ $= 0.88$	M1 M1 A1 3	or $0.6 + \text{prod of 2 probs}$ Condone $0.6 \times 0.7 + 0.6 \times 0.3 + 0.4 \times 0.7$ or $0.6 \times 0.6 + 0.6 \times 0.4 + 0.4 \times 0.7$	1 - prod of 2 P's or 0.4×0.3 $1 - 0.4 \times 0.3$
$p + (1-p) \times p = 0.51$ or $2p - p^2 = 0.51$	M1	or $p^2 + p \times (1-p) + (1-p) \times p$	Condone $p + p \times 1 - p$ M1, but $p + qp = 0.51$ M0
$p^2 - 2p + 0.51 = 0$ $(p-0.3)(p-1.7) = 0$ or $p = \frac{2 \pm \sqrt{4-4 \times 0.51}}{2}$ oe	A1 M1	Correct QE = 0 Condone omission of " = 0"	or $(1-p)^2 = 0.49$ M1A1
$p = 0.3$	M1 A1 4	Correct method for their 3-term QE Not $p = 0.3$ or 1.7	$1 - p = \pm 0.7$ M1 must have \pm Correct ans from correct but reduced wking or T & I or verification or no wking: 4 mks Ans $p = 0.3$ or 1.7 from correct but reduced wking or T & I or no wking: M1M1M1A0 Ans $p = 0.3$ following correct wking except other solution incorrect: BOD 4 mks (eg $p = \frac{2 \pm \sqrt{4-4 \times 0.51}}{2}$ so $p = 0.3$ or -1.3 so $p = 0.3$: 4 mks) $p = 0.3$ from wrong wking but correct verification: BOD 4 mks $p = 0.3$ from wrong wking alone: M0A0M0A0

4.

If done with replacement, no marks in any part of this question.				
i	All correct probs correctly placed, matching labels, if any	B2 2	B1 for 4 correct probs anywhere	Allow B2 with missing labels but only if probs consistently placed, ie R above B throughout
ii	$\frac{4}{10} \times \frac{6}{9} + \frac{6}{10} \times \frac{4}{9} \times \frac{5}{8} + \frac{6}{10} \times \frac{5}{9} \times \frac{4}{8}$ or $\frac{4}{15} + \frac{1}{6} + \frac{1}{6}$ $(= \frac{3}{5}$ AG)	B2 2	B1: two of these products (or their results) added (not multiplied) or $1 - (\frac{6}{10} \times \frac{5}{9} \times \frac{4}{8} + \frac{6}{10} \times \frac{4}{9} \times \frac{3}{8} + \frac{4}{10} \times \frac{3}{9})$ or $1 - (\frac{1}{6} + \frac{1}{10} + \frac{2}{15})$	B1: 1 - two of these products (or results) added (not multiplied) NB incorrect methods can lead to correct ans AG so no wking no mks No ft from tree in (i)

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5.

(i)	$\frac{6}{14} \times \frac{5}{13} \times \frac{3}{12}$ $\times 3!$ oe $= \frac{45}{182}$ or 0.247 (3 sfs) oe	M1 M1 A1 3	${}^6C_1 \times {}^5C_1 \times {}^3C_1$ $\div {}^{14}C_3$ With repl MOM1A0
(ii)	$\frac{6}{14} \times \frac{5}{13} \times \frac{4}{12} + \frac{5}{14} \times \frac{4}{13} \times \frac{3}{12} + \frac{3}{14} \times \frac{2}{13} \times \frac{1}{12}$ $= \frac{31}{364}$ or 0.0852 (3 sf)	M2 A1 3	${}^6C_3 + {}^5C_3 + {}^3C_3$ M1 for any one $(\div {}^{14}C_3)$ M1 all 9 numerators correct. With repl M1 $(6/14)^3 + (5/14)^3 + (3/14)^3$

6.

(i)	$\frac{1}{6} + 3 \times (\frac{1}{6})^2$ $= \frac{1}{4}$	M2 A1 3	$or 3 \times (\frac{1}{6})^2 or \frac{1}{6} + (\frac{1}{6})^2 or \frac{1}{6} + 2(\frac{1}{6})^2$ $or \frac{1}{6} + 4(\frac{1}{6})^2$ M1
(ii)	$\frac{1}{3}$	B1 1	
(iii)	3 routes clearly implied out of 18 possible (equiprobable) routes	M1 M1	$or \frac{1}{3} \times \frac{1}{6} \times 3$ M2 $or \frac{1}{3} \times \frac{1}{6} or \frac{1}{6} \times \frac{1}{6} \times 3 or \frac{1}{3} \times \frac{1}{3} \times 3 or \frac{1}{4} - \frac{1}{6}$ M1 $but \frac{1}{6} \times \frac{1}{6} \times 2$ M0
			$\frac{(\frac{1}{6})^2 \times 3}{\frac{1}{2}}$ or $\frac{1-1}{4-6}$ or $\frac{1 \times 1}{2-6}$ oe M2
			$or \frac{P(4\&twice)}{P(twice)}$ stated or $\frac{prob}{\frac{1}{2}}$ M1
			Whatever 1 st , only one possibility on 2 nd M2
	$\frac{1}{6}$	A1 3	$\frac{1}{6}, no wking$ M1M1A1 $\frac{1}{12}, no wking$ M0

7.

(i)	$\frac{25}{37}$	B2 2	B1 num, B1 denom 25/37xp B1
(ii)	$\frac{15}{23}$ seen or implied $\times \frac{39}{59}$ seen or implied $= \frac{585}{1357}$ or 0.431 (3 sfs) oe	M1 M2 A1 4	M1 num, M1 denom Allow M1 for 39/59x or + wrong p

8.

ia	$\frac{18}{19}$ or $\frac{1}{19}$ seen $\frac{17}{18}$ or $\frac{1}{18}$ seen structure correct ie 6 branches all correct incl. probs and W & R	B1 B1 B1 B1 4	regardless of probs & labels (or 14 branches with correct 0s & 1s)
b	$\frac{1}{20} + \frac{19}{20} \times \frac{1}{19} + \frac{19}{20} \times \frac{18}{19} \times \frac{1}{18}$ $= \frac{3}{20}$	M2 A1 3	M1 any 2 correct terms added $\frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$ $1 - \frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$

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9.

(i)	$\frac{12}{22} \times \frac{11}{21}$ $= \frac{2}{7}$ oe or 0.286 (3 sfs)	M1 A1 2	or ${}^{12}C_2 / {}^{22}C_2$
(ii)	$\frac{7}{15} \times \frac{6}{14} \times \frac{8}{13}$ or $\frac{8}{65}$ oe $\times 3$ oe $= \frac{24}{65}$ or 0.369 (3 sfs)	M1 M1 A1 3	Numerators any order $C_2 \times {}^6C_1$:M1 3 x prod any 3 probs (any C or P) ¹⁵ C_3 :M1 (dep <1) $1 - (\frac{8}{15} \times \frac{7}{14} \times \frac{6}{13} + 3 \times \frac{8}{15} \times \frac{7}{14} \times \frac{7}{13} + \frac{7}{15} \times \frac{6}{14} \times \frac{5}{13})$: M2 one prod omitted or wrong: M1
(iii)	$\frac{x}{45} \times \frac{x-1}{44} = \frac{1}{15}$ oe $x^2 - x - 132 = 0$ or $x(x-1) = 132$ $(x-12)(x+11) = 0$ or $x = \frac{1 \pm \sqrt{1^2 - 4 \times (-132)}}{2}$ No. of Ys = 12	M1 A1 M1 A1 4	not $\frac{x}{45} \times \frac{x}{44} = \frac{1}{15}$ or $\frac{x}{45} \times \frac{x}{45} = \frac{1}{15}$ or $\frac{x}{45} \times \frac{x-1}{45} = \frac{1}{15}$ oe ft 3-term QE for M1 condone signs interchanged allow one sign error Not $x = 12$ or -11 ans 12 from less wking, eg $12 \times 11 = 132$ or T & I: full mks Some incorrect methods: $\frac{x}{45} \times \frac{x-1}{44} = \frac{1}{15}$ oe M1 $x^2 + x = 132$ A0 $x = 11$ M1A0 $12 \times 11 = 132$ M1A1M1 $x = 12$ and (or "or") 11 A0 NB 12 from eg 12.3 rounded, check method

10.

i	$0.4 \times p = 0.12$ or $\frac{0.12}{0.4}$ or $\frac{12}{40}$ oe $p = 0.3$ oe	M1 A1 2	
ii	$0.4 \times (1 - \text{their } 0.3)$ oe eg $\frac{40}{100} \times \frac{28}{40}$ 0.28 or 28% oe	M1 A1ft 2	or $0.4 - 0.12$ or 0.28 or 28 seen Not 0.4×0.88 unless ans to (i) is 0.12