

OCR Maths S1

Topic Questions from Papers

Probability

Answers

<b>1</b>	(i)	B(5, 3/8) ${}^5C_2(3/8)^2(5/8)^3$ $= 5625/16384$ or 0.343	M1 M1 3 A1	B(5, 3/8) stated or ${}^3/8, {}^5/8$ seen and sum of powers = 5 Correct expression Answer, a.r.t. 0.343 ISW
	(ii)	${}^{1/2}p_1 = {}^3/8$ $p_1 = {}^3/4$ <b>AG</b>	M1 A1 2	or ${}^3/8 / {}^{1/2}$ or ${}^3/8 \times 2$ ${}^3/4$ correctly obtained. Must see explicit step. Verification eg ${}^{1/2} \times {}^3/4 = {}^3/8$ or ${}^3/8 / {}^{3/4} = {}^{1/2}$ : M1A1
	(iii)	${}^{1/2}p_2 = {}^1/3$ $p_2 = {}^2/3$	M1 A1 2	or ${}^1/3 / {}^{1/2}$ or ${}^1/3 \times 2$ Answer 2/3 or a.r.t. 0.667

(Q6, Jan 2005)

<b>2</b>	(i)	${}^4/7$ or 0.571 (3 sfs)	B1	<b>1</b>	
	(ii)	${}^5/8 \times {}^4/7 + {}^3/8 \times {}^5/8$ $= {}^{265}/448$ or 0.592 (3 sfs)	M1M1 A1	<b>3</b>	M1: one correct prod or add any two prods M1: all correct
	(iii)	${}^3/8 \times {}^5/8 + {}^5/8 \times {}^3/7$ $= {}^{225}/448$ or 0.502 (3 sfs)	M1M1 A1	<b>3</b>	M1: one correct prod or add any two prods M1: all correct
<b>Total</b>				<b>7</b>	

(Q2, June 2006)

<b>3</b>	(i)	${}^2/9$ or ${}^7/9$ oe seen ${}^3/9$ or ${}^6/9$ oe seen ${}^1/8$ or ${}^7/8$ oe seen Correct structure  All correct	B1 B1 B1 B1 B1	<b>5</b>	ie 8 correct branches only, ignore probs & values including probs and values, but headings not req'd
	ii	${}^3/10 \times {}^7/9 + {}^7/10 \times {}^3/9 + {}^7/10 \times {}^6/9$ ${}^{14}/15$ or 0.933 oe	M2 A1	<b>3</b>	or ${}^3/10 \times {}^7/9 + {}^7/10$ or $1 - {}^3/10 \times {}^2/9$ M1: one correct prod or any prod + ${}^7/10$ or ${}^3/10 \times {}^2/9$
	iii	${}^3/10 \times {}^2/9 \times {}^7/8 + {}^7/10 \times {}^6/9$ ${}^{21}/40$ or 0.525 oe	M2 A1	<b>3</b>	M1: one correct prod cao
	<b>Total</b>	No ft from diag except: with replacement:	(i) structure: B1 (ii) ${}^{91}/100$ : B2 (iii) 0.553: B2		<b>11</b>

(Q7, Jan 2007)

<b>4 (ia)</b>	$\frac{1}{3}$ oe	B1 1	B↔W MR: max (a)B0(b)M1M1(c)B1M1
b	P(BB) + P(WB) attempted $= \frac{4}{10} \times \frac{3}{9} + \frac{6}{10} \times \frac{4}{9}$ or $\frac{2}{15} + \frac{4}{15}$ $= \frac{2}{5}$ oe	M1 M1 A1 3	Or $\frac{4}{10} \times \frac{3}{9}$ OR $\frac{6}{10} \times \frac{4}{9}$ correct  NB $\frac{4}{10} \times \frac{4}{10} + \frac{6}{10} \times \frac{4}{10} = \frac{2}{5}$ : M1M0A0
c	Denoms 9 & 8 seen or implied $\frac{3}{9} \times \frac{2}{8} + \frac{6}{9} \times \frac{3}{8}$  $= \frac{1}{3}$ oe	B1 M1  A1 3	Or $\frac{2}{15}$ as numerator Or $\frac{2/15}{4/10}$ <span style="border: 1px solid black; padding: 2px;">Or <math>\frac{4/10 \times 6/9 \times 3/8 + 4/10 \times 3/9 \times 2/8}{\text{above} + 6/10 \times 5/9 \times 4/8 + 6/10 \times 4/9 \times 3/8}</math></span>  May not see wking
ii	P(Blue) not constant or discs not indep, so no	B1 1	Prob changes as discs removed Limit to no. of discs. Fixed no. of discs Discs will run out Context essential: "disc" or "blue" NOT fixed no. of trials NOT because without repl Ignore extra
<b>Total</b>		<b>8</b>	

(Q4, June 2007)

<b>5 (i)</b>	$\sqrt{0.04} (= 0.2)$ $(1 - \text{their } \sqrt{0.04})^2$ $= 0.64$	M1 M1 A1 3	
ii	$1 - p$ seen M1 for either $2p(1 - p) = 0.42$ or $p(1 - p) = 0.21$ oe $2p^2 - 2p + 0.42 (= 0)$ or $p^2 - p + 0.21 (= 0)$ $\frac{2 \pm \sqrt{((-2)^2 - 4 \times 0.42)}}{2 \times 2}$ or $\frac{1 \pm \sqrt{((-1)^2 - 4 \times 0.21)}}{2 \times 1}$ or $(p - 0.7)(p - 0.3) = 0$ or $(10p - 7)(10p - 3) = 0$ $p = 0.7$ or $0.3$	B1 M1 M1  M1 A1 5	$2pq = 0.42$ or $pq = 0.21$ Allow $pq = 0.42$ or opp signs, correct terms any order (= 0)  oe Correct Dep B1M1M1 Any corr subst'n or fact'n  Omit 2 in 2 <sup>nd</sup> line: max B1M1M0M0A0 One corr ans with no or inadeq wking: SC1 eg $0.6 \times 0.7 = 0.42 \Rightarrow p = 0.7$ or $0.6$  $p^2 + 2pq + q^2 = 1$ B1 $p^2 + q^2 = 0.58$ } $p = 0.21/q$ } $p^4 - 0.58p^2 + 0.0441 = 0$ M1 corr subst'n or fact'n M1  $1 - p$ seen B1 $2p(1 - p) = 0.42$ or $p(1 - p) = 0.21$ M1 $p^2 - p = -0.21$ $p^2 - p + 0.25 = -0.21 + 0.25$ oe } M1 OR $(p - 0.5)^2 - 0.25 = -0.21$ oe } $(p - 0.5)^2 = 0.04$ M1 $(p - 0.5) = \pm 0.02$ $p = 0.3$ or $0.7$ A1
<b>Total</b>		<b>8</b>	

(Q8, June 2007)

<b>6 (i)</b>	$0.4 \times p = 0.12$ 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 $0.4 \times 0.88$ unless ans to (i) is 0.12
<b>Total</b>		<b>4</b>	

(Q4, Jan 2008)

<b>7 (i)</b>	$\frac{1}{6} + 3 \times (\frac{1}{6})^2$  $= \frac{1}{4}$	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          $\frac{1}{6}$	M1 M1          A1 3	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 $\frac{\frac{1}{4} - \frac{1}{6}}{\frac{1}{2}}$ or $\frac{\frac{1}{2} \times \frac{1}{6}}{\frac{1}{2}}$ oe M2 or $\frac{P(4\&twice)}{P(twice)}$ stated or $\frac{\text{prob}}{\frac{1}{2}}$ M1  Whatever 1 <sup>st</sup> , only one possibility on 2 <sup>nd</sup> M2  $\frac{1}{6}$ , no wking M1M1A1 $\frac{1}{12}$ , no wking M0
<b>Total</b>		<b>7</b>	

(Q8, Jan 2009)

<b>8 (ia)</b>	$\frac{18}{19}$ 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>b</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  $\frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$ $1 - \frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$
<b>ia</b>	$\frac{19}{20} \times \frac{18}{19}$ $= \frac{9}{10}$ oe	M1 A1 2	$\frac{19}{20} \times \frac{18}{19} \times \frac{1}{18} + \frac{19}{20} \times \frac{18}{19} \times \frac{17}{18}$ or $\frac{1}{20} + \frac{17}{20}$
<b>b</b>	$(P(X = 1) = \frac{1}{20})$ $\frac{19}{20} \times \frac{1}{19}$ $= \frac{1}{20}$  $\sum xp$ $= \frac{57}{20}$ or 2.85	M1 A1  M1 A1 4	or $1 - (\frac{1}{20} + \frac{9}{10})$ or 2 probs of $\frac{1}{20}$ M1A1  $\geq 2$ terms, ft their $p$ 's if $\sum p = 1$  NB: $\frac{19}{20} \times 3 = 2.85$ no mks
<b>ia</b>			With replacement: Original scheme
<b>ib</b>			$\frac{1}{20} + \frac{19}{20} \times \frac{1}{20} + (\frac{19}{20})^2 \times \frac{1}{20}$ or $1 - (\frac{19}{20})^2$ M1
<b>ia</b>			$(\frac{19}{20})^2$ or $(\frac{19}{20})^2 \times \frac{1}{20} + (\frac{19}{20})^2 \times \frac{19}{20}$ M1
<b>b</b>			Original scheme But NB ans 2.85(25...) M1A0M1A0
<b>Total</b>		<b>13</b>	

(Q8, June 2009)

<b>9 (i)</b>	$\frac{25}{37}$	B2 2	B1 num, B1 denom 25/37xp B1
<b>(ii)</b>	$\frac{15}{23}$ 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
<b>Total</b>		<b>[6]</b>	

(Q7, Jan 2010)

<b>10 (i)</b>	$0.4 \times 0.7$ $0.6 + 0.4 \times 0.7$ $= 0.88$	M1 M1 A1 3	or 0.6 + prod of 2 probs Condone $0.6 \times 0.7 + 0.6 \times 0.3 + 0.4 \times 0.7$ or $0.6 \times 0.6 + 0.6 \times 0.4 + 0.4 \times 0.7$	$1 - \text{prod of } 2 \text{ P's}$ or $0.4 \times 0.3$ $1 - 0.4 \times 0.3$
ii	$p + (1 - p) \times p = 0.51$ or $2p - p^2 = 0.51$ $p^2 - 2p + 0.51 = 0$ $(p - 0.3)(p - 1.7) = 0$ or $p = \frac{2 \pm \sqrt{4 - 4 \times 0.51}}{2}$ oe $p = 0.3$	M1 A1 M1 A1 4	or $p^2 + p \times (1 - p) + (1 - p) \times p$ Correct QE = 0 Condone omission of “= 0” Correct method for their 3-term QE Not $p = 0.3$ or 1.7	Condone $p + p \times 1 - p$ M1, but $p + qp = 0.51$ M0 $(1 - p)^2 = 0.49$ M1A1 $1 - p = \pm 0.7$ 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: MIM1M1A0 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
<b>Total</b>		<b>7</b>		

(Q4, Jan 2011)

<b>11 (i)</b>	If done with replacement, no marks in any part of this question.		
	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

(Q5, June 2011)

<b>12 (i)</b>	Incorrect $p$ (eg “cubical die means 18 sides hence $p = \frac{1}{18}$ ”): can gain all B & M marks.		
ii	$\frac{25}{1679616}$ oe or 0.116 (3 sfs) $(\frac{5}{6})^7 \times \frac{1}{6}$ alone $= 0.0465$ (3 sfs) or $\frac{78125}{1679616}$	B1 1 M2 A1 3	M1 for $(\frac{5}{6})^8 \times \frac{1}{6}$ alone
iii	$(\frac{5}{6})^8$ oe alone $= 0.233$ (3 sfs) or $\frac{390625}{1679616}$	M1 A1 2	$1 - P(X \leq 8)$ , with exactly 8 correct terms NOT $1 - (\frac{5}{6})^8$ , NOT $(\frac{5}{6})^8 \times \dots$
iv	NB If more than 5 products are added (eg $P(1 \leq X \leq 12)$ ): no marks		
	$(\frac{5}{6})^9 \times \frac{1}{6} + (\frac{5}{6})^{10} \times \frac{1}{6} + (\frac{5}{6})^{11} \times \frac{1}{6} + (\frac{5}{6})^{12} \times \frac{1}{6}$ (= 0.0323 + 0.0268 + 0.0224 + 0.0187) $= 0.100$ (3 sfs)	M3 A1 4	M3 for all correct or M2 for 3 of these added or these 4 plus 1 extra or 0.0817 or 0.0680 or 0.139 or 0.116 or M1 for $\geq 1$ of these terms or values seen; ignore incorrect Allow 0.1 with wking $(\frac{5}{6})^9 - (\frac{5}{6})^{13}$ or $1 - (\frac{5}{6})^{13} - [1 - (\frac{5}{6})^9]$ M3 or $(\frac{5}{6})^{8,9 \text{ or } 10} - (\frac{5}{6})^{12, 13 \text{ or } 14}$ or $1 - (\frac{5}{6})^{12, 13 \text{ or } 14} - [(1 - (\frac{5}{6})^{8,9 \text{ or } 10})]$ M2 or $\pm [(\frac{5}{6})^9 - (1 - (\frac{5}{6})^{13})]$ or $\pm [1 - (\frac{5}{6})^9 - (\frac{5}{6})^{13}]$ M1
<b>Total</b>		<b>10</b>	

(Q8, June 2011)

13	(i)	Top: 2 branches $\frac{4}{5}, \frac{1}{5}$ & R, B shown Bottom: 1 <sup>st</sup> branch: prob = 1 or $\frac{5}{5}$ , & R shown  no 2 <sup>nd</sup> branch OR branch with prob = 0 or $\frac{0}{5}$	B1  B1 [2]	consistent  allow eg $\frac{4}{4}$  ignore any 3 <sup>rd</sup> 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 $\leq 1$ if 3 <sup>rd</sup> tree prob = 1, (ii)M1M1A0 if 3 <sup>rd</sup> 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

(Q4, June 2012)

14		$(1 - 0.1) \div 5$ (= 0.18)	M1	can be implied, eg by 18	or, using exp no. of 5's & 6's $18 \times 5$ or $10 \times 10$
		$3 \times 0.18$ or $2 \times 0.18$ or $7 \times 0.1$ (or result of these)(poss $\times 100$ ) <small>(<math>3 \times 0.18</math> only scores if using £3, not score of 3. Similarly for <math>2 \times 0.18</math>).</small>	M1	$5 \times 0.18$ or $10 \times 0.1$ (or result of these)(poss $\times 100$ )	
		$4 \times 3 \times 0.18$ AND $2 \times 0.18 + 7 \times 0.1$ (poss $\times 100$ ) (or 2.16 AND 1.06 or 216 AND 106)	M1	3 AND $5 \times 0.18 + 10 \times 0.1$ (poss $\times 100$ ) (or 3 AND 1.9 or 300 AND 190)	300 AND $18 \times 5 + 10 \times 10$ <small>(NB <math>300 + 100 \times 0.18 + 100 \times 0.1</math> is insuff)</small>
		'2.16' - '1.06' or '216' - '106' <u>must</u> be attempt gain on 1,2,3,4 - loss on 5,6	M1 <small>dep any M1</small>	3 - '1.9' or 300 - '190' <u>must</u> be attempt receipt - payout on 5,6	Eg: $300 - 100 \times (5 \times 0.18 + 6 \times 0.1) = 150$ M1M1M0M1A0
		E(profit for 100 rolls) = (£)110	A1  [5]	E(profit for 100 rolls) = (£)110  NB $300 - (0.1 \times 300 + 0.18 \times 300) = 300 - 84 = 216$ M1M1M0M0A0	Mark one method only Must be matched pair eg $300 - 106$ or $216 - 190$ : M1M1M0M0A0

(Q6, June 2012)

15	(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 <u>very</u> clearly indicated as the ans then B1M1A0

(Q2, Jan 2013)