OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

AS GCE MATHEMATICS

4732/01 Probability & Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4732/01
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.
- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.
- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **8** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

1 For the top 6 clubs in the 2010/11 season of the English Premier League, the table shows the annual salary, £x million, of the highest paid player and the number of points scored, y.

Club	Manchester United	Manchester City	Chelsea	Arsenal	Tottenham	Liverpool
x	5.6	7.4	6.5	4.1	3.6	6.5
y	80	71	71	68	62	58

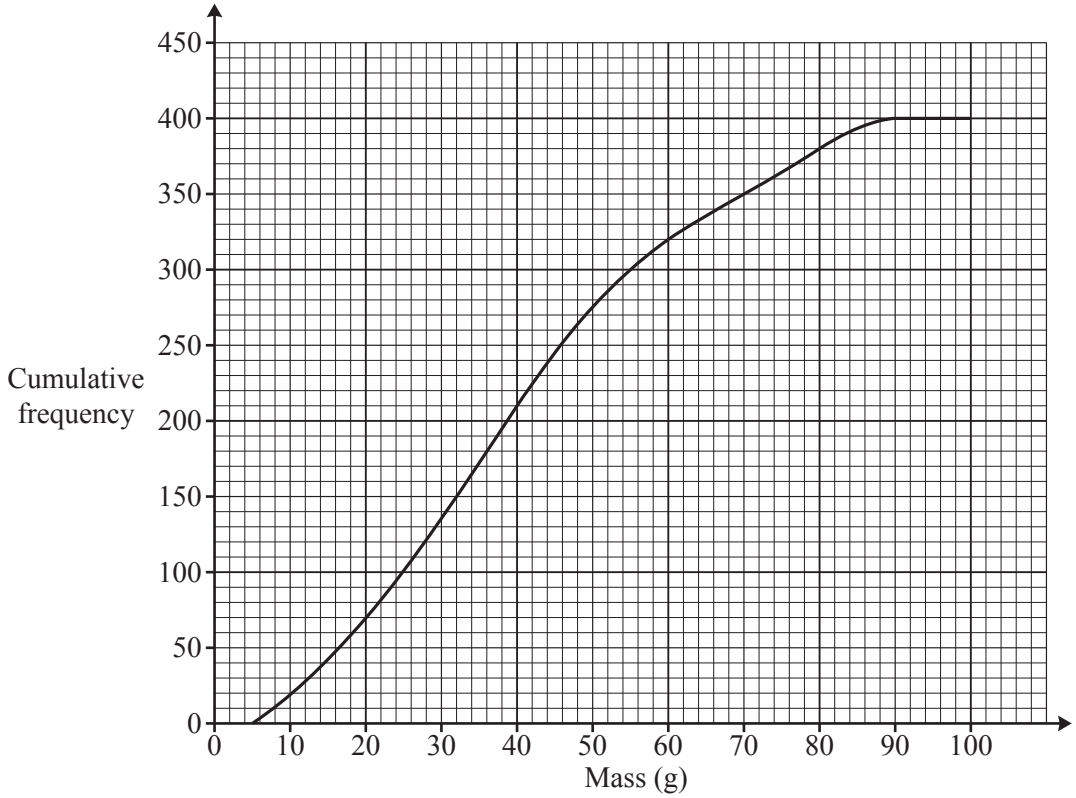
$n = 6$ $\quad \Sigma x = 33.7$ $\quad \Sigma x^2 = 200.39$ $\quad \Sigma y = 410$ $\quad \Sigma y^2 = 28\,314$ $\quad \Sigma xy = 2313.9$

(i) Use a suitable formula to calculate the product moment correlation coefficient, r, between x and y, showing that $0 < r < 0.2$. **[3]**

(ii) State what this value of r shows in this context. **[1]**

(iii) A fan suggests that the data should be used to draw a regression line in order to estimate the number of points that would be scored by another Premier League club, whose highest paid player's salary is £1.7 million. Give two reasons why such an estimate would be unlikely to be reliable. **[2]**

2 The masses, in grams, of 400 plums were recorded. The masses were then collected into class intervals of width 5 g and a cumulative frequency graph was drawn, as shown below.



(i) Find the number of plums with masses in the interval 40 g to 45 g. **[1]**

(ii) Find the percentage of plums with masses greater than 70 g. **[2]**

(iii) Give estimates of the highest and lowest masses in the sample, explaining why their exact values cannot be read from the graph. **[2]**

(iv) On the graph paper in the answer book, draw a box-and-whisker plot to illustrate the masses of the plums in the sample. **[4]**

(v) Comment briefly on the shape of the distribution of masses. **[1]**

3 An expert tested the quality of the wines produced by a vineyard in 9 particular years. He placed them in the following order, starting with the best.

1980 1983 1981 1982 1984 1985 1987 1986 1988

(i) Calculate Spearman's rank correlation coefficient, r_s, between the year of production and the quality of these wines. The years should be ranked from the earliest (1) to the latest (9). **[5]**

(ii) State what this value of r_s shows in this context. **[1]**

4 The table shows the load a lorry was carrying, x tonnes, and the fuel economy, y km per litre, for 8 different journeys. You should assume that neither variable is controlled.

Load (x tonnes)	5.1	5.8	6.5	7.1	7.6	8.4	9.5	10.5
Fuel economy (y km per litre)	6.2	6.1	5.9	5.6	5.3	5.4	5.3	5.1

$n = 8$ $\quad \Sigma x = 60.5$ $\quad \Sigma y = 44.9$ $\quad \Sigma x^2 = 481.13$ $\quad \Sigma y^2 = 253.17$ $\quad \Sigma xy = 334.65$

(i) Calculate the equation of the regression line of y on x. **[4]**

(ii) Estimate the fuel economy for a load of 9.2 tonnes. **[2]**

(iii) An analyst calculated the equation of the regression line of x on y. Without calculating this equation, state the coordinates of the point where the two regression lines intersect. **[1]**

(iv) Describe briefly the method required to estimate the load when the fuel economy is 5.8 km per litre. **[2]**

5 Each year Jack enters a ballot for a concert ticket. The probability that Jack will win a ticket in any particular year is 0.27.

(i) Find the probability that the first time Jack wins a ticket is

(a) on his 8th attempt, **[2]**

(b) after his 8th attempt. **[2]**

(ii) Write down an expression for the probability that Jack wins a ticket on exactly 2 of his first 8 attempts, and evaluate this expression. **[3]**

(iii) Find the probability that Jack wins his 3rd ticket on his 9th attempt and his 4th ticket on his 12th attempt. **[3]**

6 **(i)** The seven digits 1, 1, 2, 3, 4, 5, 6 are arranged in a random order in a line. Find the probability that they form the number 1 452 163. **[3]**

(ii) Three of the seven digits 1, 1, 2, 3, 4, 5, 6 are chosen at random, without regard to order.

(a) How many possible groups of three digits contain two 1s? **[1]**

(b) How many possible groups of three digits contain exactly one 1? **[2]**

(c) How many possible groups of three digits can be formed altogether? **[2]**

7 Froox sweets are packed into tubes of 10 sweets, chosen at random. 25% of Froox sweets are yellow.

(i) Find the probability that in a randomly selected tube of Froox sweets there are

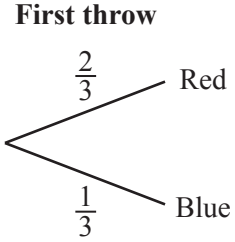
(a) exactly 3 yellow sweets, **[3]**

(b) at least 3 yellow sweets. **[2]**

(ii) Find the probability that in a box containing 6 tubes of Froox sweets, there is at least 1 tube that contains at least 3 yellow sweets. **[3]**

8 A game is played with a fair, six-sided die which has 4 red faces and 2 blue faces. One turn consists of throwing the die repeatedly until a blue face is on top or until the die has been thrown 4 times.

(i) In the answer book, complete the probability tree diagram for one turn.



[2]

(ii) Find the probability that in one particular turn the die is thrown 4 times. **[2]**

(iii) Adnan and Beryl each have one turn. Find the probability that Adnan throws the die more times than Beryl. **[4]**

(iv) State one change that needs to be made to the rules so that the number of throws in one turn will have a geometric distribution. **[1]**

9 The random variable X has probability distribution given by

$$\mathrm{P}(X = x) = a + bx \qquad \text{for } x = 1, 2 \text{ and } 3,$$

where a and b are constants.

(i) Show that $3a + 6b = 1$. **[2]**

(ii) Given that $\mathrm{E}(X) = \frac{5}{3}$, find a and b. **[4]**

END OF QUESTION PAPER

S1 June 2015 Final mark scheme

Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to ≥ 3sfs, ISW for later rounding
Penalise over-rounding only once in paper. "oe" means "or equivalent"

Question			Answer	Marks	Guidance	
1	(i)		$S_{xx} = 200.39 - \frac{33.7^2}{6}$		or 11.108 or 11.1 or $\frac{1333}{120}$	
			$S_{yy} = 28314 - \frac{410^2}{6}$		or 297.333 or 297 or $\frac{892}{3}$	
			$S_{xy} = 2313.9 - \frac{33.7\times410}{6}$	M1	or 11.067 or 11.1 or $\frac{166}{15}$	Correct sub in a correct S formula or correct value of one S seen
			$r = \frac{"11.067"}{\sqrt{"11.108"\times"297.333"}}$	M1		Correct sub in 3 correct S formulae and a correct r formula
			= 0.193 (3 sf)	A1		No working: 0.193 M1M1A1
				[3]		Ignore comment about $0 < r < 0.2$
1	(ii)		(For these 6 clubs)		Allow without "For these 6 clubs" & "top"	Allow "Salary has little effect on points"
			No/little/poor/weak oe			
			relationship/corr'n/link oe		or "no strong corr'n between etc"	Ignore all else including "positive"
			between (top) salaries and no. of points	B1	In context.	NOT if use "goals" instead of "points"
				[1]		
1	(iii)		Extrapolation oe		Outside range of values. Salary is less than the others.	NOT "Corr'n does not imply causation"
			Corr'n poor/weak or no rel'nship/link oe		r small or r close to 0 or r not close to 1	NOT "Could be other factors"
			or Points not close to line		or Results do not correlate well	NOT if use "goals" instead of "points"
			Small sample or only (top) 6 clubs oe	B1 B1	Any two; allow without context	
				[2]		
2	(i)		35	B1	Allow 30 to 40 inclusive	
				[1]		
2	(ii)		$\frac{50\pm2}{400} \times 100$ oe	M1	NOT $\frac{50\pm2}{450} \times 100$	NOT $\frac{100\pm2}{400 \text{ or } 450} \times 100$
			= 12% to 13%	A1		NOT $\frac{350\pm2}{400} \times 100$ (unless sub from 100)
				[2]		
2	(iii)		eg 7.5, 87.5 or 5, 90 or 5-10, 85-90	B1	or any values in intervals 5 - 10 & 85 - 90	NOT "Because it's cumulative frequency"
			"Classes" or "intervals" or "groups" or "mid-points" or "bounds" seen	B1	No raw data given. Not have each data value	NOT "Because it's a line of best fit"
			Data lost oe		Exact values not given or can't be read off oe	NOT "Because graph is difficult to read"
						NOT "because graph is a curve"
				[2]	Ignore all else for 2nd B1, **not 1st B1**	NOT "Cont data has no exact data pts"

Question			Answer	Marks	Guidance	
2	(iv)		Median = 39 ± 1 drawn Quartiles = 25 ± 1, 55 ± 1 drawn Ends in ranges 5 - 10 & 85 - 90 drawn Correct B&W plot ± 1 drawn	B1 B1 B1f B1f **[4]**	or stated or stated or ft (iii) or ft (iii) mark intention (allow unruled lines)	Mark diagram even if contradicts statements of values in (iv) or (iii) If no diagram, award max B1B1B1 for statements of med, quartiles & ends
2	(v)		Stretched out at top end oe Not symmetrical More concentrated towards lower end More values (or data) in lower half of range Median closer to lowest value Average towards lower end More plums have lower masses Majority of distribution towards lower end More below 50 (or 45) Upper whisker longer than lower whisker	B1 **[1]**	Positive skew, Skewed to right (or to higher values) Larger skewness at top Larger plums more spread than smaller ones Ignore all else No need for context	**NOT** any of below: more large extremes than small extremes IQR is towards the lower end skewed to the left (or to lower values) majority below 39 distribution towards lower end
3	(i)		Year 80 81 82 83 84 85 86 87 88 Age 1 2 3 4 5 6 7 8 9 Quality 1 3 4 2 5 6 8 7 9 Attempt ranks Correct ranks Attempt Σd^2 (= 8) $1 - \frac{6\times"8"}{9\times(81-1)}$ $= \frac{14}{15}$ or $0.9\dot{3}$ or 0.933 (3 sf)	 M1 A1 M1 M1 A1 **[5]**	Y 80 83 81 82 84 85 87 86 88 Q 1 2 3 4 5 6 7 8 9 A 1 4 2 3 5 6 8 7 9 Allow both sets of ranks reversed NB $0.9\dot{3}$ is correct	One set reversed, max 4 mks, eg Y 80 81 82 83 84 85 86 87 88 A 9 8 7 6 5 4 3 2 1 Q 1 3 4 2 5 6 8 7 9 or similar Attempt ranks M1 Incorrect ranks A0 Attempt Σd^2 (= 232) M1 $1 - \frac{6\times"232"}{9\times(81-1)}$ M1 $-\frac{14}{15}$ or $-0.9\dot{3}$ or –0.933 (3 sf) A1
3	(ii)		Older is better oe or newer is worse oe As age increases, quality increases Must imply older is better oe, ie "good (or positive) corr'n between age and quality" is not enough	B1 **[1]**	No ft from (i) -0.933 in (i) leads to same conclusion as +0.933 in (ii) Nothing contradictory seen, **ie NOT ignore all else** In context; no need to include "rank"	 NOT as year increases quality increases NOT High/strong/good corr'n/agreement/ rel'nship between age and quality oe

Question			Answer	Marks	Guidance	
4	(i)		$S_{xx} = 481.13 - \frac{60.5^2}{8}$ or 23.59875 or 23.6 or $\frac{18879}{800}$ $S_{xy} = 334.65 - \frac{60.5\times44.9}{8}$ or –4.90625 or -4.91 or $-\frac{157}{32}$ $b = \frac{334.65-\frac{60.5\times44.9}{8}}{481.13-\frac{60.5^2}{8}}$ oe or –0.20790 or –0.208 or $-\frac{3925}{18879}$ $y - \frac{44.9}{8} =$ "–0.20790"$(x - \frac{60.5}{8})$ y = -0.208x + 7.18 (or + 7.19) (3 sf)	M1 M1 M1 A1 **[4]**	Correct sub in any correct S_{xx} or S_{xy} formula or correct value of either S Correct sub in both Ss and in a correct b formula or $a = \frac{44.9}{8} -$ "–0.20790" $\times \frac{60.5}{8}$ or $y = -\frac{3925}{18879}x + 7.18/9$ Must include "y =" Allow y = -0.21x + 7.2 (awrt 2 sf)	Alternative method: 44.9 = 8a + 60.5b M1 334.65 = 60.5a + 481.13b M1 hence a = 7.18 or b = -0.208 A1 y = –0.208x + 7.18 A1 no wking, correct ans M1M1M1A1 If find x on y line, can score first M1 only or ans x = 31 -4.2y seen first M1 only
4	(ii)		"–0.208" × 9.2 + "7.18" = 5.27 or 5.28 (km/l) (3 sf)	M1 A1ft **[2]**	ft their equn from (i)	but no ft from x on y line
4	(iii)		(7.56, 5.61) (3 sf) or $(\frac{121}{16}, \frac{449}{80})$ oe	B1 **[1]**	Ignore calc'n of reg line, if done	NOT $(\frac{60.5}{8}, \frac{44.9}{8})$
4	(iv)		Use reg line of x on y (either equn or line) Sub y = 5.8 or fuel = 5.8 or km/l = 5.8	M1 A1 **[2]**	Must specify or imply x on y, otherwise M0A0 NOT "Use either x on y or y on x" NOT "and read off **y** coord"	If calc x on y reg line (allow errors)M1 Subst 5.8 into their x on y line A1 Ignore all else
5	(i)	(a)	$(1 - 0.27)^7 \times 0.27$ = 0 0298 (3 sf)	M1 A1 **[2]**	alone	

Question			Answer	Marks	Guidance	
5	(i)	(b)	$(1 - 0.27)^8$	M1	alone or 1 - P(X = 1,2,3,4,5,6,7,8) all terms correct (= 1 - 0.91935)	NOT $(1 - 0.27)^8 \times \ldots$ NOT 1- (1-0.27)^8
			= 0.0806 (3 sf) or 0.08065	A1 **[2]**		
5	(ii)		Bin stated $^8C_2 \times (1 - 0.27)^6 \times 0.27^2$ 0.309 (3 sf)	B1 B1 B1 **[3]**	or implied by $^8C_2$ or $^8C_6$ or $(1–0.27)^a \times 0.27^b$ (a+b=8) NOTE. Must see sub in formula for this B1	or by ans 0.309. Allow "Bio" Allow correct + ... Correct ans, no working: B1B0B1
5	(iii)		Their (ii) × 0.27 seen together Their (ii) × 0.27 × $(1 - 0.27)^2$ × 0.27 ie wholly correct method ft(ii)	M1 M1	or $(^8C_2 \times (1 - 0.27)^6 \times 0.27^2) \times 0.27$ seen together or $^8C_2 \times (1 - 0.27)^6 \times 0.27^2 \times 0.27 \times (1 - 0.27)^2 \times 0.27$ ie wholly correct method	or $^8C_2 \times (1 - 0.27)^8 \times 0.27^4$ SC: $(1 - 0.27)^8 \times 0.27^4$ oe alone M0M1A0
			= 0.0120 (3 sf)	A1ft **[3]**	Allow 0.012; ft their **(ii)** only	
6	(i)		7! or 5040 or $^7P_7$ seen	M1	or $5! \times (^6C_2 + 6)$ NOT $5! \times {}^6C_2$	or $\frac{2}{7} \times \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} \times \frac{1}{3} \times \frac{1}{2}$ alone M2
			$1 \div \frac{7!}{2}$ or $\frac{2}{7!}$	M1	$\frac{1}{5! \times (6C2 + 6)}$	or $\geq$ 5 correct fracs mult: or 6 correct fracts mult × M1
			= $\frac{1}{2520}$ or 0.000397 (3 sf)	A1 **[3]**	or $\frac{2}{5040}$ oe	
6	(ii)	(a)	5	B1 **[1]**	Ignore any working seen	
6	(ii)	(b)	$^5C_2$ alone (or $\times {}^2C_2$) or $^6C_3 \div 2$(!) or $\frac{2}{7} \times {}^7C_3$ or $^5P_2 \div 2$ = 10	M1 A1 **[2]**	alone, eg NOT $^5C_2 \times \ldots$ or $^5C_2 + \ldots$	But allow $^5C_2$ as denom of prob M1A0
6	(ii)	(c)	"5" + "10" + $^5C_3$ = 25	M1 A1f **[2]**	or $^6C_3$ + "5" or $^7C_3$ - "10" or $^7C_3 - {}^5C_2$ ft (a) &/or (b) only if working seen	Allow as denom of a prob M1A0

Question			Answer	Marks	Guidance	
7	(i)	(a)	Binomial seen or implied $0.7759 - 0.5256$ or ${}^{10}C_3 \times (1-0.25)^7 \times 0.25^3$ $= 0.250$ (3 sf)	B1 M1 A1 **[3]**	by tables or ${}^{10}C_3$ or ${}^{10}C_7$ Allow 0.25	or by $0.25^a \times 0.75^b$ ($a + b = 10$)
7	(i)	(b)	$1 - 0.5256$ or $1 - ((1-0.25)^{10} + 10(1-0.25)^9 \times 0.25$ $+ {}^{10}C_2(1-0.25)^8 \times 0.25^2)$ $= 0.4744$ or 0.474 (3 sf)	M1 A1 **[2]**	or P(X = 3,4,5,6,7,8,9,10) all correct terms Allow ${}^{10}C_8$ instead of ${}^{10}C_2$	NOT 1 - 0.7759 (P(X >3) from table)
7	(ii)		0.4744 or 0.474) or 0.5256 or 0.526 seen $1 - (1 - \text{“}0.4744\text{”})^6$ oe $= 0.979$ (3 sf)	M1 M1 A1f **[3]**	Their (i)(b) seen, or result of 1-(i)(b) seen or P(X = 1,2,3,4,5,6) all correct terms seen ft from **(i)(b)**	eg B(6, 0.474) or P($X \geq 3$) = 0.474
8	If 0.3 and 0.6 or 0.3 and 0.7 or similar used, can score (i) B1B0(ii) M1A0 (iii) M1M1M1A0 (iv) B1					
	(i)		Correct structure with no extra branches Probs and R and B all correct	B1 B1dep **[2]**	Allow extra branches with correct 0 & 1 Ignore other probs	ignore probs and R & B
8	(ii)		$\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$ $= \frac{8}{27}$ or 0.296 (3 sf)	M1 A1 **[2]**	or $\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{1}{3} + \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$ NOT $\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$ No ft from tree for A1	ft their tree, eg "without replacement" gives $\frac{2}{3} \times \frac{3}{5} \times \frac{2}{4}$ ($=\frac{1}{5}$) M1A0

Question	Answer	Marks	Guidance
8 (iii)	There are basically 6 cases, as in LH column. Some group these into 3 cases, as in middle column. Others use 9 cases - treat these as grouped into the 6 cases below and mark accordingly. Must decide which case a candidates is using, and use the corresponding scheme. NB. Listing Adnan and Beryl separately gains no marks. They must be combined into cases. For example $(\frac{2}{3})^3 \times \frac{1}{3} = \frac{8}{81}$ is correct for P(Adnan 4 throws and Beryl 1throw), but it could also come from P(Adnan gets RRRB) which scores no marks by itself. If correct 6 (or 3) cases, or equiv, are given, but extra cases also given, award 1st M1, and possibly 2nd M1, but no more. No ft from tree, but if clearly state cases may score 1st M1 only.		
	All six cases seen or implied: 2&1; 3&2, 3&1; 4&3, 4&2, 4&1 or 2&1; 3 & (< 3); 4& (< 4)	M1	All three cases soi: R & B; RR & RB; RRR & RRB M1 or R & B; RR & RB; RRRR & RRB; RRRB & RRB ie 3 cases: (≥2 & 1) (≥3 & 2) (4 & 3)
	$P(2\&1) = \frac{2}{3} \times \frac{1}{3} \times \frac{1}{3}$ or $\frac{2}{27}$		$P(R \& B) = \frac{2}{3} \times \frac{1}{3}$ or $\frac{2}{9}$ M1
	$P(3\&2) = (\frac{2}{3})^2 \times \frac{1}{3} \times \frac{2}{3} \times \frac{1}{3}$ or $\frac{8}{243}$		**NB Must be clearly part of 3-case method**
	$P(3\&1) = (\frac{2}{3})^2 \times \frac{1}{3} \times \frac{1}{3}$ or $\frac{4}{81}$		$P(RR \& RB) = (\frac{2}{3})^2 \times \frac{2}{3} \times \frac{1}{3}$ or $\frac{8}{81}$
	$P(4\&3) = (\frac{2}{3})^3 \times (\frac{2}{3})^2 \times \frac{1}{3}$ or $(\frac{2}{3})^4 \times (\frac{2}{3})^2 \times \frac{1}{3} + (\frac{2}{3})^3 \times \frac{1}{3} \times (\frac{2}{3})^2 \times \frac{1}{3}$ or $\frac{32}{729}$		$P(RRR \& RRB) = (\frac{2}{3})^3 \times (\frac{2}{3})^2 \times \frac{1}{3}$ or $\frac{32}{729}$ Both these correct expressions or results and add all 3 cases oe ie completely correct method M1 $\frac{266}{729}$ or 0.365 (3 sf) A1
	$P(4\&2) = (\frac{2}{3})^3 \times \frac{2}{3} \times \frac{1}{3}$ or $(\frac{2}{3})^4 \times \frac{2}{3} \times \frac{1}{3} + (\frac{2}{3})^3 \times \frac{1}{3} \times \frac{2}{3} \times \frac{1}{3}$ or $\frac{16}{243}$		
	$P(4\&1) = (\frac{2}{3})^3 \times \frac{1}{3}$ or $(\frac{2}{3})^4 \times \frac{1}{3} + (\frac{2}{3})^3 \times (\frac{1}{3})^2$ or $\frac{8}{81}$		May see other groupings of 6 cases into 3 cases eg 4&(1or2or3) 3&(1or2) 2&1 M1
	Correct expressions (or results) for 3 of these 6 probs	M1	$\frac{8}{27} \times \frac{19}{27}$ oe or $\frac{152}{729}$ M1
	Correct expressions (or results) for the other 3 of these 6 probs & no extra cases, and add all 6 cases ie completely correct method	M1	$\frac{4}{27} \times \frac{5}{9} + \frac{2}{9} \times \frac{1}{3}$ oe or $\frac{20}{243} + \frac{2}{27}$ or $\frac{38}{243}$ ie completely correct method M1
	$\frac{266}{729}$ or 0.365 (3 sf)	A1	$\frac{266}{729}$ or 0.365 (3 sf) A1
	See next page for more	**[4]**	

	All four cases soi: B&B; RB & RB; RRB & RRB; RRRX & RRRX ie 1&1 or 2&2 or 3&3 or 4&4 M1
	$(\frac{1}{3})^2 + (\frac{2}{3} \times \frac{1}{3})^2 + (\frac{2}{3} \times \frac{2}{3} \times \frac{1}{3})^2 + (\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3})^2$ or $\frac{1}{9} + \frac{4}{81} + \frac{16}{729} + \frac{64}{729}$ or $\frac{197}{729}$ all correct M1
	$\frac{1}{2}(1 - \text{`}\frac{197}{729}\text{'})$ M1
	$\frac{266}{729}$ or 0.365 (3 sf) A1
	NB $\frac{2}{3} \times \frac{1}{3} = \frac{2}{9}$ often seen, usually scores 0. Must be clearly part of 3-case method to score.

Question			Answer	Marks	Guidance	
8	(iii)	cont	4 COMMON INCORRECT METHODS: All six cases seen or implied: M1 $\frac{2}{27}+\frac{8}{243}+\frac{4}{81}+\frac{32}{2187}+\frac{16}{729}+\frac{8}{243}$ oe M1M0 $=\frac{494}{2187}$ or 0.226 A0 $\frac{2}{3}\times\frac{1}{3}+(\frac{2}{3})^2\times\frac{1}{3}+(\frac{2}{3})^3\times\frac{1}{3}+(\frac{2}{3})^4$ or $\frac{2}{3}\times\frac{1}{3}+(\frac{2}{3})^2\times\frac{1}{3}+(\frac{2}{3})^3\times\frac{1}{3}$ M0M0M0M0 P(2&1) + P(3&2) + P(4&3) $=\frac{2}{3}\times\frac{1}{3}\times\frac{1}{3}+(\frac{2}{3})^2\times\frac{1}{3}\times\frac{2}{3}\times\frac{1}{3}+$ $(\frac{2}{3})^4\times(\frac{2}{3})^2\times\frac{1}{3}+(\frac{2}{3})^3\times\frac{1}{3}\times(\frac{2}{3})^2\times\frac{1}{3}$ M0M1M0A0		ANOTHER EXAMPLE $\frac{RB}{B}$ $\frac{RRB}{B+RB}$ $\frac{RRRB}{B+RB+RRB}$ $\frac{RRRR}{B+RB+RRB}$ ie 2&1 3&(1or2) 4&(1or2or3) This scores the 1st M1 for all 3 cases soi (The last two "fractions" together make the 3rd case)	ANOTHER INCORRECT METHOD $(\frac{2}{3})^3\times\frac{1}{3}+(\frac{2}{3})^2\times\frac{1}{3}+\frac{2}{3}\times\frac{1}{3}$ $(\frac{2}{3})^2\times\frac{1}{3}\times\frac{2}{3}+(\frac{2}{3})^3\times\frac{1}{3}\times\frac{2}{3}$ $+(\frac{2}{3})^3\times\frac{1}{3}\times(\frac{2}{3})^2$ ie attempt 4&1, 3&1, 2&1; 3&2, 4&2; 4&3 Some of these overlap, but 1st, 5th, 6th correct. Overall M1M1M0A0
8	(iv)		Unlimited number of throws oe Not stop at 4 throws oe	B1 [1]	Not fixed number of throws Turn continues until blue obtained	Allow Throw die until blue obtained NOT Continue until 1st success NOT "Not stop at 4 throws or when blue obtained" Ignore all else
9	(i)		$a+b$, $a+2b$, $a+3b$ $a+b+a+2b+a+3b=1$ oe $(3a+6b=1$ **AG** $)$	B1 B1dep [2]	All three seen Must see this line oe before final answer or "Probabilities add up to 1" oe stated	Must include "= 1"
9	(ii)		$a+b+2(a+2b)+3(a+3b)=\frac{5}{3}$ $6a+14b=\frac{5}{3}$ or $18a+42b=5$ eg $6\times\frac{1-6b}{3}+14b=\frac{5}{3}$ or $2b=-\frac{1}{3}$ or $6a+14\times\frac{1-3a}{6}=\frac{5}{3}$ or $3a=2$ $a=\frac{2}{3}$, $b=-\frac{1}{6}$	M1 A1f A1 A1 [4]	ft their probs or any correct three term equn, ft their probs or any correct equn in a or b only. cao cao	