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Friday 24 May 2013 – 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 in the centre of 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 The lengths, in centimetres, of 18 snakes are given below.

24 62 20 65 27 67 69 32 40 53 55 47 33 45 55 56 49 58

(i) Draw an ordered stem-and-leaf diagram for the data. **[3]**

(ii) Find the mean and median of the lengths of the snakes. **[2]**

(iii) It was found that one of the lengths had been measured incorrectly. After this length was corrected, the median increased by 1 cm. Give two possibilities for the incorrect length and give a corrected value in each case. **[2]**

2 **(i)** The table shows the times, in minutes, spent by five students revising for a test, and the grades that they achieved in the test.

Student	Ann	Bill	Caz	Den	Ed
Time revising	0	60	35	100	45
Grade	C	D	E	B	A

Calculate Spearman's rank correlation coefficient. **[5]**

(ii) The table below shows the ranks given by two judges to four competitors.

Competitor	P	Q	R	S
Judge 1 rank	1	2	3	4
Judge 2 rank	3	2	1	4

Spearman's rank correlation coefficient for these ranks is denoted by r_s. With the same set of ranks for Judge 1, write down a different set of ranks for Judge 2 which gives the same value of r_s. There is no need to find the value of r_s. **[2]**

3 The probability distribution of a random variable X is shown.

x	1	3	5	7
$P(X = x)$	0.4	0.3	0.2	0.1

(i) Find $E(X)$ and $Var(X)$. **[5]**

(ii) Three independent values of X, denoted by X_1, X_2 and X_3, are chosen. Given that $X_1 + X_2 + X_3 = 19$, write down all the possible sets of values for X_1, X_2 and X_3 and hence find $P(X_1 = 7)$. **[2]**

(iii) 11 independent values of X are chosen. Use an appropriate formula to find the probability that exactly 4 of these values are 5s. **[3]**

4 At a stall in a fair, contestants have to estimate the mass of a cake. A group of 10 people made estimates, m kg, and for each person the value of $(m - 5)$ was recorded. The mean and standard deviation of $(m - 5)$ were found to be 0.74 and 0.13 respectively.

(i) Write down the mean and standard deviation of m. **[2]**

The mean and standard deviation of the estimates made by another group of 15 people were found to be 5.6 kg and 0.19 kg respectively.

(ii) Calculate the mean of all 25 estimates. **[2]**

(iii) Fiona claims that if a group's estimates are more consistent, they are likely to be more accurate. Given that the true mass of the cake is 5.65 kg, comment on this claim. **[2]**

5 The table shows some of the values of the seasonally adjusted Unemployment Rate (UR), x%, and the Consumer Price Index (CPI), y%, in the United Kingdom from April 2008 to July 2010.

Date	April 2008	July 2008	October 2008	January 2009	April 2009	July 2009	October 2009	January 2010	April 2010	July 2010
UR, x%	5.2	5.7	6.1	6.8	7.5	7.8	7.8	7.9	7.8	7.7
CPI, y%	3.0	4.4	4.5	3.0	2.3	1.8	1.5	3.5	3.7	3.1

These data are summarised below.

$$n = 10 \quad \Sigma x = 70.3 \quad \Sigma x^2 = 503.45 \quad \Sigma y = 30.8 \quad \Sigma y^2 = 103.94 \quad \Sigma xy = 211.9$$

(i) Calculate the product moment correlation coefficient, r, for the data, showing that $-0.6 < r < -0.5$. **[3]**

(ii) Karen says "The negative value of r shows that when the Unemployment Rate increases, it causes the Consumer Price Index to decrease." Give a criticism of this statement. **[1]**

(iii) (a) Calculate the equation of the regression line of x on y. **[3]**

(b) Use your equation to estimate the value of the Unemployment Rate in a month when the Consumer Price Index is 4.0%. **[2]**

6 The diagram shows five cards, each with a letter on it.

The letters A and E are vowels; the letters B, C and D are consonants.

(i) Two of the five cards are chosen at random, without replacement. Find the probability that they both have vowels on them. **[2]**

(ii) The two cards are replaced. Now three of the five cards are chosen at random, without replacement. Find the probability that they include exactly one card with a vowel on it. **[3]**

(iii) The three cards are replaced. Now four of the five cards are chosen at random without replacement. Find the probability that they include the card with the letter B on it. **[2]**

7 In a factory, an inspector checks a random sample of 30 mugs from a large batch and notes the number, X, which are defective. He then deals with the batch as follows.

- If $X < 2$, the batch is accepted.
- If $X > 2$, the batch is rejected.
- If $X = 2$, the inspector selects another random sample of only 15 mugs from the batch. If this second sample contains 1 or more defective mugs, the batch is rejected. Otherwise the batch is accepted.

It is given that 5% of mugs are defective.

(i) (a) Find the probability that the batch is rejected after just the first sample is checked. **[3]**

(b) Show that the probability that the batch is rejected is 0.327, correct to 3 significant figures. **[5]**

(ii) Batches are checked one after another. Find the probability that the first batch to be rejected is either the 4th or the 5th batch that is checked. **[3]**

8 (i) A bag contains 12 black discs, 10 white discs and 5 green discs. Three discs are drawn at random from the bag, without replacement. Find the probability that all three discs are of different colours. **[3]**

(ii) A bag contains 30 red discs and 20 blue discs. A second bag contains 50 discs, each of which is either red or blue. A disc is drawn at random from each bag. The probability that these two discs are of different colours is 0.54. Find the number of red discs that were in the second bag at the start. **[4]**

9 A game is played with a token on a board with a grid printed on it. The token starts at the point (0, 0) and moves in steps. Each step is either 1 unit in the positive x-direction with probability 0.8, or 1 unit in the positive y-direction with probability 0.2. The token stops when it reaches a point with a y-coordinate of 1. It is given that the token stops at (X, 1).

(i) (a) Find the probability that $X = 10$. **[2]**

(b) Find the probability that $X < 10$. **[3]**

(ii) Find the expected number of steps taken by the token. **[2]**

(iii) Hence, write down the value of $\mathrm{E}(X)$. **[1]**

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.

Question			Answer	Marks	Guidance	
1	(i)		2 | 0 4 7 3 | 2 3 4 | 0 5 7 9 5 | 3 5 5 6 8 6 | 2 5 7 9 2 | 4 means 24 or similar	 B1 B1 B1 **[3]**	B1 for stem correct AND (3 branches correct OR 5 branches correct nos but incorrectly ordered) B1 for all correct	Ignore "0" and/or "1" in stem, without leaves Allow incorrect alignment. Allow space instead of line. Allow left–facing diag If all digits are in correct rows and orders, award this mark unless: 4th row is not the longest OR eg a 3rd digit in one row is clearly aligned with a 4th digit in another
1	(ii)		47.6 (3 sf) or $\frac{857}{18}$ or $47\frac{11}{18}$ (cm) oe 51 (cm)	B1 B1ft **[2]**	cao ft wrong diag	eg 857 ÷ 18 = 41.6 B0 but $\frac{857}{18}$ = 41.6 ISW B1
1	(iii)		49 (or 9th no.) becomes 51 or 53 (or 10th no.) becomes 55	B1 B1 **[2]**	No marks for identifying 49 & 53 alone or 51 & 55 alone	NB NO ft from wrong diag NOT eg '51 or higher' Allow embedded answer eg 53 identified as incorrect and state(55+49)÷2=52 scores 2nd B1
2	(i)		5 2 4 1 3 or A B C D E (grades) 3 4 5 2 1 3 1 5 2 4 d^2 4 4 1 1 4 Σd^2 (= 14) $1 - \frac{6\times"14"}{5\times(5^2-1)}$ = 0.3 oe	M1 A1 M1 M1 A1 **[5]**	Attempt ranks Correct ranks; allow both sets reversed Can be implied by eg $\Sigma d^2 = 14$ Attempt Σd^2 dep 1st M1 ft Σd^2 dep 1st M1 If one set reversed, $r_s = -0.3$ M1A0M1M1A0	One set reversed: A0 Use PMCC on ranks: 1st M1A1 as main scheme then: $\Sigma x = \Sigma y = 15$ $\Sigma x^2 = \Sigma y^2 = 55$ $\Sigma xy = 48$ $S_{xx} = S_{yy} = 10$ $S_{xy} = 3$ allow one arith error M1 $r = 3/\sqrt{(10\times10)}$ allow one arith error M1 = 0.3 A1
2	(ii)		$\Sigma d^2 = 8$ or '2 the same and 2 differ by 2' 1 4 3 2	M1 A1 **[2]**	May be implied	Allow $d^2 = 8$ or similar

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.

Question			Answer	Marks	Guidance	
3	(i)		$1\times0.4 + 3\times0.3 + 5\times0.2 + 7\times0.1$ $= 3$ $1^2\times0.4 + 3^2\times0.3 + 5^2\times0.2 + 7^2\times0.1$ $-$ "3"^{2} $= 4$	M1 A1 M1 M1 A1 **[5]**	≥ 3 terms correct ÷ eg 4 M0 ≥ 3 terms correct ÷ eg 4 M0 Dep +ve result	Use of $\Sigma(x - \bar{x})^2\times p$: $2^2\times0.4 + 0 + 2^2\times0.2 + 4^2\times0.1$ M2 or 2 correct non–zero terms M1
3	(ii)		775, 757, 577 $\frac{2}{3}$ or 0.667 (3 sf)	B1 B1 **[2]**	Must show all three	Allow repeats, eg list of 6 orders Alt method X_1: 5 or 7, X_2: 5 or 7; X_3: 5 or 7 or X_1, X_2, X_3 can be 5 or 7 B1
3	(iii)		Binomial stated, or seen or implied with any n & p $^{11}C_4 \times 0.8^7 \times 0.2^4$ $= 0.111$ (3 sf)	B1 M1 A1 **[3]**	eg by $0.8^r \times 0.2^s$ (r,s>1) not just by ^nC_r Correct method Correct answer, no working M1M1A1	NB 0.0388 scores B1M0A0 as it is $^{11}C_5\times0.8^6\times0.8^5$
4	(i)		5.74 0.13 or 'the same'	B1 B1 **[2]**	NB 0.13 seen within working; B0	eg $\frac{\Sigma x^2}{10}$ – (their mean)^2 = 0.13^2 scores B0 for 0.13
4	(ii)		(10×'5.74' + 15×5.6) ÷ 25oe all correct = 5.656 = 5.66 (3 sf)	M1 A1ft **[2]**	eg $5.74\times\frac{2}{5} + 5.6\times\frac{3}{5}$ ft their 5.74	NB (5.74 + 5.6) ÷ 2 = 5.67 M0A0 NB 5.7 with no wking: M0A0 even if already penalised elsewhere for over–rounding
4	(iii)		1st gp (or one gp) is more consistent (or less spread oe) but less accurate (or mean further from true mean oe)	B1ft B1ft **[2]**	2nd gp (or one gp) more accurate or etc but less consistent or etc If neither B1 scored, but state 'consistency does not imply accuracy' or similar: SC B1 Equiv answers accepted, but no others	1st gp (or one gp) more consistent or etc 2nd gp (or the other gp) more accurate or etc Ignore all other, eg ignore 'Claim false' or 'Claim true' etc even if it contradicts other statements Reference to mean of all 25 does not score Follow through their values for 1st gp: eg if 1st gp sd = 5.13: 1st gp less accurate and less consistent oe B1B1 Similar for other ft.

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.

Question			Answer	Marks	Guidance	
5	(i)		$S_{xx} = 503.45 - \frac{70.3^2}{10}$ (= 9.241) $S_{yy} = 103.94 - \frac{30.8^2}{10}$ (= 9.076) $S_{xy} = 211.9 - \frac{70.3\times30.8}{10}$ (= -4.624) $r = \frac{"-4.624"}{\sqrt{"9.241"\times"9.076"}}$ = –0.5049…. or –0.505 (3 sfs)	M1 M1 A1 **[3]**	Correct sub in any correct *S* formula Correct sub in any correct *r* formula Correct ans with no wking: M1M1A1	Must be correct sub in all *S*'s & *r* but not nec'y accurate
5	(ii)		Correlation (of UR & CPI) does not imply causation oe or *r* not close to –1	B1 **[1]**	Both (UR & CPI) may depend on another factor or *r* small or poor corr'n oe Ignore all else	Allow One may depend on another factor Allow without context NOT eg UR is independent NOT eg Only for the given years NOT eg Only for certain months
5	(iii)	(a)	$b' = \frac{S_{xy}}{S_{yy}} = \frac{"-4.624"}{"9.076"}$ (= $-\frac{1156}{2269}$ or –0.50948) $x - \frac{70.3}{10} = "-\frac{1156}{2269}"(y - \frac{30.8}{10})$ x = –0.51y + 8.6 (2 sfs) or $x = -\frac{1156}{2269}y + 8.6$	M1 M1 A1 **[3]**	ft their *S*'s or $a' =$ "$-\frac{1156}{2269}$"× ($-\frac{30.8}{10}$) + $\frac{70.3}{10}$ NB use b' (= –0.509), not *r*(= –0.5049)	If *y* on *x*: $b = \frac{S_{xy}}{Sxx} = \frac{"-4.624"}{"9.241"}$ (= –0.500) M1 y–3.08="–0.500"×(x–7.03) or a = 3.08+0.5×7.03 M1 y = –0.50x + 6.6 A0
5	(iii)	(b)	x = –0.509 × 4.0 + 8.60 = 6.56 (3 sf) or 6.6 (2 sf)	M1 A1ft **[2]**	Allow sub y = 0.04 for M1 only ft their equn; ans to 2 sf	If *y* on *x* found in **(a)** 4.0 = –0.500x + 6.60 M1 x = 5.2 (2 sf) A1ft
6			In all three parts of q 6, where the right answer is seen following a method which is unclear, award full marks. If the right answer follows from a method that is very clearly incorrect, award M0A0 in (i) & (iii), and in (ii) award M0M0A0 unless there is a partly correct method worth M1.			
6	(i)		$\frac{1}{5}\times\frac{1}{4}\times 2$ or $\frac{2}{5}\times\frac{1}{4}$ alone oe = $\frac{1}{10}$ or 0.1 oe	M1 A1 **[2]**	or $\frac{^2C_2}{^5C_2}$ or $\frac{1}{^5C_2}$ or $\frac{^2P_2}{^5P_2}$ Allow $^5C_3$ instead of $^5C_2$	Allow M1 for $\frac{1}{5}\times\frac{1}{4}$, but NOT other methods leading to $\frac{1}{20}$ and NOT $\frac{1}{20}$ with no wking M1 for totally correct method except $\frac{1}{5}\times\frac{1}{4}$ seen: M1 NB $\frac{2}{5}\times\frac{1}{4}\times2$ M0A0; $\frac{2}{^5C_2}$ M0A0; $\frac{2}{5}\times\frac{1}{5}$ M0A0

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.

Question			Answer	Marks	Guidance	
6	(ii)		$\frac{2}{5}\times\frac{3}{4}\times\frac{2}{3}$ or $\frac{1}{5}\times\frac{3}{4}\times\frac{2}{3}\times 2$ oe or $\frac{1}{5}$ or 0.2 (not from incorrect method) or correct list of 6 comb's with 1 vowel or $\frac{2}{\ldots}\times\frac{3}{\ldots}\times\frac{2}{\ldots}\times 3$ or $\frac{1}{\ldots}\times\frac{3}{\ldots}\times\frac{2}{\ldots}\times 6$	M1	$\frac{2\times {}^3C_2}{\ldots\ldots}$ or $\frac{\ldots\ldots}{{}^5C_3}$ or $\frac{6}{\ldots\ldots}$ or $\frac{2}{5}\times\frac{3}{5}\times\frac{3}{5}$	Only if using complement (ie 1–P(0V or 2V)): $\frac{3}{5}\times\frac{2}{4}\times\frac{1}{3}$ OR $\frac{2}{5}\times\frac{3}{4}\times\frac{1}{3}\times 3$ M1
			$\frac{1}{5}\times\frac{3}{4}\times\frac{2}{3}\times 2\times 3$ oe fully correct method	M1	$\frac{2\times {}^3C_2}{{}^5C_3}$ oe or $6\div 10$ Allow ${}^5C_2$ instead of ${}^5C_3$. Not P's	$1-(\frac{3}{5}\times\frac{2}{4}\times\frac{1}{3}+\frac{2}{5}\times\frac{3}{4}\times\frac{1}{3}\times 3)$ M1 5! or 120 alone is probably an incorrect method in this part
			$=\frac{3}{5}$ or 0.6 oe	A1 **[3]**		See comment before 6(i)
6	(iii)		$1-\frac{1}{{}^5C_4}$ or $1-\frac{1}{5}$ or $\frac{5!-4!}{5!}$ or $\frac{1\times {}^4C_3}{{}^5C_4}$ or $\frac{1}{5}\times 4$	M1	or $(\frac{1}{5}\times\frac{4}{4}\times\frac{3}{3}\times\frac{2}{2})+(\frac{4}{5}\times\frac{1}{4}\times\frac{3}{3}\times\frac{2}{2})$ $+(\frac{4}{5}\times\frac{3}{4}\times\frac{1}{3}\times\frac{2}{2})+(\frac{4}{5}\times\frac{3}{4}\times\frac{2}{3}\times\frac{1}{2})$	or $1-\frac{4}{5}\times\frac{3}{4}\times\frac{2}{3}\times\frac{1}{2}$ or $\frac{24+24+24+24}{5!}$
			$=\frac{4}{5}$ or 0.8 oe	A1 **[2]**		$\frac{4}{5}\times\ldots$ M0A0 eg $\frac{4}{5}\times\frac{1}{5}$ M0A0 See comment before 6(i)
7	(i)	(a)	$X\sim$B(30, 0.05) seen or implied	B1	eg by 0.8122 or 1–0.5535 or $0.95^r\times 0.05^s$ (r , $s>1$) Allow B(30,0.95) or B(30, 0.5) for B1 30×0.05 alone insufficient for B1 ${}^nC_r$ insufficient for B1	If $n=15$: B(15, 0.05) B1
			P($X>2$) = 1 – 0.8122 alone or $1-(0.95^{30}+30\times 0.95^{29}\times 0.05+{}^{30}C_2\times 0.95^{28}\times 0.05^2)$	M1		$1-(0.95^{15}+15\times 0.95^{14}\times 0.05+{}^{15}C_2\times 0.95^{13}\times 0.05^2)$ M1
			= 0. 1878 or 0.188 (3 sfs)	A1 **[3]**		= 0.0362 A0

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.

Question			Answer	Marks	Guidance	
7	(i)	(b)	Addition method: X~B(30,0.05) & Y~B(15,0.05) stated or implied	B1	NB eg 0.0362 implies B(15, 0.05) see below	Subtraction methods: X~B(30,0.05)&Y~B(15,0.05) stated or impl B1
			$P(X = 2) = (0.8122–0.5535)$ or ${}^{30}C_2\times0.95^{28}\times0.05^2$ or 0.2587/6 OR $P(Y \geq 1) = (1 – 0.95^{15})$ or 0.5367	M1		$P(X=2) = (0.8122–0.5535)$ or ${}^{30}C_2\times0.95^{28}\times0.05^2$ or 0.2587/6 OR $P(Y=0) = 0.95^{15}$ or 0.4633 M1
			"0.2587/6" × "0.5367" or 0.1388	M1	fully correct method for $P(X=2)\times P(Y\geq1)$	fully correct method for $P(X=2)\times P(Y=0)$ "0.2587" × "0.4633" or 0.1199/8 M1
			$P(X > 2) + P(X = 2) \times P(Y \geq 1)$ = "0.1878" + "0.1388" alone	M1	[their (a)+any p] alone, but dep 1st M1	$1 – (P(X = 0,1) + P(X=2)\times P(Y=0))$ = 1 – ("0.5535" + "0.1199") OR $P(X \geq 2) – P(X=2)\times P(Y=0))$ = (1 – "0.5535") – "0.1199" dep 1st M1 M1
			= 0. 327 (3 sf) **AG**	A1		= 0. 327 (3 sf) **AG** A1
			For A1 must see correct wking or 0.3265/6...		If ans 0.327, check whether it comes from a correct method (possibly not in MS) or clearly comes from an incorrect method eg (0.4465 + 0.2587)× 0.4633 = 0.327 (ie $(P(X \geq 2) + P(X = 2)) \times P(Y = 0)$ B1M1M0M0A0	Do not use marks from a mixture of 3rd column and other columns. Decide which column would give most marks and mark according to that method.
				[5]		If n = 15 for both distr's, see next page NB If 0.1392 seen, it comes from given answer – (i)(a) (ie 0.3270 – 0.1878).

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.

Question			Answer	Marks	Guidance	
7	(i)	**(b)**	Alternative scheme for the case where $n = 15$ is used for both distr's			If $n = 15$ for both distr's: B(15, 0.05) B0 $P(X = 2) = {}^{15}C_2 \times 0.05^2 \times 0.95^{13}$ or 0.1348 OR $P(Y \geq 1) = 1 - 0.95^{15}$ or 0.5367 M1 "0.1348"×"0.5367" or 0.0723 correct method M1 their **(i)(a)** + "0.0732" Dep 1st M1 M1 = 0.1085 A0 NB Also mark subtraction methods if seen.
7	**(ii)**		Any use of 0.327 or their **(i)(b)** for 1st M1 $(1 - 0.327)^3 \times 0.327 + (1 - 0.327)^4 \times 0.327$ Allow "correct" use of their **(i)(a)** or **(i)(b)** for 2nd M1 = 0.167 (3 sf)	M1 M1 A1 **[3]**	$(0.5535 + 0.2586 \times 0.4633)^3 \times 0.327 +$ $(0.5535 + 0.2586 \times 0.4633)^4 \times 0.327$	 $1 - 0.673^5 - (1 - 0.673^3)$ oe Allow any use of their **(i)(b)** for 1st M1 then if "correct" use, also 2nd M1 Allow use of their **(i)(a)** in "correct" method for M0M1A0 No marks for use of 0.95 & 0.05
8	**(i)**		12×10×5 (in numerators or alone) OR any prod of 3 probs×6(or ×3! or ${}^3P_3$) $\frac{12}{27} \times \frac{10}{26} \times \frac{5}{25} \times 6$ or $\frac{12 \times 10 \times 5}{{}^{27}C_3}$ = $\frac{8}{39}$ oe or 0.205 (3 sfs)	M1 M1 A1 **[3]**	or ${}^{12}C_1 \times {}^{10}C_1 \times {}^5C_1$ or 600 (in numerators or alone) or eg $(\frac{12}{27} \times \frac{10}{26} \times \frac{5}{25} + \frac{12}{27} \times \frac{5}{26} \times \frac{10}{25}) \times 3$	 or $\frac{4}{117}$ or 0.0342 oe Fully correct method Examples: $\frac{12}{27} \times \frac{10}{27} \times \frac{5}{27} \times 6$ or $\frac{12}{25} \times \frac{10}{24} \times \frac{5}{23}$ M1M0A0 or $\frac{1}{27} \times \frac{1}{26} \times \frac{1}{25} \times 6$ M1M0A0

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.

Question			Answer	Marks	Guidance		
8	(ii)		$0.4 \times \frac{x}{50}$ OR $0.6 \times \frac{50-x}{50}$ oe or $0.4 \times \frac{?}{50}$	M1	$0.4 \times p$ OR $0.6 \times (1-p)$ or similar	$0.4 \times \frac{x}{50}$ or etc	$0.4 \times a$ etc M1
			$0.4 \times \frac{x}{50} + 0.6 \times \frac{50-x}{50} = 0.54$	M1	$0.4 \times p + 0.6 \times (1-p) = 0.54$	$0.4 \times \frac{x}{50} + 0.6 \times \frac{y}{50} = 0.54$ AND $x + y = 50$	$0.4a + 0.6b = 0.54$ AND $a + b = 1$ M1
			$4x = 60$ oe, two terms	A1	$p = 0.3$	$4x = 60$ or $4y = 140$	$a = 0.3$ or $b = 0.7$ A1
			no. of red = 15	A1	no. of red = 15 Allow $x = 15$ as answer, but not if contradicted later	no. of red = 15	no. of red = 15 A1
			T & I: $0.4 \times \frac{x}{50}$ or etc OR one trial ($n \neq 15$) M1 Trial of $n = 15$ M1A1 Answer stated A1	[4]	If $x \leftrightarrow (50-x)$ or $p \leftrightarrow (1-p)$: similar mks including 1st A1 for $p = 0.7$ or $x = 35$	Correct answer scores full marks unless clearly from incorrect method.	
9			If 0.8 ↔ 0.2 apparently used consistently in 9(i)(a), (i)(b) & possibly (ii). SC; can score all M–marks in all three parts, and A1 in (ii) but A0 in (i)(a) and A0 (i)(b) This may be implied by their answers without working as follows (i)(a) $0.2^{10} \times 0.8 = 8.19 \times 10^{-8}$; $0.2^{9} \times 0.8 = 4.10 \times 10^{-7}$; $0.2^{11} \times 0.8 = 1.64 \times 10^{-8}$ M1A0 (i)(b) $1 - 0.2^{10} = 0.999999898$ M1M1A0; $1 - 0.2^{9} = 0.999999488$ M0M1A0; $1 - 0.2^{11} = 0.999999979$; $0.2^{10} = 1.024 \times 10^{-7}$ M1M0A0 But if 0.9999…. or similar, unclear precisely which method used so M0M0A0 (ii) $1 \div 0.8 = 1.25$ M1A1 **NB!!!!!** Any other p ($\neq$ 0.2 or 0.8) can score only M1 in (ii) & possibly B1ft in (iii)				
9	(i)	(a)	$0.8^{10} \times 0.2$ = 0.0215 (3 sf)	M1 A1 [2]	Allow $0.8^{9} \times 0.2$ or $0.8^{11} \times 0.2$ or 0.0268 or 0.0172	If 0.8 ↔ 0.2, see above	
9	(i)	(b)	0.8^{10} or 0.107…. $1 - 0.8^{10}$ alone = 0.893 (3 sf)	M1 M1 A1 [3]	Not $0.8^{10} \times$ …. M0M0 Not just 0.8^{9} or 0.8^{11} M0M0 Allow M1 for $1-0.8^{9}$ or $1-0.8^{11}$ alone or 0.866 or 0.914	$0.2 + 0.8 \times 0.2 + \ldots + 0.8^{9} \times 0.2$ (10 terms) M2 Allow M1 for 1 term omitted or extra Allow use of dots as above, for M1 or M2, so long as their 1st & last and one other term seen If 0.8 ↔ 0.2, see above	

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.

Question			Answer	Marks	Guidance	
9	(ii)		$\frac{1}{0.2}$ alone	M1		Allow 1 ÷ their incorrect p used in (i)(a)
			= 5	A1	(5, 1) M1A0	Ignore eg "E(X) ="
				[2]		If 1 ÷ 0.8 = 1.25, see above
9	(iii)		4 Allow (4, 1)	B1ft	or (ii) – 1 or (ii) × 0.8	ft (their (ii)–1, 1)
				[1]		