

Wednesday 20 May 2015 – Morning

AS GCE MATHEMATICS (MEI)

4766/01 Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:

- Printed Answer Book 4766/01
- MEI Examination Formulae and Tables (MF2)

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.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

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 advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

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This paper has been pre modified for carrier language

Section A (36 marks)

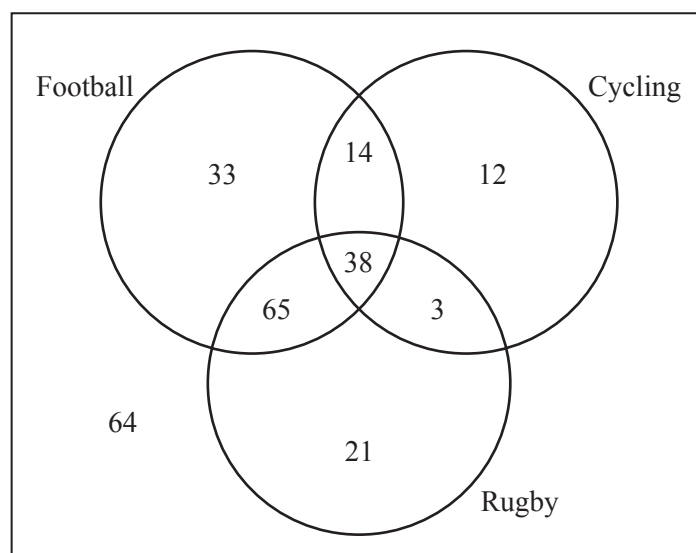
- 1 The amounts of electricity, x kWh (kilowatt hours), used by 40 households in a three-month period are summarised as follows.

$$n = 40 \qquad \Sigma x = 59\,972 \qquad \Sigma x^2 = 96\,767\,028$$

- (i) Calculate the mean and standard deviation of x . [3]
- (ii) The formula $y = 0.163x + 14.5$ gives the cost in pounds of the electricity used by each household. Use your answers to part (i) to deduce the mean and standard deviation of the costs of the electricity used by these 40 households. [3]

- 2 A survey is being carried out into the sports viewing habits of people in a particular area. As part of the survey, 250 people are asked which of the following sports they have watched on television in the past month.
- Football
 - Cycling
 - Rugby

The numbers of people who have watched these sports are shown in the Venn diagram.



One of the people is selected at random.

- (i) Find the probability that this person has in the past month
- (A) watched cycling but not football, [1]
- (B) watched either one or two of the three sports. [2]
- (ii) Given that this person has watched cycling, find the probability that this person has not watched football. [2]
- 3 A normal pack of 52 playing cards contains 4 aces. A card is drawn at random from the pack. It is then replaced and the pack is shuffled, after which another card is drawn at random.
- (i) Find the probability that neither card is an ace. [2]
- (ii) This process is repeated 10 times. Find the expected number of times for which neither card is an ace. [1]

- 4 A rugby team of 15 people is to be selected from a squad of 25 players.
- (i) How many different teams are possible? [2]
 - (ii) In fact the team has to consist of 8 forwards and 7 backs. If 13 of the squad are forwards and the other 12 are backs, how many different teams are now possible? [2]
 - (iii) Find the probability that, if the team is selected at random from the squad of 25 players, it contains the correct numbers of forwards and backs. [2]
- 5 At a tourist information office the numbers of people seeking information each hour over the course of a 12-hour day are shown below.
- 6 25 38 39 31 18 35 31 33 15 21 28
- (i) Construct a sorted stem and leaf diagram to represent these data. [3]
 - (ii) State the type of skewness suggested by your stem and leaf diagram. [1]
 - (iii) For these data find the median, the mean and the mode. Comment on the usefulness of the mode in this case. [4]
- 6 Three fair six-sided dice are thrown. The random variable X represents the highest of the three scores on the dice.
- (i) Show that $P(X = 6) = \frac{91}{216}$. [3]

The table shows the probability distribution of X .

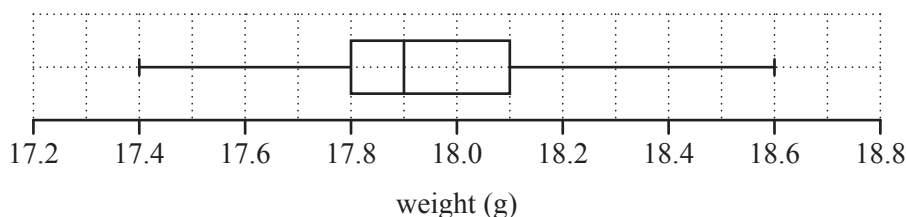
r	1	2	3	4	5	6
$P(X = r)$	$\frac{1}{216}$	$\frac{7}{216}$	$\frac{19}{216}$	$\frac{37}{216}$	$\frac{61}{216}$	$\frac{91}{216}$

- (ii) Find $E(X)$ and $\text{Var}(X)$. [5]

Section B (36 marks)

- 7 A drug for treating a particular minor illness cures, on average, 78% of patients. Twenty people with this minor illness are selected at random and treated with the drug.
- (i) (A) Find the probability that exactly 19 patients are cured. [3]
 - (B) Find the probability that at most 18 patients are cured. [3]
 - (C) Find the expected number of patients who are cured. [1]
 - (ii) A pharmaceutical company is trialling a new drug to treat this illness. Researchers at the company hope that a higher percentage of patients will be cured when given this new drug. Twenty patients are selected at random, and given the new drug. Of these, 19 are cured. Carry out a hypothesis test at the 1% significance level to investigate whether there is any evidence to suggest that the new drug is more effective than the old one. [8]
 - (iii) If the researchers had chosen to carry out the hypothesis test at the 5% significance level, what would the result have been? Justify your answer. [2]

- 8 The box and whisker plot below summarises the weights in grams of the 20 chocolates in a box.



- (i) Find the interquartile range of the data and hence determine whether there are any outliers at either end of the distribution. [5]

Ben buys a box of these chocolates each weekend. The chocolates all look the same on the outside, but 7 of them have orange centres, 6 have cherry centres, 4 have coffee centres and 3 have lemon centres.

One weekend, each of Ben's 3 children eats one of the chocolates, chosen at random.

- (ii) Calculate the probabilities of the following events.

A : all 3 chocolates have orange centres

B : all 3 chocolates have the same centres [6]

- (iii) Find $P(A|B)$ and $P(B|A)$. [3]

The following weekend, Ben buys an identical box of chocolates and again each of his 3 children eats one of the chocolates, chosen at random.

- (iv) Find the probability that, on both weekends, the 3 chocolates that they eat all have orange centres. [2]
- (v) Ben likes all of the chocolates except those with cherry centres. On another weekend he is the first of his family to eat some of the chocolates. Find the probability that he has to select more than 2 chocolates before he finds one that he likes. [3]

END OF QUESTION PAPER

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Question		Answer	Marks	Guidance	
1	(i)	$\text{Mean} = \frac{59972}{40} = 1499$ <p>Condone full answer of 1499.3 (despite over-specification rule)</p> $S_{xx} = 96767028 - \frac{59972^2}{40} = 6851008$ $s = \sqrt{\frac{6851008}{39}} = \sqrt{175667} = 419$ <p>NB Full answer is 419. 1263 (but only allow to 4sf due to over-specification rule)</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>CAO Ignore units</p> <p>For S_{xx}</p> <p>CAO ignore units</p>	<p>NB Allow 1500 NB Answer must be decimal</p> <p>M1 for $96767028 - 40 \times \text{their mean}^2$ BUT NOTE M0 if their $S_{xx} < 0$</p> <p>For s^2 of 176000 (or better) allow M1A0 with or without working For RMSD of 414 (or better) allow M1A0 provided working seen For RMSD² of 171000 (or better) allow M1A0 provided working seen For use of 1499: $S_{xx} = 6886988$, $s^2 = 176589$, $s = 420.225$, RMSD = 414.9 For use of 1500: $S_{xx} = 6767028$, $s^2 = 173513.5$, $s = 416.549$, RMSD = 411.3 Give same credit to answers as for correct answers</p>
1	(ii)	<p>New mean = $(0.163 \times 1499) + 14.5 = \text{£}258.84$ (No penalty for giving to 5sf as this is an exact sum of money)</p> <p>New sd = 0.163×419 = $\text{£}68.30$</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>FT their mean provided answer is positive</p> <p>FT their sd for M1 and A1</p> <p>Allow $\text{£}68.29$ to $\text{£}68.32$ Allow 68.3</p>	<p>If candidate 'starts again' only award marks for CAO Allow $\text{£}259$ or $\text{£}259.00$ from 1500 or $\text{£}258.89$ from 1499.3 Condone 258.8 and 258.9 Accept answers rounded to 3 sf or more eg $\text{£}258.80$, $\text{£}258.90$ Or for 0.163×419.1 oe</p> <p>Do not penalise lack of units in mean or sd Deduct at most 1 mark overall in whole question for over-specification of either mean or SD or both</p>

Question			Answer	Marks	Guidance	
2	(i)	(A)	$P(\text{Watched cyc but not fb}) = \frac{15}{250} = \frac{3}{50} = 0.06$	B1 [1]	CAO (aef)	
2	(i)	(B)	$P(\text{Watched one or two}) = \frac{33+12+21+14+3+65}{250}$ $= \frac{148}{250} = \frac{74}{125} = 0.592$	M1 A1 [2]	OR: $\frac{250 - (64 + 38)}{250} =$ CAO (aef)	For M1 terms must be added with no extra terms (added or subtracted)
2	(ii)		$P(\text{Not watched fb} \text{watched cyc}) = \frac{15}{67} = 0.224 \quad (0.223880597\dots)$	M1 A1 [2]	CAO (aef)	For denominator of either 67 or 67/250 or 0.268 Allow 0.22 with working
3	(i)		$P(\text{Neither is an ace}) = \left(1 - \frac{4}{52}\right)^2$ $= \frac{2304}{2704} = \frac{144}{169} = 0.852 \quad (0.8572071\dots)$	M1 A1 [2]	For 48/52 oe seen CAO	Allow 0.85 with working
3	(ii)		Expected number = $10 \times 0.852 = 8.52$	B1 [1]	FT their (i) if seen	Do <u>not</u> allow whole number final answer even if 8.52 seen first. Allow fractional answer
4	(i)		$\binom{25}{15}$ $= 3268760$	M1 A1 [2]		Accept ${}^{25}C_{15}$ or ${}^{25!}/(15!10!)$ or equivalent for M1 No marks for permutations Exact answer required
4	(ii)		$\binom{13}{8} \times \binom{12}{7} = 1287 \times 792$ $= 1019304$	M1 A1 [2]	For product of both correct combinations CAO	No marks for permutations Exact answer required

Question			Answer	Marks	Guidance	
			<p>Mark awarded for stating not useful and</p> <ul style="list-style-type: none"> -not representative of data -does not represent Central Tendency -happened by chance (or similar) -comment about not appearing significantly more (only one repetition/only twice/ etc) <p>No mark for stating it would be useful</p> <p>OR NOT USEFUL because of</p> <ul style="list-style-type: none"> -spread/range -sample size -negatively skewed -unaffected by outliers -isn't close to mean and median 	[4]	comment	
6	(i)		$P(X = 6) = 1 - P(X < 6) = 1 - \left(\frac{5}{6}\right)^3 = 1 - \frac{125}{216}$ $= \frac{91}{216}$	<p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>For $\left(\frac{5}{6}\right)^3$</p> <p>For $1 - \left(\frac{5}{6}\right)^3$</p> <p>NB ANSWER GIVEN</p>	
			<p>OR: $= \left(\frac{1}{6}\right)^3 + 3 \times \left(\frac{5}{6}\right) \times \left(\frac{1}{6}\right)^2 + 3 \times \left(\frac{5}{6}\right)^2 \times \left(\frac{1}{6}\right)$</p> $= \frac{91}{216}$	<p>M1</p> <p>M1</p> <p>A1</p>	<p>For second or third product term</p> <p>For attempt at three terms</p> <p>NB ANSWER GIVEN</p>	<p>Correct, including $\times 3$ or probabilities seen on correct tree diagram</p> <p>With no extras, but allow omission of $\times 3$</p> <p>NB Zero for 1 – (sum of probs given in part (ii))</p>
			<p>OR: $1 + 15 + 75$</p> $= \frac{1+15+75}{216}$	<p>M1</p> <p>M1</p>	for 15 or 75 seen	

Question			Answer	Marks	Guidance	
			$= \frac{91}{216}$	A1	NB ANSWER GIVEN	
6	(ii)		$E(X) = \left(1 \times \frac{1}{216}\right) + \left(2 \times \frac{7}{216}\right) + \left(3 \times \frac{19}{216}\right) + \left(4 \times \frac{37}{216}\right) + \left(5 \times \frac{61}{216}\right) + \left(6 \times \frac{91}{216}\right)$ $= \frac{1071}{216} = \frac{119}{24} = 4.96 \text{ (exact answer 4.9583333)}$ $E(X^2) = \left(1 \times \frac{1}{216}\right) + \left(4 \times \frac{7}{216}\right) + \left(9 \times \frac{19}{216}\right) + \left(16 \times \frac{37}{216}\right) + \left(25 \times \frac{61}{216}\right) + \left(36 \times \frac{91}{216}\right)$ $= \frac{5593}{216} = 25.89$ $\text{Var}(X) = 25.89 - 4.958...^2$ $= 1.31 \text{ Accept answers in range 1.28 to 1.31 with correct working or } 2261/1728 \text{ (Exact answer 1.308449...)}$	<p>M1 For Σrp (at least 3 terms correct)</p> <p>A1 CAO</p> <p>M1* For $\Sigma r^2 p$ (at least 3 terms correct)</p> <p>M1* dep for – their $(E(X))^2$</p> <p>A1 FT their $E(X)$ provided $\text{Var}(X) > 0$</p> <p>[5]</p>	<p>NB ANSWER GIVEN</p> <p>For Σrp (at least 3 terms correct)</p> <p>CAO</p> <p>For $\Sigma r^2 p$ (at least 3 terms correct)</p> <p>for – their $(E(X))^2$</p> <p>FT their $E(X)$ provided $\text{Var}(X) > 0$</p>	<p>Accept fractional answers Do not allow answer of 5 unless more accurate answer given first Use of $E(X-\mu)^2$ gets M1 for attempt at $(x-\mu)^2$ should see $(-3.96)^2, (-2.96)^2, (-1.96)^2, (-0.96)^2, 0.04^2, 1.04^2$, (if $E(X)$ wrong FT their $E(X)$) (all 6 correct for M1), then M1 for $\Sigma p(x-\mu)^2$ (at least 3 terms correct) Division by 6 or other spurious value at end and/or rooting final answer gives max M1A1M1M1A0, or M1A0M1M1A0 if $E(X)$ also divided by 6.</p> <p>Do not FT $E(X) = 5$ if full marks given for $E(X)$ Deduct at most 1 mark for over-specification of either mean or variance or both Unsupported correct answers get 5 marks (Probably from calculator)</p>
7	(i)	(A)	$X \sim B(20, 0.78)$			

Question			Answer	Marks	Guidance	
			$P(\text{Exactly 19 cured}) = \binom{20}{19} \times 0.78^{19} \times 0.22^1$ $= 0.0392 \text{ (0.039197)}$	M1 M1 A1 [3]	For $0.78^{19} \times 0.22^1$ For $\binom{20}{19} \times p^{19} \times q^1$ CAO	Allow M2A0 for linear interpolation from tables leading to $0.9918 - 0.9488 = 0.0430$ But zero for use of tables with 0.8 leading to $0.9885 - 0.9308 = 0.0577$ With $p + q = 1$ Also for 20×0.00196 Allow 0.039 or better Condone 0.03919 but not 0.0391
7	(i)	(B)	$P(\text{Exactly 20 cured}) = \binom{20}{20} \times 0.78^{20} \times 0.22^0 = 0.0069$ $P(\text{At most 18 cured}) = 1 - (0.0069 + 0.0392)$ $= 0.954 \text{ (0.95385)}$	M1 M1 A1 [3]	For 0.78^{20} oe For $P(19) + P(20)$ CAO	Allow M2 for 0.9488 for linear interpolation from tables or M1 for $1 - 0.9918 = 0.0082$ and second M1 for correct FT using answer to (i)(A) Zero for use of $p = 0.8$ here Not necessarily correct, but both attempts at binomial, including coefficient in (i) and no extra terms (such as $P(X=18)$) Condone use of $p = 0.8$ Allow 0.95 with working
7	(i)	(C)	$E(X) = np = 20 \times 0.78 = 15.6$	B1 [1]	CAO	Do not allow final answer of 15 or 16 even if correct 15.6 given earlier
7	(ii)		Let $X \sim B(20, 0.78)$ Let p = probability of a patient being cured (for population) $H_0: p = 0.78$ $H_1: p > 0.78$	B1 B1 B1	For definition of p For H_0 For H_1	In context See below for additional notes No further marks if point probabilities

Question			Answer	Marks	Guidance	
			$P(X \geq 19) = 0.0392 + 0.0069$ $= 0.0461$ $0.0461 > 1\%$ So not significant. Conclude that there is not enough evidence to suggest that the new drug is more effective than the old one.	B1 B1* M1* dep A1 E1 [8]	For NOTATION $P(X \geq 19)$ or $P(X > 18)$ or $1 - P(X \leq 18)$ or $1 - P(X < 19)$ CAO For 0.0461 allow 0.0462 For comparison with 1%	used Notation $P(X = 19)$ scores B0. If they have the correct $P(X \geq 19)$ then give B1 and ignore any further incorrect notation. FT answer to (i)B for following three marks provided based on $1 - (P(19) + P(20))$ Dep on sensible attempt at $P(X \geq 19)$ Allow 'accept H_0 ' or 'reject H_1 ' Must include 'insufficient evidence' or something similar such as 'to suggest that' ie an element of doubt either in the A or E mark. Must be in context to gain E1 mark. Do NOT allow 'sufficient evidence to suggest proportion cured is 0.78' or similar <u>99% method:</u> $P(X \leq 18) = 0.9539$ B1B1* CAO $0.9539 < 99\%$ M1* then as per scheme
			ALTERNATIVE METHOD FOR FINAL 5 MARKS $P(X \geq 19) = 0.0461 > 1\%$	B1	If combination of methods used, mark both and give higher mark. For either probability	No further marks if point probabilities used Do not insist on correct notation as candidates have to work out two probabilities for full marks.

Question			Answer	Marks	Guidance	
			$P(X \geq 20) = 0.0069 < 1\%$ So critical region is $\{20\}$ (19 not in CR so) not significant. Conclude that there is not enough evidence to suggest that the new drug is more effective than the old one.	M1 B1* A1* dep E1* dep	For at least one comparison with 1% CAO dep on the two correct probabilities Dep on correct CR Ignore any work on lower critical region	Allow comparison in form of statement 'critical region at 1% level is ...' No marks if CR not justified Condone $X \geq 20$, $X = 20$, oe but not $P(X \geq 20)$, etc Allow 'accept H_0 ' or 'reject H_1 '
7	(iii)		With a 5% significance level rather than a 1% level, the null hypothesis would have been rejected. OR: 'there would be enough evidence to suggest that the new drug is more effective than the old one.' This is because $0.0461 < 5\%$	B1* B1* dep [2]	oe oe	FT their probability from (ii) but NO marks if point probabilities used There must be a sensible attempt to use $P(X = 19) + P(X = 20)$ or must have correct CR. Dep on correct answer of 0.0461 compared with 5% or 0.9539 compared with 95% or correct CR.
8	(i)		Inter-quartile range = $18.1 - 17.8 = 0.3$ Lower limit $17.8 - (1.5 \times 0.3) (= 17.35)$ No outliers at lower end. Upper limit $18.1 + (1.5 \times 0.3) (= 18.55)$ (Max is 18.6) so at least one outlier at upper end.	B1 M1 A1 M1 A1	dep on 17.35 dep on 18.55	FT their IQR for M marks only Allow 'No values below 17.35 for first A1' Allow 'Lower limit = 17.35 so no outliers (at lower end)' Watch for use of median giving 17.45 which gets M0A0 You must be convinced that comments about no outliers refer to lower tail only. Allow 'At least one value above 18.55' for second A1 Allow 'any value above 18.55 is an outlier' so at least one outlier.

Question			Answer	Marks	Guidance	
						Do not allow 'There MAY be one outlier' oe Condone 'one outlier' Condone 'there are outliers' Watch for use of median giving 18.35 which gets M0A0 You must be convinced that comments about some outliers refer to upper tail only.
				[5]		
8	(ii)		$P(A) = P(\text{All 3 have orange centres}) = \frac{7}{20} \times \frac{6}{19} \times \frac{5}{18} = \frac{7}{228}$ $= 0.0307 \text{ (0.030702)}$ $P(B) = P(\text{All 3 have same centres}) =$ $\left(\frac{7}{20} \times \frac{6}{19} \times \frac{5}{18}\right) + \left(\frac{6}{20} \times \frac{5}{19} \times \frac{4}{18}\right) + \left(\frac{4}{20} \times \frac{3}{19} \times \frac{2}{18}\right) + \left(\frac{3}{20} \times \frac{2}{19} \times \frac{1}{18}\right) =$ $= 0.0307 + 0.0175 + 0.0035 + 0.0009$ $= 0.0526 = \frac{1}{19} \text{ (0.052632)}$ $\left(= \frac{7}{228} + \frac{1}{57} + \frac{1}{285} + \frac{1}{1140}\right)$	M1 M1 A1 M1 M1 A1 [6]	For 7/20× For product of correct three fractions Without extra terms CAO Allow full marks for fully simplified fractional answers For at least two correct triple products or fractions or decimals For sum of all four correct CAO Allow 0.053 or anything which rounds up to 0.053 with working	Allow final answer of 0.031 with working ALTERNATIVE SCHEME ${}^7C_3/{}^{20}C_3 = 35/1140 = 7/228 = 0.0307$ M1 for either term in correct position in a fraction M1 for correct fraction A1 CAO ALTERNATIVE SCHEME ${}^7C_3/{}^{20}C_3 + {}^6C_3/{}^{20}C_3 + {}^4C_3/{}^{20}C_3 + {}^3C_3/{}^{20}C_3$ M1 for at least two correct terms M1 for sum of all four (all correct) either as combinations or decimals A1 CAO Please check all of the answer space for this part
8	(iii)		$P(A B) = \frac{0.0307..}{0.0526..}$	M1	For their 'A' divided by their 'B'	Allow 0.584 from $\frac{0.0307}{0.0526}$

Question			Answer	Marks	Guidance	
			$= 0.583 \quad (= 0.58333)$ $P(B A) = 1$	A1 B1 [3]	FT their answers to (ii) provided answer < 1 CAO	Allow $\frac{7}{12}$
8	(iv)		$P(\text{All have orange centres}) = 0.0307^2 = 0.00094 \quad \text{or} = \frac{49}{51984}$ $= (0.00094260)$	M1 A1 [2]	For their 0.0307^2 FT	Allow 9.4×10^{-4} condone 0.0009 or 9×10^{-4}
8	(v)		$P(\text{Has to select} > 2) = 1 - P(\text{Has to select} \leq 2)$ $= 1 - \left(\frac{14}{20} + \left(\frac{6}{20} \times \frac{14}{19} \right) \right) = 1 - (0.7 + 0.221) = 1 - 0.921$ $= 0.079 \quad (=0.078947)$	M1 M1 A1 [3]	For $\left(\frac{6}{20} \times \frac{14}{19} \right)$ For 1 – sum of both CAO	For any of the methods below allow SC2 for $1 - 0.079 = 0.921$ or $1 - 3/38 = 35/38$ o.e. as final answer This is $1 - P(C' + CC')$
			OR $P(\text{Has to select} > 2) = P(\text{First 2 both cherry}) = \left(\frac{6}{20} \times \frac{5}{19} \right)$ $= 0.079 \quad = \frac{3}{38}$	M2 A1	For whole product CAO	Without extra terms added M1 if multiplied by k/18 only where $0 < k < 18$ (seen as a triple product only) This is $P(CC)$.
			OR $1 - (P(0 \text{ cherries}) + P(1 \text{ cherry})) =$ $1 - \left(\frac{14}{20} \times \frac{13}{19} + \left(\frac{6}{20} \times \frac{14}{19} \right) + \left(\frac{14}{20} \times \frac{6}{19} \right) \right)$ $= 1 - (0.4789 + 0.2211 + 0.2211) = 1 - 0.9209$ $= 0.079$ OR $\left(\frac{6}{20} \times \frac{5}{19} \times \frac{14}{18} \right) + \left(\frac{6}{20} \times \frac{5}{19} \times \frac{4}{18} \times \frac{14}{17} \right) + \left(\frac{6}{20} \times \frac{5}{19} \times \frac{4}{18} \times \frac{3}{17} \times \frac{14}{16} \right) + \left(\frac{6}{20} \times \frac{5}{19} \times \frac{4}{18} \times \frac{3}{17} \times \frac{2}{16} \times \frac{14}{15} \right) + \left(\frac{6}{20} \times \frac{5}{19} \times \frac{4}{18} \times \frac{3}{17} \times \frac{2}{16} \times \frac{1}{15} \times \frac{14}{14} \right)$	M1 M1 A1 M1	For any term For 1 – sum of all three CAO For any term	This is $1 - P(C'C' + CC' + C'C)$ This is $P(CCC' + CCCC' + CCCCC' + CCCCCC' + CCCCCC')$

Question			Answer	Marks	Guidance	
			$= \frac{7}{114} + \frac{14}{969} + \frac{7}{2584} + \frac{7}{19380} + \frac{1}{38760}$ $= 0.079$	M1 A1	For sum of all five terms (all correct) CAO	

NOTE RE OVER-SPECIFICATION OF ANSWERS

If answers are grossly over-specified, deduct the final answer mark (max once per question). Probabilities should also be rounded to a sensible degree of accuracy. In general final non probability answers should not be given to more than 4 significant figures. Allow probabilities given to 5 sig fig.

PLEASE HIGHLIGHT ANY OVER-SPECIFICATION and also non alignment in question 5(i)

Please note that there are no G or E marks in scoris, so use B instead

NB Please annotate every additional answer sheet even if full marks awarded or the page is blank – Use BP symbol

Other rules for annotation: In the 10 standardisation scripts annotate everything that gets anything other than zero or full marks. After this, annotate down the right hand side in Q7(ii), up to where marks stop being scored, in the order given in the mark scheme. Annotate anywhere else where necessary to clarify how you have awarded the marks.

Additional notes re Q7 part ii (first three marks)

Minimum needed for B1 is p = probability of being cured.

Allow $p = P(\text{patient being cured})$

Definition of p must include word probability (or chance or proportion or percentage or likelihood but NOT possibility, number or amount).

Preferably given as a separate comment. However can be at end of H_0 as long as it is a clear definition ' p = the probability of patient being cured.'

Do NOT allow ' p = probability of patient in the sample being cured'

Do NOT allow 'p = the probability of patient being cured is different'

Allow $p=78\%$, allow only p or θ or π or ρ . However allow any single symbol if defined (including x)

Allow $H_0 = p=0.78$, Allow $H_0 : p=\frac{39}{50}$ or $p=\frac{78}{100}$

Allow H_0 and H_1 in place of H_0 and H_1

Do not allow $H_0 : P(X=x) = 0.78$

Do not allow $H_0 : =0.78, =78\%, P(0.78), p(x)=0.78, x=0.78$ (unless x correctly defined as a probability)

Do not allow H_0 and H_1 reversed

For hypotheses given in words allow Maximum B0B1B1

Hypotheses in words must include probability (or chance or proportion or percentage) and the figure 0.78 or

Thus eg $H_0 : P(\text{patient being cured}) = 0.78, H_1 : P(\text{patient being cured}) > 0.78$ gets B0B1B1

Do not allow if H_1 wrong

Additional notes re Q7 part ii

Smallest critical region method:

Smallest critical region that 19 could fall into is $\{19, 20\}$ and has size 0.0461 gets B1, This is $> 1\%$ gets M1, B1, A1, E1 as per scheme

NB These marks only awarded if 19 used, not other values.

Use of k method with no probabilities quoted:

This gets zero marks.

Use of k method with one probability quoted:

Mark as per scheme

Line diagram method and Bar chart method

No marks unless correct probabilities shown on diagram, then mark as per scheme.

Lower tailed test done with $H_1 : p < 0.78$

Hyp gets max B1B1B0

If compare with 1% give SC2 for $P(X \leq 19) = 1 - 0.0069 = 0.9931 > 1\%$ and SC1 for final conclusion, otherwise give zero.

Two-tailed test done with $H_1 : p \neq 0.78$

Provided compare with 0.5% give SC2 for $P(X \geq 19) = 0.0461 > 0.5\%$ and SC1 for final conclusion