GCE

Mathematics

Advanced GCE

Unit **4732:** Probability and Statistics 1

Mark Scheme for June 2012

Annotations

Annotation in scoris	Meaning
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

Subject-specific Marking Instructions for GCE Mathematics (OCR) Statistics strand

a.   Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b.   An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c.   The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

Candidates are expected to give numerical answers to an appropriate degree of accuracy. 3 significant figures may often be the norm for this, but this always needs to be considered in the context of the problem in hand. For example, in quoting probabilities from Normal tables, we generally expect *some* evidence of interpolation and so quotation to 4 decimal places will often be appropriate. But even this does not always apply – quotations of the standard critical points for significance tests such as 1.96, 1.645, 2.576 (maybe even 2.58 – but not 2.57) will commonly suffice, especially if the calculated value of a test statistic is nowhere near any of these values. Sensible discretion *must* be exercised in such cases.

Discretion must also be exercised in the case of small variations in the degree of accuracy to which an answer is given. For example, if 3 significant figures are expected (either because of an explicit instruction or because the general context of a problem demands it) but only 2 are given, loss of an accuracy ("A") mark is likely to be appropriate; but if 4 significant figures are given, this should not normally be penalised. Likewise, answers which are slightly deviant from what is expected in a very minor manner (for example a Normal probability

given, after an attempt at interpolation, as 0.6418 whereas 0.6417 was expected) should not be penalised. However, answers which are *grossly* over- or under-specified should normally result in the loss of a mark. This includes cases such as, for example, insistence that the value of a test statistic is (say) 2.128888446667 merely because that is the value that happened to come off the candidate's calculator. Note that this applies to answers that are given as final stages of calculations; intermediate working should usually be carried out, and quoted, to a greater degree of accuracy to avoid the danger of premature approximation.

The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

g.   Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h.   Genuine misreading (of numbers or symbols, occasionally even of text) occurs. If this results in the object and/or difficulty of the question being considerably changed, it is likely that all the marks for that question, or section of the question, will be lost. However, misreads are often such that the object and/or difficulty remain substantially unaltered; these cases are considered below.

The simple rule is that *all* method ("M") marks [and of course all independent ("B") marks] remain accessible but at least some accuracy ("A") marks do not. It is difficult to legislate in an overall sense beyond this global statement because misreads, even when the object and/or difficulty remains unchanged, can vary greatly in their effects. For example, a misread of 1.02 as 10.2 (perhaps as a quoted value of a sample mean) may well be catastrophic; whereas a misread of 1.6748 as 1.6746 may have so slight an effect as to be almost unnoticeable in the candidate's work.

A misread should normally attract *some* penalty, though this would often be only 1 mark and should rarely if ever be more than 2. Commonly in sections of questions where there is a numerical answer either at the end of the section or to be obtained and commented on (eg the value of a test statistic), this answer will have an "A" mark that may actually be designated as "cao" [correct answer only]. This should be interpreted *strictly* – if the misread has led to failure to obtain this value, then this "A" mark must be withheld even if all method marks have been earned. It will also often be the case that such a mark is implicitly "cao" even if not explicitly designated as such.

On the other hand, we commonly allow "fresh starts" within a question or part of question. For example, a follow-through of the candidate's value of a test statistic is generally allowed (and often explicitly stated as such within the marking scheme), so that the candidate may exhibit knowledge of how to compare it with a critical value and draw conclusions. Such "fresh starts" are not affected by any earlier misreads.

A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression. Such misreads are more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the same way as numerical misreads, *mutatis mutandis*. This also applied to misreads of text, which are fairly rare but can cause major problems in fair marking.

The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

	Question		Answer	Marks	Guidance	
1	(i)		$\Sigma x = 1366 \quad \Sigma y = 17.6 \quad \Sigma x^2 = 374460 \quad \Sigma y^2 = 62.82$ $\Sigma xy = 4784.8$	B1	any three correct; may be implied by 2 *S's*	OR, using $S_{xx} = \Sigma(x - \bar{x})^2$ etc: $\bar{x} = \frac{1366}{5}$ or 273.2, $\bar{y} = \frac{17.6}{5}$ or 3.52, either:B1
			$S_{xx} = 374460 - \frac{1366^2}{5}$ or 1268.8 $S_{yy} = 62.82 - \frac{17.6^2}{5}$ or 0.868 $S_{xy} = 4784.8 - \frac{1366 \times 17.6}{5}$ or –23.52	M1	correct sub in any correct *S* formula, ft Σs, $\bar{x}$, $\bar{y}$	$(-23.2)^2 + (-3.2)^2 + (-9.2)^2 + 16.8^2 + 18.8^2$ $0.68^2 + 0.18^2 + (-0.32)^2 + (-0.02)^2 + (-0.52)^2$ $(-23.2)\times0.68 + (-3.2)\times0.18 + (-9.2)\times(-0.32) + 16.8\times(-0.02)$ $+18.8\times(-0.52)$
			$r = \frac{-23.52}{\sqrt{1268.8 \times 0.868}}$ or $\frac{-23.52}{33.186...}$ oe	M1	corr sub into 3 *S*s and *r*, ft Σs, $\bar{x}$, $\bar{y}$	If no working seen:
			= –0.709 (3 sfs)	A1 **[4]**	cao	–0.71: SC 3; –0.7: SC 1

1	(ii)		$b = \frac{"-23.52"}{"1268.8"}$ or $-\frac{147}{7930}$ or –0.0185 (3 sfs)
			 $y - \frac{"17.6"}{5} = "-0.0185"(x - \frac{"1366"}{5})$
			 $\Rightarrow y = -0.019x + 8.6$ or better, ie 2 sfs enough
			
			 $(y = -0.019 \times 280 + 8.6$ $(= 3.39$ to $3.41))$
			
			 Est sales = £3390 to £3410
			          or 3.39 thousand to 3.41 thousand
				M1
				 M1
				
				 A1
				
				 A1ft
				 [4]
					ft their S_{xy} & S_{xx} & Σs from (i)
					 or $a = \frac{"17.6"}{5} - "(-0.0185)" \times \frac{"1366"}{5}$
					      if *a* incorrect, must see method for M1
					 cao; must be "*y* = …"
					 coeffs that round to –0.019 & 8.6 to 2 sfs
					
					 ft their *y*×1000, dep M1M1, dep sub 280 (not 280000)
					 Allow "k" for thousand
					 No working, ans in range: M1M1A0A1
						use of *x* on *y* line:
						 $b' = \frac{"-23.52"}{"0.868"}$ (or –27.1) M0
						 $x - \frac{"1366"}{5} = "-27.1"(y - \frac{"17.6"}{5})$
						 or $a' = \frac{"1366"}{5} - "(-27.1)" \times \frac{"17.6"}{5}$) M1
						    (if a' incorrect, must see method for M1)
						 $x = -27.1y + 369$ cao A1
						
						 3277 or 3278 A0

1	(iii)		There may be other factors oe Correlation does not imply causation oe	B1 **[1]**	or any suggestion of another factor that could be involved, eg Depends on state of the economy oe Must state or clearly imply: EITHER <u>corr'n</u> does not imply <u>causation</u> OR there could be <u>another factor</u> involved Ignore all else	NOT: Tourists & sales not nec'y linked Sales are not entirely dep on tourists Could be a coincidence Might be different other years More tourists wd incr sales –0.8 is not strong corr'n Only shows good neg corr'n Sample is small Could be affected by extremes <u>Neg</u> corr'n not nec'y imply <u>neg</u> relnship

	Question		Answer	Marks	Guidance	
2			$\frac{1.4}{50}$ $\quad\quad\quad$ $(= 0.028)$	M1	$1.4 + 50\times1.5$ $\quad\quad$ $(= 76.4)$	eg $\frac{1.4+1.5}{50}$ M0M0A0
			$1.5 + \frac{1.4}{50}$	M1 dep M1	$\frac{'76.4'}{50}$	
			$= 1.528$ or $\frac{191}{125}$ or 1.53 (3 sf)	A1	$(\Sigma x^2 - 2\times1.5\times'76.4' + 50\times1.5^2 = 0.05)$ $(\Rightarrow \Sigma x^2 = 116.75;$ no marks yet)	
			$\frac{0.05}{50} - (\frac{1.4}{50})^2$ $\quad$ or 0.000216 seen	M1	$\frac{0.05 + 2\times1.5\times'76.4' - 50\times1.5^2}{50} - '1.528'^2$ all correct	not $\frac{0.05}{50} - '1.528'^2$
			$\sqrt{0.000216}$	M1	fully correct method, ie nothing added etc	
			$= 0.0147$ (3 sf)	A1	cao not isw	
				[6]		
3	(i)		23	B1	Allow 22.5	NOT 22 (ie 3.5th no) Correct ans is the 4th or 3.75th no.
				[1]		
3	(ii)		0	B1	B1 for 30, 30	
			0	B1		
				[2]		
3	(iii)		38 $\quad\quad\quad$ or $\quad$ 40		B1 for 38 or 39 seen	eg 38, 38.5, 39 $\quad\quad$ B1B0 (ie UQ $= \frac{3}{4} \times 14 = 10.5$th no.)
			39 $\quad\quad\quad\quad$ 40.75	B2	B2 for 38 & 39 seen alone, not in a range	
						'Between 39 & 46' $\quad$ B1B0
						$38 \leq$ any letter < 40 $\quad$ B1B0
					Mixture, eg 38, 40.75 $\quad\quad$ B1B0	
					3/8 and 3/9 (both): $\quad\quad\quad$ B1B0	SC 42, 42.5 only $\quad\quad$ B1B0
					8 and 9(both): $\quad\quad\quad\quad$ B1B0	(ie UQ $= 11.5$th no.) Correct ans are the poss 11th or 11.25th nos
				[2]	40, 40.75: similar scheme as for 38, 39	

	Question		Answer	Marks	Guidance	
3	(iv)		Shows all the data or you can see all the values oe You can see the actual/exact/indiv numbers/values/results No data is lost oe Shows the shape of the distribution oe Can perform calculations of your choice (eg mean) Shows which group (or class, NOT value) has the highest frequency (or is the mode) oe	 B1 **[1]**	any implication of <u>all</u> the data or the <u>actual</u> numbers/values/results or similar eg Can compare each indiv result Easier to see the numbers eg can <u>find</u> frequencies No mks for ans to (v) given in (iv) unless labelled as (v)	NOT Shows the spread/skew/trend Any comment on skew You can <u>see</u> the actual frequ's Easier to compare sets of data Shows more info or more data Easier to read off the data Ignore all other

3	(v)		Shows the median or it's easier to see the median
			      (or quartiles or IQR)
			It can measure the middle 50% easily
				B1
				[1]
					eg Shows mean and quartiles B1
					      Shows range and median B1
					
					No mks for ans to (v) given in (iv) unless labelled as (v)
					
					Ignore all other
						NOT
						Shows the spread/skew/trend
						Can see data in diag form
						Shows max or min or range
						Easier to compare sets of data
						Not affected by outliers
						Easy to see outliers
						Shows s.d. or shows mean
						Can see important data items/measures

4	(i)		Top: 2 branches $\frac{4}{5}$, $\frac{1}{5}$ & R, B shown
			Bottom:
			   1st branch: prob = 1 or $\frac{5}{5}$, & R shown
			
			   no 2nd branch OR branch with prob = 0 or $\frac{0}{5}$
				B1
				
				B1
				
				[2]
					consistent
					
					allow eg $\frac{4}{4}$
					
					ignore any 3rd layer branches
						
						Any missing label(s) on first three branches, subtr B1 once
						
						No label needed on zero branch, if drawn.

	Question		Answer	Marks	Guidance	
4	(ii)		$\frac{5}{6}\times\frac{1}{5}$ or $\frac{1}{6}(\times 1)$ or $\frac{1}{6}$ seen	M1		or $1-\frac{5}{6}\times\frac{4}{5}$ or $1-\frac{2}{3}$ M2
			$\frac{5}{6}\times\frac{1}{5}+\frac{1}{6}(\times 1)$	M1	all correct	ft incorrect tree dep probs ≤ 1
			$=\frac{1}{3}$ oe	A1 [3]	cao	if 3rd tree prob = 1, (ii)M1M1A0 if 3rd tree prob $\neq$ 1, (ii)M1M0A0
						NB!! $2\times\frac{5}{6}\times\frac{1}{5}=\frac{1}{3}$ M1M0A0
4	(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	M1	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	but $\frac{5}{6}\times(\frac{4}{5}\times\frac{3}{4}+\frac{1}{5})$ M0
			$=\frac{4}{5}$ or 0.8 oe	A1 [2]	May be seen without working M1A1 cao	ft incorrect tree: (iii) M1A0
5	(i)	(a)	1	B1 [1]		NOT close to 1
5	(i)	(b)	–1	B1 [1]		NOT close to –1
5	(ii)		Σd^2 attempted (= 10)	M1	if Σd^2 = 10, may be implied by next line if $\Sigma d^2\neq$ 10, must see working	S_{xx} or $S_{yy}=30-\frac{100}{4}$ (= 5) or
			$1-\frac{6\times\Sigma d^2}{4(4^2-1)}$	M1	dep M1	$S_{xy}=25-\frac{100}{4}$ (= 0) M1
			$= 0$	A1 [3]	Use of $(\Sigma d)^2$ M0M0A0	$\frac{0}{\sqrt{5\times 5}}$ M1

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Question			Answer	Marks	Guidance	
5	(iii)		No ft from (i)(a), (i)(b) & (ii)			NOT: They agree or Strongly agree They agree most ranks Similar rankings As A's ranks increase so do B's Perfect relnship
			ia: Total (or perfect or max or complete)agreement They have the same opinions/ranks/numbers etc They were identical	B1	Identical opinions/views/marks/ranks/ decisions/results/numbers oe Agree on all the ranks	
			ib: Opposite/reverse opinions/views/marks/ranks/ decisions/results oe	B1	Total (or max or complete or perfect) disagreement A's highest is B's lowest oe "Opposite" seen is sufficient	NOT: Don't agree any ranks Disagree or Strongly disagree Disagree on all ranks Perfect neg relnship
			ii: For $r = 0$ must state or imply:			NOT: Different views Don't agree but some rel'nshp Ranks all different No corr'n betw judges' views Don't agree nothing in common at all not much in common completely different orders opinions completely different half way between (a) and (b)
			either <u>NO</u> relationship or similar		No relationship/pattern/link/similarity between opinions/views/marks/ranks/ decisions/results oe opinions/etc… not related scoring appears random	
			or indicate <u>BOTH</u> agreement & disagreement or <u>NEITHER</u> agree nor disagree		Neither agree nor disagree oe Both agree & disagree oe Agree for some, disagree for others oe mixed/varied opinions on the ranks	
			or <u>DIFFERENT</u> but <u>NOT</u> <u>OPPOSITE</u>	B1 [3]	All three parts: Must refer to (or imply) opinions/views/marks/ranks/scores or (dis)agreement, or relationship or pattern oe, NOT just corr'n	Ignore all other

Question			Answer	Marks	Guidance	
6			$(1 - 0.1) \div 5 \qquad\qquad (= 0.18)$	M1	can be implied, eg by 18	or, using exp no. of 5's & 6's
			3×0.18 or 2×0.18 or 7×0.1 (or result of these)$(\text{poss} \times 100)$ $(3 \times 0.18$ only scores if using £3, not score of 3. Similarly for $2 \times 0.18)$.	M1	5×0.18 or 10×0.1 (or result of these)$(\text{poss} \times 100)$	18×5 or 10×10
			$4 \times 3 \times 0.18$ 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 $18 \times 5 + 10 \times 10$ (NB 300+ 100$\times$0.18 +100$\times$0.1 is insuff)
			'2.16' – '1.06' or '216' – '106' <u>must</u> be attempt gain on 1,2,3,4 – loss on 5,6	M1 dep any M1	3 – '1.9' or 300 – '190' <u>must</u> be attempt receipt – payout on 5,6	Eg: $300-100 \times (5 \times 0.18 + \underline{\mathbf{6}} \times 0.1) = 150$ M1M1M0M1A0
			E(profit for 100 rolls) = (£)110	A1	E(profit for 100 rolls) = (£)110	Mark one method only Must be matched pair eg 300–106 or 216–190:
					NB 300–$(0.1 \times 300 + 0.18 \times 300) = 300 - 84 = 216$ M1M1M0M0A0	M1M1M0M0A0
				[5]		
7	(i)	(a)	$^7P_5$ or $\frac{7!}{2!}$ or $7 \times 6 \times 5 \times 4 \times 3$ or $^7C_5 \times 5!$ alone = 2520	M1 A1 **[2]**	$^7P_2$ or $\frac{7!}{2!}$ M0A0	$^7C_5 = 21$ or $5! = 120$ M0A0 but see (i)(b)
7	(i)	(b)	$^6P_4$ or $\frac{6!}{2!}$ or $6 \times 5 \times 4 \times 3$ or $^6C_4 \times 4!$ or 360	M1	alone or $\times 2$ only	or '2520' – $5 \times\ ^6P_4$ M2
			$\times\ 2$ (see middle column)	M1	$^6P_4 \times 2$ or 6! alone M2 $^6C_4 \times 2$ or $6! \times 2$ alone M0M1 only any other $\times 2$ M0M0 or '2520'$\times \frac{2}{7}$ M2A0 (eg (ia)21 (ib) $21 \times \frac{2}{7} = 6$ M2A0 but if ans is 6, must see wking)	SC ONLY on ft from (i)(a): if (i)(a) $5! = 120$, then (i)(b)$4! \times 2 = 48$ alone M1M0A0 Other SC $^5P_3 \times 2$ M2 (from a vowel at <u>each</u> end, ie treat as MR) NOT isw eg $\frac{720}{'2520'} = \frac{2}{7}$ M1M1A0
			= 720	A1 **[3]**	cao	
7	(ii)	(a)	21	B1 **[1]**		

Question			Answer	Marks	Guidance	
7	(ii)	(b)	$^5C_3$ or $\frac{5!}{3!2!}$ or $^5C_5$ seen or 10 seen in num	M1	$\frac{5}{7}\times\frac{4}{6}$ oe seen	Allow $^5C_2$ seen BOD
			$\frac{^5C_3}{^5C_3+{}^5C_5}$ oe	M1	$\frac{5}{7}\times\frac{4}{6}\div(\frac{5}{7}\times\frac{4}{6}+\frac{2}{7}\times\frac{1}{6})$	
			$\frac{10}{11}$ or 0.909 (3 sf)	A1 **[3]**		
8	(i)		1 – 0.1754 alone = 0.825 (3 sfs)	M1 A1 **[2]**	Allow 1– 0.2855 or 0.7145 or 0.715 alone	
8	(ii)	(a)	$^4C_2 \times 0.7^2 \times 0.3^2$	M1	All correct	
			$= \frac{1323}{5000}$ or 0.265 (3 sf)	A1 **[2]**		
8	(ii)	(b)	4,4,2 & 4,3,3 only, seen or implied	B1	Both needed	
			$P(Y = 4) = 0.7^4$ (or $\frac{2401}{10000}$ or 0.2401)	M1		
			$P(Y = 3) = 4 \times 0.3 \times 0.7^3$ (or $\frac{1029}{2500}$ or 0.4116)	M1		if "3×" omitted twice or "3!×" used twice allow M1M0 eg ans 0.0560, 0.0559,0.336, probably B1M1M1M1M0A0 but must see method
			$P(4,3,3) = 3 \times "0.2401" \times "0.4116"^2$ (or 0.122)	M1	ie 3 × their P(4) × (their P(3))^2	
			$P(4,4,2) = 3 \times 0.2401"^2 \times "0.265"$ (or 0.0458)	M1	ie 3 × (their P(4))^2 × their P(2) ft (ii)(a) For M mks ignore extra combs eg P(4,4,3)	

			$P(Tot = 10) = 0.168$ (3 sfs)	A1	If B(30, 0.6) clearly being used:
					Any 5 combs adding to 10 seen B1
					P(8) = $^{30}C_8\times0.4^{22}\times0.6^8$ or 0.0002
					P(9) = $^{30}C_9\times0.4^{21}\times0.6^9$ or 0.0007
					P(10) = $^{30}C_{10}\times0.4^{20}\times0.6^{10}$ or 0.0020
					                  all three correct M2
					                     or two correct M1	

				[6]	No more marks	

Question			Answer	Marks	Guidance	
9	(i)	(a)	Geo stated or implied $0.9^5 \times 0.1$ alone $= 0.059(0\ldots)$ (2 sfs) **[3]**	M1 M1 A1	eg by $0.9^p \times 0.1$ or $0.1^p \times 0.9$ alone, $p>1$ all correct	
9	(i)	(b)	0.9^5 or $0.59\ldots$ (NB cf ans to (i)(a)!!) $1 - 0.9^5$ $= 0.4095$ or 0.410 (3 sfs) **[3]**	M1 M1 A1	$0.1 + 0.9 \times 0.1 + \ldots 0.9^4 \times 0.1$: M2 1 term wrong or omit or extra or $1 -$ (all terms correct): M1 or $1 - 0.9^6$: M1	M0M0A0 for $0.9^p \times 0.1$
9	(ii)	(a)	$0.05 + 0.95^2 \times 0.05$ $= \frac{761}{8000}$ or 0.0951 (3 sfs) **[2]**	M1 A1	All correct	NB!! $2 \times 0.95 \times 0.05 = 0.095$ M0A0
9	(ii)	(b)	$0.05, 0.95^2 \times 0.05, \ldots$ or $\frac{1}{20}, \frac{361}{8000}, \ldots$ oe $\frac{0.05}{1-0.95^2}$ or $\frac{0.05}{1-0.9025}$ oe $= \frac{20}{39}$ or 0.513 (3 sfs) **[3]**	M1 M1 A1	≥ 2 terms. Not nec'y added May be implied by next line or $\frac{0.05}{1-(1-0.5)^2}$ or $\frac{0.05}{2 \times 0.05 - 0.05^2}$ or $\frac{1}{1.95}$ oe	or $r = 0.95^2$ stated or implied NB $\frac{0.05}{1-0.5 \times 0.05} = 0.0513$ M0A0

Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to $\geq$ 3sfs, ISW for later rounding. Penalise over-rounding only once in <u>paper</u>.