GCE

Mathematics A

H230/01: Pure Mathematics and Statistics

AS Level

Mark Scheme for June 2024

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING
RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. **Annotations**

Annotation	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
BP	Blank Page
Seen	
Highlighting	

Other abbreviations in mark scheme	Meaning
dep*	Mark dependent on a previous mark, indicated by *. The * may be omitted if only one previous M mark
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
AG	Answer given
awrt	Anything which rounds to
BC	By Calculator
DR	This question included the instruction: In this question you must show detailed reasoning.

5**. Subject Specific Marking Instructions**

a. Annotations must be used during your marking. For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required.

For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

Award NR (No Response)
- if there is nothing written at all in the answer space and no attempt elsewhere in the script
- OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
- OR if there is a mark (e.g. a dash, a question mark, a picture) which isn't an attempt at the question.

Note: Award 0 marks only for an attempt that earns no credit (including copying out the question).

If a candidate uses the answer space for one question to answer another, for example using the space for 8(b) to answer 8(a), then give benefit of doubt unless it is ambiguous for which part it is intended.

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 always 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, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

If you are in any doubt whatsoever 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, e.g. 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 method mark may usually be implied by a correct answer unless the question includes the DR statement, the command words "Determine" or "Show that", or some other indication that the method must be given explicitly.

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.

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, what is acceptable will be detailed in the mark scheme. If this is not the case please, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

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. We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so.
- When a value is given in the paper only accept an answer correct to at least as many significant figures as the given value.
- When a value is not given in the paper accept any answer that agrees with the correct value to 3 s.f. unless a different level of accuracy has been asked for in the question, or the mark scheme specifies an acceptable range.

NB for Specification B (MEI) the rubric is not specific about the level of accuracy required, so this statement reads "2 s.f".

Follow through should be used so that only one mark in any question is lost for each distinct accuracy error.
Candidates using a value of 9.80, 9.81 or 10 for g should usually be penalised for any final accuracy marks which do not agree to the value found with 9.8 which is given in the rubric.

g. Rules for replaced work and multiple attempts:
- If one attempt is clearly indicated as the one to mark, or only one is left uncrossed out, then mark that attempt and ignore the others.
- If more than one attempt is left not crossed out, then mark the last attempt unless it only repeats part of the first attempt or is substantially less complete.
- if a candidate crosses out all of their attempts, the assessor should attempt to mark the crossed out answer(s) as above and award marks appropriately.

h. For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A or B mark in the question. Marks designated as cao may be awarded as long as there are no other errors.
If a candidate corrects the misread in a later part, do not continue to follow through. Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

i. If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers, provided that there is nothing in the wording of the question specifying that analytical methods are required such as the bold "In this question you must show detailed reasoning", or the command words "Show" or "Determine". Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j. If in any case the scheme operates with considerable unfairness consult your Team Leader.

Question			Answer	Marks	AO	Guidance
1			**DR**			
			$\ln\left(\frac{x^3}{5x^2}\right) = \ln 2$	**M1**	**1.1**	Correct use of log rule(s) to combine terms, or $\ln\left(\frac{x}{5}\right) = \ln 2$
			$\frac{x}{5} = 2$	**A1**	**2.1**	Correctly remove logs from their equation, accept $\frac{x^3}{5x^2} = 2$
			$x = 10$	**A1**	**1.1**	Answer without working scores 0 (DR).
			Alternative method			
			$\ln(x^3) - \ln 5 - \ln(x^2) = \ln 2$	**M1**		Correct use of log rule to fully separate terms
			$\ln x = \ln 10$	**A1**		Express their equation in the form $\ln x = \ln k$
			$x = 10$	**A1**		
				[3]		

Question			Answer	Marks	AO	Guidance
2	(a)		$(\overrightarrow{OM} =)0.5\text{i} + 4\text{j}$	B1 [1]	1.1	Or column vector equivalent (not coordinates)
2	(b)		$(\overrightarrow{AB} =) -3i + 2j$ $3^2 + 2^2$ (= 13) Mag = $\sqrt{13}$	B1 M1 A1 [3]	1.1a 1.1 1.1	soi, condone 3i − 2j FT their $\overrightarrow{AB}$ (need not be labelled but do not give this mark for finding the magnitude of $\overrightarrow{OA}$, $\overrightarrow{OB}$, or $\overrightarrow{OM}$) May be implied by correct answer (including inexact 3.606…) cao but isw further work (e.g. writing as a decimal)
2	(c)		$\tan^{-1}\left(\frac{3}{2}\right)$ = 56.3°	M1 A1 [2]	1.1 1.1	or $\cos^{-1}\frac{2}{\sqrt{13}}$ or $\sin^{-1}\frac{3}{\sqrt{13}}$ or correct sine/cosine rule setup for θ (0.98279… rads)

Question			Answer	Marks	AO	Guidance
3			$\frac{1}{2} \times 3 \times 5 \times \sin\alpha = \frac{5}{2}$	**M1***	**1.1a**	
			$\sin\alpha = \frac{1}{3}$	**A1**	**1.1**	oe, condone $\sin\alpha = \frac{1}{3}$ for M1A1 only
			$\cos\alpha = \pm\sqrt{1 - their\left(\frac{1}{3}\right)^2}$	**M1dep***	**2.1**	Use of Pythagorean identity but accept in $\cos^2$ Allow without $\pm$
			$= \frac{2\sqrt{2}}{3}$ or $\frac{\sqrt{8}}{3}$	**A1**	**1.1**	cao
			or $-\frac{2\sqrt{2}}{3}$ or $-\frac{\sqrt{8}}{3}$ oe	**A1**	**1.1**	cao
				[5]		

Question			Answer	Marks	AO	Guidance
4	(a)		${}^{12}C_5\, a^7\, b^5$ oe	**B1** **[1]**	**1.2**	Any equivalent form e.g. $\binom{12}{5} a^7 b^5$, $\binom{12}{7} a^7 b^5$, $792\, a^7 b^5$ isw incorrect attempts to evaluate
4	(b)	(i)	$a + b = 1$	**B1** **[1]**	**1.2**	Accept in words e.g. "a and b must add up to 1"
4	(b)	(ii)	B(12, b) or Binomial, 12 trials, P(success) = b	**B2** **[2]**	**3.3** **3.3**	**B1** for B or Binomial and $n = 12$, e.g. B(12, a) scores B1B0 **B1** for $p = b$ or $p = 1 - a$

Question			Answer	Marks	AO	Guidance
5	(a)		$\frac{dy}{dx} = 8x - x^{-2}$	M1	1.1a	Attempt to differentiate, at least one term correct
				A1	1.1	All correct, oe
			$8x - x^{-2} = 0$	M1	2.1	Their $\frac{dy}{dx} = 0$ (must see this step)
				A1	1.1	For $x = \frac{1}{2}$ (and no further invalid solutions)
			$(\frac{1}{2}, 3)$	A1	1.1	For $y = 3$ www
				[5]		
5	(b)		$\frac{d^2y}{dx^2} = 8 + 2x^{-3}$	M1	3.1a	Attempt to differentiate their $\frac{dy}{dx}$, at least one term correct
			This is positive (for $x = \frac{1}{2}$ or for all $x>0$)			Or >0 etc. No need to show calculation but if present it must be correct for their x (e.g. 24)
			Hence minimum	A1FT	2.4	Need both lines for A1 and no incorrect working in this part (FT their $\frac{dy}{dx}$ and their x but do not award this mark for an incorrect $\frac{d^2y}{dx^2}$ or incorrect method in part (b)).
						If correct work in this part leads to $\frac{d^2y}{dx^2} < 0$ then conclusion should be 'maximum'.
				[2]		
5	(c)		$8x - x^{-2} \geq 0$	M1	3.1a	Their $\frac{dy}{dx} \geq 0$. Allow >
			$x \geq \frac{1}{2}$	A1FT	1.1	FT their x. Allow > and allow without working, but www.
				[2]		

Question			Answer	Marks	AO	Guidance
6			$(y =) -x^2 + c$	M1	3.1a	Allow omission of "$y =$". Must include "$+ c$"
			$-13 = -4^2 + c$ $(c = 3)$	M1	1.1	FT their integral of $-2x$. Must include "$+ c$"
			$-x^2 + 3 = 2x$	A1FT	1.1	FT their integral of $-2x$ and their c
			$x^2 + 2x - 3\ (= 0)$	M1	2.1	Rearrange their quadratic equation to solvable form. Must see this step
			$(x + 3)(x - 1) = 0$ or $(x + 1)^2 - 4 = 0$			
			or $x = \frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times (-3)}}{2}$	M1	1.1	FT their c. May be implied by correct values for x
			$x = 1$ or -3	A1	1.1	
			$(1, 2)$ $(-3, -6)$	A1	1.1	Condone y=2, y=−6 as long as clearly identified and paired. SC **B1B1** for correct solutions without working in second half (i.e. max M1M1A1M0M0B1B1 5/7)
				[7]		

Question			Answer	Marks	AO	Guidance
7	(a)		**DR** $(x + 2)^4 - 6(x + 2)^2 - 16$ $x^4 + 8x^3 + 24x^2 + 32x + 16 - 6(x^2 + 4x + 4) - 16$ $= x^4 + 8x^3 + 18x^2 + 8x - 24$ **AG**	B1	1.1	For this correct intermediate step or an equivalent correct expression after expansions leading to AG or a clear conclusion www.
				[1]		
7	(b)		**DR** $(x + 2)^4 - 6(x + 2)^2 - 16 = 0$			(Applying the given identity)
			$((x + 2)^2 - 8)((x + 2)^2 + 2) = 0$			or $(y^2 - 8)(y^2 + 2) = 0$ or $(z - 8)(z + 2) = 0$
			or $(x + 2)^2 = \frac{6 \pm \sqrt{36 + 64}}{2}$ oe	M1	3.1a	or $y^2 = \frac{6 \pm \sqrt{36 + 64}}{2}$ Attempt to factorise or apply formula
			$(x + 2)^2 = 8$ or -2	A1	2.1	or $y^2 = 8$ or -2 soi
			$(x + 2)^2 = -2$ has no roots	A1	2.3	Somehow indicated or $y^2 = -2$ has no roots
			$x = -2 + \sqrt{8}$ or $-2 - \sqrt{8}$	A1	1.1	or $x = -2 + 2\sqrt{2}$ or $-2 - 2\sqrt{2}$ or $x = 0.828$ or -4.83 (3 sf) Answers only receive no credit (DR). SC **B1B1** (max 2/4) for correct answers and 'no roots' case $(x = -2)$ if only the working to solve the first quadratic is omitted.
				[4]		

Question			Answer	Marks	AO	Guidance
8			$[(x-3)^2 - 9 + y^2 = 16$ or $(x-3)^2 + y^2 = 25]$			May not be seen
			Centre (3, 0)	**B1**	**2.1**	soi
			radius 5	**B1**	**1.1**	soi
			Translation of $\begin{pmatrix} k \\ k \end{pmatrix}$ soi	**M1**	**1.1**	e.g. $(3+\alpha, \alpha)$
			$k = 2\times5\cos 45^0$	**M1**	**1.1**	For use of the distance between centres C and D being $2r$ (look for attempts at Pythagoras in an isosceles triangle with hypotenuse 10) e.g. $2\times\frac{5}{\sqrt{2}}$ or $5\sqrt{2}$ or $\frac{10}{\sqrt{2}}$ oe or 7.07 or 7.1
			Centre of D is $(3 + 5\sqrt{2}, 5\sqrt{2})$	**A1**	**2.2a**	(10.1,7.1)
				[5]		

Question			Answer	Marks	AO	Guidance
9			**DR**			
				M1	**3.1a**	M1 for correct factorisation of numerator and denominator
			$\frac{a^{\frac{5}{2}}(a-1))}{a(a^{\frac{1}{2}}-1)} \times \frac{(a^{\frac{1}{2}}+1)}{(a^{\frac{1}{2}}+1)}$	**M1**	**2.1**	M1 for multiplying numerator and denominator by $\left(a^{\frac{1}{2}}+1\right)$ or $a\left(a^{\frac{1}{2}}+1\right)$ or another multiple of this.
			$= \frac{a^{\frac{3}{2}}(a-1)(a^{\frac{1}{2}}+1)}{a-1}$ or $\frac{a^{\frac{5}{2}}(a-1)(a^{\frac{1}{2}}+1)}{a(a-1)}$	**A1**	**1.1**	A1 for correct, simplified, denominator (dependent only on second M1 above)
			$= a^{\frac{3}{2}}(a^{\frac{1}{2}}+1)$ or $a^2+a^{\frac{3}{2}}$	**A1**	**1.1**	
			$= a^2+\sqrt{a^3}$	**A1**	**2.2a**	
			Alternative method			
			$\frac{a^{\frac{5}{2}}(a-1))}{a(a^{\frac{1}{2}}-1)}$	**M1**		M1 for correct factorisation of numerator and denominator
			$= \frac{a^{\frac{3}{2}}(a^{\frac{1}{2}}-1)(a^{\frac{1}{2}}+1)}{(a^{\frac{1}{2}}-1)}$	**M1A1**		M1 for factorising $(a-1)$; A1 for correct factors These two marks may be implied by the next line
			$= a^{\frac{3}{2}}(a^{\frac{1}{2}}+1)$ or $a^2+a^{\frac{3}{2}}$	**A1**		
			$= a^2+\sqrt{a^3}$	**A1**		
				[5]		

Question			Answer	Marks	AO	Guidance
10	(a)		$\frac{42}{60}$ or $\frac{7}{10}$ or 0.7	B1 [1]	1.1	Condone 70%, isw
10	(b)		$\frac{35}{40}$ or $\frac{7}{8}$ or 0.875	B1 [1]	1.1	Condone 87.5%, isw
10	(c)		$\frac{35}{60}\times\frac{5}{59}$ oe or 0.0494…. (× 2) = 0.0989 (3 sf)	M1 A1 [2]	3.1a 1.1	M0 for $\frac{35}{60}\times\frac{5}{60}$ or $\frac{7}{144}$ or 0.0486.. or $\frac{7}{72}$ ie "with replacement" $\frac{35}{354}$ SC **B1** for correct answer without working (www)

Question			Answer	Marks	AO	Guidance
11	(a)	(i)	$\frac{73+6a}{23+a}$ $\frac{73+6a}{23+a} = 3.4$ $a = 2$	M1* M1 dep* A1 [3]	3.1a 2.1 1.1	$\frac{\Sigma xf}{\Sigma f}$ attempted, must see a in numerator and denominator FT their $\frac{\Sigma xf}{\Sigma f}$ Condone Trial & Improvement only if correct answer reached.
11	(a)	(ii)	$\frac{\Sigma x^2 f}{\Sigma f} - 3.4^2$ attempted $(= 12.76 - 3.4^2 = 1.2)$ $\sqrt{'1.2'}$ = 1.10 (3 sf)	M1* M1 dep* A1 [3]	1.1 1.1 1.1	FT their a. Must see two values divided and not $\Sigma f = 6$. May be implied by previous M-mark and answer but must have some numerical evaluation for this mark (even if just inside the square root) Allow 1.1 or 1.095 SC **B1** for correct answer without working (max 1/3)
11	(b)		s larger than (a)(ii) because scores in table are (concentrated) towards the middle and (as the dice is fair) the scores will be spread **evenly** oe	B1 [1]	3.2a	Examples: • "s larger because scores will be spread **evenly"** B1 • "as the data will be more spread" B0 • "because there are equal chances a number will roll" B0 • "larger because there is an equal chance for each number, but for part a)ii) there was an area of the data with a higher probability" B0 Must have the idea of **even**/uniform spread (due to fair dice).

Question			Answer	Marks	AO	Guidance
12	(a)		**Either:** Lichfield, large increase in 65-74 **Or**: Redditch, large increase in 60-64	**B1** **[1]**	**2.2b**	Explanation need not say 'increase' but must not interpret the data incorrectly (e.g. discussing proportions rather than increases). Must refer to a specific age range, not just 'elderly' or 'retirement age'. Examples: • Redditch as "their population is largely 60-64 .." B0 (incorrect interpretation) • "Lichfield 33% from 60-64, 50% from 65-74, 29 for 75 and above" B0 • Lichfield with both 65-74 and 75+ increases referred to. B1 • Correct explanation with 'largest' (and no reference to increase) B1 BOD • Redditch as "60-64 ….a 77% increase" B1 BOD Condone Lichfield and/or Stratford-on-Avon (75 or above) but only if explanation justifies why (e.g. large increase in the most elderly group which may lead to an increased demand for provision)
12	(b)		**Either: No -** The 11% increase in 0-9 means more provision will be needed (Regardless of increase in 10-19) **Or**: **Yes -** The 11% increase in 10-19 has already happened (so is not relevant.)	**B1** **[1]**	**2.3**	Must refer to specific age ranges, i.e. not just '11%' and must explicitly agree/disagree (e.g. yes/no). Alternatively may argue (for 'No') that the data shows the **% increase**, not the absolute **size** of the population, so although the % increase is the **same** for 0-9 and 10-19, there may still be **more** 0-9 year olds. Without any incorrect explanation.

Question			Answer	Marks	AO	Guidance
12	(c)	(i)	**Either**: Drop in 10-19, so likely to be excess provision, so increase in 0-9 no problem **Or**: Drop in 10-19, so facilities may have been reduced, so increase in 0-9 is still a problem **Or:** Drop in 10-19, but increase in 0-9 is small, so even if facilities reduced, little or no extra provision needed.	**B1** **[1]**	**2.2b**	Must refer to both columns and give a 'so what', without any incorrect explanation.
12	(c)	(ii)	**Either**: Increase in 10-19 means extra provision already made, so decrease in 0-9 means there will be spare capacity **Or**: Increase in 10-19 possibly means overcrowding, so decrease in 0-9 will help	**B1** **[1]**	**2.4**	Must refer to both columns and give a 'so what', without any incorrect explanation.
12	(d)		Little movement in or out of LAs OR no significant change to the underlying total population numbers.	**B1** **[1]**	**2.4**	Examples: • "every member of the population was included" B0 • "the data is equally distributed within the classes" B0 • "people haven't moved away from/to the area" B1 BOD • "no significant changes in population occurred" B1 BOD Must be an assumption needed across parts (a),(b) and (c) – i.e. something about the data, not the behaviour of a specific group.

Question			Answer	Marks	AO	Guidance
13	(a)		Arrivals at other gates may not be included Arrivals at other days/times may not be included	**B1** **B1** **[2]**	**1.1** **1.1**	(must give two distinct points and refer specifically to the sampling method i.e. entrance, time or 'first 50') Examples: • "It doesn't include the entire population" B0 • " Not everyone has an equal chance of being chosen" B0 • "the sample size is probably too small" B0 • "they are only sampling from one entrance" B1 • "they are only asking from a pool of people who arrive early" B1 • "students using a particular entrance are going to have similar results" B1 BOD • "Most students might not pick that entrance" B1 BOD • "More students might come in on a different morning" B1 BOD • "a particular year group might prefer coming through a specific gate" B1 BOD • "the first 50 students will be those who arrive earliest and may not be representative" B1

Question			Answer	Marks	AO	Guidance
13	(b)					**Allow 2 sf throughout**
			H_0: $p = 0.3$ where p = **proportion** of students (at college) who think lunches satisfactory	**B1**	**1.1**	Allow "where p is the population **proportion**" Allow "like" for "think lunches satisfactory" Subtract B1 for each error e.g.:
			H_1: $p < 0.3$	**B1**	**2.5**	• 2-tail B1B0 • undefined p or 'probability' B1B0 • use of X,x and not defined B0B0 • not in terms of parameter B1B0 • p = sample proportion implied B1B0 • Not include value 0.3 B0B0 • e.g. $H_0 = 0.3$ etc: B0B0
			B(50, 0.3) & $X = 9$ Allow $X = 8$ or 10	**M1**	**3.3**	Correct distribution and value of X, both may be stated or implied e.g. by 0.0183 ($X \leq 8$) or 0.0220 ($X = 9$) even if within incorrect statement e.g. P($X = 9$) = 0.040.
			P($X \leq 9$) = 0.04023…	**A1**	**3.4**	**BC** allow 2 sf (0.040)
			0.040… < 0.05	**A1FT**	**1.1**	Correct for their value of 0.0402, FT their hypotheses (e.g. >0.95) and condone 5% for 0.05.
			Reject H_0	**M1**	**1.1**	dep P($X \leq 9$ or 8 or 10) stated or calculated. Condone "Accept H_1" but not "Do not reject H_1" Correct conclusion from their comparison.
			Sufficient evidence that proportion who think lunches satisfactory is < 0.3	**A1**	**2.2b**	In context, not definite, e.g. not "Proportion who think lunches satisfactory is < 0.3" or "has decreased" Accept "sufficient evidence to support Dev's claim" but not just "Dev is correct" www (not dependent on B1B1 and can gain this mark if 0.04 to 1sf only)
				[7]		

Question			Answer	Marks	AO	Guidance
13	(c)		**Yes**. Whether one sample member says lunch is satisfactory is not independent of other members.	**B1** **[1]**	**3.5b**	Accept **Yes**, P(success) not constant Accept **No**, P(success) is nearly constant [because the school is large] Examples: • "each student may not be independent from one another" (not sample member and no mention of opinion) B0

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