GCE

Mathematics B MEI

H630/02: 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. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **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
E	Explanation mark 1
SC	Special case
^	Omission sign
MR	Misread
BP	Blank Page
Seen	
Highlighting	

Other abbreviations in mark scheme	Meaning
E1	Mark for explaining a result or establishing a given result
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.
BP	Blank Page
Seen	
Highlighting	

6. **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 No Response (NR) if:

- there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

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.

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, 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. Unless units are specifically requested, there is no penalty for wrong or missing units as long as the answer is numerically correct and expressed either in SI or in the units of the question. (e.g. lengths will be assumed to be in metres unless in a particular question all the lengths are in km, when this would be assumed to be the unspecified unit.)
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 2 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 A the rubric specifies 3 s.f. as standard, so this statement reads "3 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. E marks are lost unless, by chance, the given results are established by equivalent working. 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			$7x^2 + 4x + 6$	**B1** **B1** **B1**	**1.1** **1.1** **1.1**	one mark for each correct term
				[3]		

Question			Answer	Marks	AO	Guidance
2	**(a)**		$(-2)^2 - 4 \times 3 \times 5$ **soi** -56	**M1** **A1** **[2]**	**1.1** **1.1**	-56 implies both marks. Condone $-2^2 - 4 \times 3 \times 5$ for this mark- but if recovered then both marks can be scored. Ignore comparisons e.g. -56 > 0 etc
2	**(b)**		0	**B1FT** **[1]**	**1.2**	'Zero' or 'None' or 'No real roots/solutions' If they solve the 3TQ then state 'no real roots' etc then B1 as the discriminant embedded in the quadratic. Reason/justification not needed for this mark. If their (a) is incorrect then FT their discriminant value.

Question			Answer	Marks	AO	Guidance
3	(a)		200	B1	1.1	
				[1]		
3	(b)		Horizontal lines from 150 **and** 50 on vertical axis to curve **and** vertical lines to horizontal axis	M1	1.1	Mark the intention here- e.g. condone freehand drawn lines. M**ust use the diagram to score this mark. Condone values shown on the time axes**
			$4.2 - 1.3 = 2.9$	B1	1.1	allow 2.7 to 3.1 nfww. Answers in this range with no lines drawn on the diagram can score this mark provided no incorrect work seen. (M0B1 possible here).
				[2]		
3	(c)		**3.9 > *their* 2.9 (or comparison of which IQR is higher/lower)** so amount of time spent cooking by people in village B is **more variable** than those in village A.	B1 FT	2.2b	Need to consider the statistical evidence (IQRs) here so need a **comparison of values (allow implicit comparison) and a conclusion (must see the word 'variable')** Must be a conclusion consistent with their comparison of their values. FT their 3(b) value. 'More variable' is B0 (No IQRs compared) 'More variable as it's bigger' is B0 (No mention of IQRs) 'More variable as IQR is bigger' is B1 (question asking whether B more/less variable than A in that order so not ambiguous) Additional incorrect reasons scores B0.
				[1]		

Question			Answer	Marks	AO	Guidance
4			attempt to multiply out $\frac{1+4\sqrt{3}}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}} = \ldots$	**M1**	**1.1a**	Multiplying by the correct conjugate, **and** making a valid attempt at the resulting multiplication on **either** numerator **or** denominator- condoning sign/bracket errors only
			$\frac{2-\sqrt{3}+8\sqrt{3}-12}{2^2-\sqrt{3}^2}$ or better with attempt at numerator	**A1**	**1.1**	A valid attempt at multiplication on the numerator must be made to score this mark (condoning one sign or coeff. error only) If they write down $(1+4\sqrt{3})(2-\sqrt{3}) = -10+7\sqrt{3}$ and $(2+\sqrt{3})(2-\sqrt{3}) = 1$ then M0A0A0 as detailed reasoning required.
			$-10+7\sqrt{3}$	**A1**	**1.1**	Correct result from correct work. At least one correct intermediate line of working required before the final answer.
				[3]		

Question			Answer	Marks	AO	Guidance
5	**(a)**		positive association or positive correlation	**B1**	**2.2b**	May be a contextual interpretation e.g. 'as the mobile phone subscribers per 100 population increases, real GDP per capita also increases.' Ignore references to 'strong/weak' etc. 'Linear' not required. Contradictory statements lose the mark e.g 'positive correlation' followed by incorrect interpretation.
				[1]		

Question			Answer	Marks	AO	Guidance
5	(b)		negative association or negative correlation	B1	2.2b	Accept 'as the mobile phone subscribers per 100 population increases, real GDP per capita decreases' o.e. Ignore references to 'strong/weak' etc. 'Linear' not required. Contradictory statements lose the mark e.g 'negative correlation' followed by incorrect interpretation.
				[1]		
5	(c)		Neither/None of them – samples are same size and different samples can lead to different conclusions. Or 'Neither as the patterns of the data contrast/are different'.	B1	2.4	Allow e.g. neither since combining results suggests no correlation. **SC**: IF they interpret (b) as 'little/no correlation' then they can score for a correct FT reason e.g superimposing (a) onto (b) implies no real relationship- so 2nd diagram more likely to represent the true situation. **SC:** From pre-release material/large data set accept 'the first scatter diagram is more representative of the true relationship as the PMCC is positive for this data when all countries in Africa are considered' Any reference to sample size being too small is B0 as comparing these two scatter diagrams of equal size. e.g. 'Neither as sample size is too small' is B0 'Neither as total in both samples ≠ total in Africa' is B0 'Neither as the patterns of the data contrast/are different' is B1
				[1]		

Question			Answer	Marks	AO	Guidance
6			$m_1 = -\frac{2}{3}$	**B1**	**3.1a**	May be implied by a correct re-arrangement of given equation or by the correct perp gradient, or by the calculation of m_2 Condone $m_1 = -\frac{2}{3}x$
			$m_2 = -\frac{1}{their -\frac{2}{3}}$	**M1**	**1.1**	Must follow legitimate attempt to find gradient of perp line Condone $m_2 = \frac{3}{2}x$ etc if $\frac{3}{2}$ used in their perp. line
			$y - -1 = \frac{3}{2}(x - 4)$ **oe**	**M1**	**1.1a**	May see eg $-1 = \frac{3}{2} \times 4 + c$ This mark is for using the equation of the line correctly with the point (4, -1) so can be scored even with an incorrect gradient provided their $m_2 \neq their\ m_1$
			$y = \frac{3}{2}x - 7$	**A1**	**1.1**	Must be in this form only.
				[4]		

Question			Answer	Marks	AO	Guidance
7			$^7C_5$ **or** $^7C_2$ **soi**	**M1**	**1.1**	e.g. sight of 21 implies this mark. May be seen in a full binomial expansion but must extract this coefficient.
			3^2 **or** $(\pm 2)^5$ seen	**B1**	**1.1**	Could be implied by their working- may need to check
			$^7C_5 \times 3^2 \times (-2)^5$	**A1**	**1.1**	Correct coefficient unsimplified- may be embedded in term involving x^5; condone omission of negative sign. Must deal with the $(-2x)^5$ correctly for this mark so $(-2)^5$ must be seen or implied e.g. ± 32 or $\pm 32x^5$ soi.
			–6048	**A1**	**1.1**	-6048x^5 is A0 but accept if they underline/circle etc the -6048 NOTE: May see full binomial expansion here- look for the term in x^5 and mark as above.
				[4]		

Question			Answer	Marks	AO	Guidance
8			$(2x+3)^2 - 4x^2 = 33$	**B1**	**3.1a**	substitution to eliminate *y*
			$4x^2 + 12x + 9 - 4x^2 = 33$ Or $12x + 9 = 33$	**M1**	**2.1**	Expansion of the quadratic to obtain a **correct equation, allow one sign error or one coefficient error**, this can be implied by a correct linear equation.
			$x = 2$	**A1**	**1.1**	Progress to solve and obtain correct value
			(2, 7) **cao**	**A1**	**1.1**	
			Alternative: $y^2 - 4\left(\frac{y-3}{2}\right)^2 = 33$	**B1**	**3.1a**	substitution to eliminate *x*
			$y^2 - (y^2 - 6y + 9) = 33$ Or $6y - 9 = 33$	**M1**	**2.1**	Expansion of the quadratic to obtain a **correct equation**, **allow one sign error or one coefficient error** this can be implied by a correct linear equation.
			$y = 7$	**A1**	**1.1**	Progress to solve and obtain correct value
			(2, 7) **cao**	**A1**	**1.1**	
				[4]		

Question			Answer	Marks	AO	Guidance
9	**(a)**		p(A) = $\frac{1}{3}$ o.e.	**B1**	**1.1**	e.g. $\frac{2}{6}$ etc
				[1]		
9	**(b)**		p(B) = $\frac{1}{2}$ o.e.	**B1**	**1.1**	e.g. $\frac{3}{6}$ etc
				[2]		
9	**(c)**		$\frac{5}{6}$	**B1FT**	**1.1**	FT their $\frac{1}{3}+\frac{1}{2}$ provided their probability total ≤ 1
				[1]		
9	**(d)**		p(odd, odd) + p(even, even) **soi** **or** 1 - p(odd, even) etc	**M1**	**3.1a**	Can score this mark for the intention to calculate p(odd, odd) + p(even, even)- may be stated, or partial cases listed, or with a tree diagram with correct pathways or with a statement of 'odd, odd' and 'even, even' and an attempt to add.
			$\left(\frac{2}{3}\right)^2+\left(\frac{1}{3}\right)^2$	**A1**	**2.1**	
			$\frac{5}{9}$ o.e. $\frac{20}{36}$ etc	**A1**	**1.1**	allow $0.\dot{5}$ correct to 3 dp or better so 0.555… or 0.555 but not 0.55 however isw once $\frac{5}{9}$ o.e. seen. Condone 0.556

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>Alternative 1
Sample space:
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<tr><th></th><th>1</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
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$\frac{5}{9}$ o.e. $\frac{20}{36}$ etc</td><td>M1

A1

A1</td><td>3.1a

2.1

1.1</td><td>Complete sample space diagram with maximum two errors

Extraction of even outcomes- may circle or underline etc.

allow $0.\dot{5}$ correct to 3 dp or better so 0.555… or 0.555 but not 0.55 however isw once $\frac{5}{9}$ o.e. seen. Condone 0.556</td></tr>
<tr><td></td><td></td><td></td><td>Alternative 2
Listing cases: (1,3) (1, 5) (1, 7) (3,5) (3,7) (4,6) (5,7) x2 and
(1, 1) (3, 3) (4, 4) (5, 5) (6, 6) (7, 7)

A complete list extracted.

$\frac{5}{9}$ o.e. $\frac{20}{36}$ etc</td><td>M1

A1

A1</td><td>3.1a

2.1

1.1</td><td>Must make a clear attempt at pairing odd with odd and even with even. The list can be incomplete for this mark.

May be implied by a correct answer.

allow $0.\dot{5}$ correct to 3 dp or better so 0.555… or 0.555 but not 0.55 however isw once $\frac{5}{9}$ o.e. seen. Condone 0.556</td></tr>
<tr><td></td><td></td><td></td><td></td><td>[3]</td><td></td><td></td></tr>
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Question			Answer	Marks	AO	Guidance
10	**(a)**		29.3 > 10 **oe** so **birth rates on average higher** in Africa than in Europe	**B1**	**2.4**	Must refer to means e.g 'averages' is B0 so 'mean of Africa > mean of Europe so **birth rates (on average) higher (or 'in general birth rate is higher) in Africa' etc** than in Europe' is B1 The comparison can be indirect/implicit- e.g. mean of Africa > mean of Europe so… Average of Africa > average of Europe so **birth rates on average higher** in Africa than in Europe' is B0 Accept reverse statements with 10 < 29.3
			8.43 > 1.94 so **birth rates more variable** (larger dispersion) in Africa than in Europe Condone 'more distributed' or 'more spread out' BOD for 'more variable'	**B1**	**2.4**	Must refer to SDs as they must use the given information. Accept reverse statements with 1.94 < 8.43 In both parts, **must refer to specific statistical data given- means/SDs**- no general comments without reference to values. The references can be implicit (mean of Africa > mean of Europe) so… etc
				[2]		
10	**(b)**		$'29.3 - 2 \times 8.43'(= 12.44)$	**M1**	**1.1**	Calculation of $\mu - 2\sigma$ only. Ignore attempts at upper bound. '12.44' not needed for this mark.
			9.86 < 12.44 **so 9.86 is outlier oe**	**A1**	**2.3**	May see e.g. so 9.86 is more than 2 standard deviations away from the mean. **Must give a concluding statement** 'so it's an outlier etc' and must also **compare 9.86 with correct value**, so an error with the calculation loses this mark. The comparison can be indirect e.g. 9.86 outside acceptable range etc.
				[2]		

Question			Answer	Marks	AO	Guidance
10	**(c)**		It should **not** be discarded as it's genuine data	**B1**	**2.4**	Must have 'No/should not' **and** reason: 'No as Mauritius does has a very low birth rate' is B1. 'The data for Mauritius is accurate data' o.e. is B1 'No as there are some countries in the LDS with very low birth rates' is B1.
				[1]		
10	**(d)**		Not all of the data was available	**B1**	**2.2a**	'No data for the other countries' – BOD B1 Any reference to countries being small or 'data may not be available' is B0- needs to convey the fact that it wasn't in the LDS
				[1]		

Question			Answer	Marks	AO	Guidance
11	**(a)**		$5\sqrt{4} - 4 - 6 = 10 - 10 = 0$	**B1**	**1.1**	Command word 'verify' so attempts at solving score zero. Need to see the substitution of the given value(s) and minimal processing to obtain 0 on the RHS

Question			Answer	Marks	AO	Guidance
			$5\sqrt{9} - 9 - 6 = 15 - 15 = 0$	**B1**	**1.1**	Need to see the substitution of the given value(s) and minimal processing to obtain 0 on the RHS
				[2]		
11	**(b)**		$\int_{(4)}^{(9)} \left(5x^{\frac{1}{2}} - x - 6\right) \mathrm{d}x$	**M1**	**1.1**	Attempting the integration (ignore limits) and obtaining **at least two terms of the correct form** in $\alpha x^{\frac{3}{2}} + \beta x^2 + \gamma x$ where $\alpha, \beta, \gamma \in \mathbb{R}$
			$\frac{10}{3}x^{\frac{3}{2}} - \frac{x^2}{2} - 6x$ **oe**	**A1**	**1.1**	Fully correct integrated expression- coeffs need not be simplified, but they must be correct.
			$\left[\frac{10}{3}9^{\frac{3}{2}} - \frac{9^2}{2} - 6(9)\right] - [\frac{10}{3}4^{\frac{3}{2}} - \frac{4^2}{2} - 6(4)]$	**M1**	**1.1**	Must show substitution of corrects limits into their integrand of the correct form and subtract the right way - detailed reasoning required. NB – 4.5 – $\left(-\frac{16}{3}\right)$
			$-\frac{9}{2} - \left(-\frac{16}{3}\right) = \frac{5}{6}$	**A1**	**1.1**	**At least one line of working required before seeing the final answer** Accept equivalents or a decimal – awrt 0.833.
				[4]		

Question			Answer	Marks	AO	Guidance
12	**(a)**		H_0: $p = 0.08$ **and** H_1: $p < 0.08$	**B1**	**1.1**	Requires both. Can be stated in words. NOTE: $H_0 = 0.08$ etc is B0

Question			Answer	Marks	AO	Guidance
			p is the **probability** that a person selected at random has **blue eyes**	**B1**	**2.5**	Accept '**proportion**' instead of probability but not number/amount etc. Must have highlighted words to score B1 here
				[2]		
12	**(b)**		0.057(43…) **BC**	**B1**	**1.1**	By calculator- awrt 0.057
				[1]		
12	**(c)**		0.057 > 0.05 A CR approach is possible here too where the CR is $X \leq 2$ then '3 not in CR' etc.	**M1**	**3.4**	their 0.057 correctly compared with 0.05 NOTE: comparing p (X = 3) = 0.03849 with 0.05 scores 0 in part (c)
			do not reject H_0 or accept H_0 or reject H_1	**M1**	**1.1**	FT consistent conclusion with their probability
			insufficient evidence to **suggest** that the **probability** that a person selected at random has blue eyes is **less than** 0.08 **OR** **insufficient evidence** to **suggest** that the **probability** that a person selected at random has blue eyes **has decreased.** **OR** **insufficient evidence** to **support the medical researchers' belief.**	**A1**	**2.2b**	Highlighted words needed. Must be a full contextual conclusion. Accept proportion instead of probability but NOT number/amount. No assertive statements e.g. conclusions with 'shows that' or 'proves that' etc score A0 Accept 'not enough evidence' for 'insufficient evidence'. The researcher believed the true probability was less than 0.08 in the question so accept this equivalent statement.
				[3]		

Question			Answer	Marks	AO	Guidance
13			$\left[\frac{dy}{dx}\right] = 12x^2 + 14x - 6$	**M1**	**3.1a**	Expression of the form $\alpha x^2 + \beta x + \gamma$ where $\alpha, \beta, \gamma \in \mathbb{R}$ with **at least two terms of the correct form**
				A1	**1.1**	Fully correct derivative
			Attempt to solve $12x^2 + 14x - 6 = 0$ or any multiple e.g. $6x^2 + 7x - 3 = 0$ (accept with < 0 or > 0 etc shown)	**M1**	**1.1**	May see quadratic formula (QF) or $(2x + 3)(3x - 1)$ or completing the square or calculator method. $(2x \pm 3)(3x \pm 1)$ M1 $k(2x \pm 3)(3x \pm 1)$ M1 Solving $\alpha x^2 + \beta x + \gamma = 0$ to get $(ax + b)(cx + d)$ where $\lvert ac \rvert = \alpha$ and $\lvert bd \rvert = \gamma$ scores M1 If using QF a correctly quoted formula followed by a slip in the substitution of values scores M1, but if the formula isn't quoted and there are errors in the substitution then M0.
			$x = -\frac{3}{2}$ **and** $x = \frac{1}{3}$ only identified	**A1**	**1.1**	If these values are stated incorrectly with no method shown for solving the quadratic, then the last three marks are lost.
			$-\frac{3}{2} < x < \frac{1}{3}$	**A1**	**3.2a**	Accept strict or non-strict inequalities here. Accept $x > -\frac{3}{2}$ **and** $x < \frac{1}{3}$ or $x \in \left(-\frac{3}{2}, \frac{1}{3}\right)$ with strict or non-strict inequalities but NOT $x > -\frac{3}{2}$ or $x < \frac{1}{3}$
				[5]		

Question			Answer	Marks	AO	Guidance
14			$5 - \cos\theta - 6(1 - \cos^2\theta) = 0$	**B1**	**3.1a**	Using the correct identity. May be seen anywhere in the working. Condone poor notation such as missing arguments.
			$6\cos^2\theta - \cos\theta - 1 = 0$	**M1**	**2.1**	Simplifies to **3 term** quadratic **in cosine** and sets equal to 0. Can score this mark if $1 + \cos^2\theta$ used (gives an unsolvable quadratic).
			eg $(3\cos\theta + 1)(2\cos\theta - 1) = 0$	**M1**	**1.1**	Attempt to solve a quadratic in cosine- may see use of quadratic formula; allow sign errors only in either method. **Calculator methods not acceptable here- detailed reasoning required.** If using QF a correctly quoted formula followed by a slip in the substitution of values scores M1, but if the formula isn't quoted and there are errors in the substitution then M0.
			$\cos\theta = \frac{1}{2}$ ***and*** $\cos\theta = -\frac{1}{3}$ seen	**A1**	**1.1**	
			$\underline{60° \textbf{\textit{and}} \circ 300°}$ **or** $\underline{109° \textbf{\textit{and}} 251°}$ **or** $60° \underline{\textbf{\textit{and}} 109°}$	**A1**	**1.1**	A complete solve for either trig equation or two 'first values' obtained: allow 109.47… and 250.53…; or e.g. 109.5 and 250.5 (or awrt 109 and 251)

Question			Answer	Marks	AO	Guidance
			all 4 correct with no extras	**A1**	**1.1**	SC 1: If the candidate uses a calculator to obtain $\cos\theta = \frac{1}{2}$ ***and*** $\cos\theta = -\frac{1}{3}$ then proceeds to a fully correct solution, then award SC 4/6 SC 2: If the candidate uses a calculator to obtain $\cos\theta = \frac{1}{2}$ ***and*** $\cos\theta = -\frac{1}{3}$ then proceeds to partially correct solution with at least two correct values then award SC 3/6
				[6]		

Question			Answer	Marks	AO	Guidance
15	**(a)**		$50 \times$ their $\frac{6}{32}$ Or 50×0.1875 $\frac{75}{8}$ **oe or** 9 games	**M1** **A1**	**3.4** **1.1**	condone $50 \times \frac{5}{32} = 7.8125$ Must be a genuine attempt at using binomial distribution. Coeff of 5 must be seen or implied or cumulative binomial found. NOTE: $p(4H) = 5 \times \frac{1}{2} \times \left(\frac{1}{2}\right)^4 = \frac{5}{32}$ (0.15625) and $p(5H) = \left(\frac{1}{2}\right)^5 = \frac{1}{32}$ (0.03125) $p(X \geq 4) = 0.1875$ If they round to 10 then withhold this mark
				[2]		

Question			Answer	Marks	AO	Guidance
15	(b)		**Combined/larger** sample because unbiased samples become **more representative** of theoretical distributions as **sample size increases**	**B1**	**3.5b**	Needs to refer to the idea that experimental data only mimics theoretical distributions if the samples are large and representative. Accept 'increasing the sample size/combining the samples gives a more accurate estimate of the value of p' Accept for this context 'the larger the sample, the more accurate the data' B1
				[1]		
15	(c)		$40p = 28$ so $p = 0.7$	**B1**	**1.1**	
				[1]		
15	(d)		$50 \times (5 \times 0.7^4 \times 0.3 + 0.7^5)$ Or $50 \times p(X \geq 4)$ using $X \sim B(5, 0.7)$ Gives 50×0.52822 26.4.. or 26	**M1** **A1**	**3.3** **3.4**	Makes a valid attempt at calculating using $X \sim B(5, 0.7)$ Must be a genuine attempt at using binomial distribution. Coeff of 5 must be seen or implied or cumulative binomial found. condone $50 \times 5 \times 0.7^4 \times 0.3$
				[2]		
15	(e)		Ali's model better fit since 25 much closer to 26 than to 9 **cao**	**B1 FT**	**3.5a**	Correct statement FT their values from (a) and (d) Must compare 25 with the expected number of wins for both Ali and Sam for the reasoning. The comparison can be indirect e.g. Ali's better as number of expected wins closer to the true value.
				[1]		

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