OCR
Oxford Cambridge and RSA

GCE

Mathematics A

H230/01: Pure Mathematics and Statistics

AS Level

Mark Scheme for June 2023

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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.

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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	Mark	AO	Guidance
1	(a)		LHS $= \cos x + \sin x \times \frac{\sin x}{\cos x}$	M1*	1.1a	Use of tan = sin/cos
			$= \frac{\cos^2 x + \sin^2 x}{\cos x}$	dM1	1.1	Attempt common denominator (by multiplying numerator) OR apply $\sin^2 x + \cos^2 x \equiv 1$ in correct working to reach $\cos x + \frac{1-\cos^2 x}{\cos x}$ oe
			$= \frac{1}{\cos x}$ **AG**	A1	2.2a	www, Must see previous line and answer
				[3]		
1	(b)		$\tan^2 x = \frac{1}{2}$	M1	1.1a	or $3\sin^2 x = 1$ or $2 = 3\cos^2 x$ and attempt to solve
			$\tan x = \pm\frac{1}{\sqrt{2}}$			$\sin x = \pm\frac{1}{\sqrt{3}}$ $\cos x = \pm\frac{\sqrt{2}}{\sqrt{3}}$
			$x = 35.3°$ or $x = 145°$ (Both)	A1	1.1	(35.26…°, 144.7…°) A0 if any additional solutions within range (isw any outside)
				[2]		

Question			Answer	Mark	AO	Guidance
2	(a)	(i)	$\overrightarrow{AB} = \begin{pmatrix}-3\\6\end{pmatrix} - \begin{pmatrix}-4\\3\end{pmatrix}$ or $\begin{pmatrix}1\\3\end{pmatrix}$	M1	1.1	One of these. Attempt **b** − **a** or **c** − **b** or similar
			$\overrightarrow{BC} = \begin{pmatrix}-1\\12\end{pmatrix} - \begin{pmatrix}-3\\6\end{pmatrix}$ or $\begin{pmatrix}2\\6\end{pmatrix}$			
			$\overrightarrow{BC} = 2\ \overrightarrow{AB}$ or $\overrightarrow{BC}$ is a multiple of $\overrightarrow{AB}$	A1	2.1	Dep correct $\overrightarrow{AB}$ and $\overrightarrow{BC}$ Multiple (2) not required, but if given must be correct.
			Hence B lies on AC			
			Alternative method 1:			
			$\overrightarrow{AB} = \begin{pmatrix}-3\\6\end{pmatrix} - \begin{pmatrix}-4\\3\end{pmatrix}$ or $\begin{pmatrix}1\\3\end{pmatrix}$	M1		One of these. Attempt **b** − **a** and **c** − **a** or similar

			$\overrightarrow{AC} = \begin{pmatrix}-1\\12\end{pmatrix} - \begin{pmatrix}-4\\3\end{pmatrix}$ or $\begin{pmatrix}3\\9\end{pmatrix}$ $\overrightarrow{AC} = 3\overrightarrow{AB}$ or $\overrightarrow{AC}$ is a multiple of $\overrightarrow{AB}$ Hence B lies on AC	**A1**		Dep correct $\overrightarrow{AB}$ and $\overrightarrow{AC}$ Multiple (3) not required, but if given must be correct.
			Alternative method 2: Gradient of line AC is $m = 3$ Equation of line AC is $y - (3) = 3(x - (-4))$ $(y = 3x + 15)$ At $x = -3,\ y = 3(-3) + 15 = 6$ (i.e. B) Hence B lies on AC	**M1** **A1**		Find (gradient and) equation of line AC – need not be simplified Substituting in x-coordinate of B (or both x,y) to show consistent Dep on correct equation
			Alternative method 3: Gradient of line AB is 3 AND Gradient of line BC is 3 As B lies on both AB and BC, and AB and BC have the same gradient, B lies on AC. (OR therefore A,B,C are colinear)	**M1** **A1**		Must both be explicitly stated for this method. Must make a convincing argument (not just conclude directly from two gradients) www.
				[2]		
2	**(a)**	**(ii)**	$AB : BC = 1 : 2$	**B1** **[1]**	**1.1**	Must be a ratio (but may be equivalent e.g. 2 : 4)
2	**(b)**		Q marked at (4, 2) or (4, 2) stated Magnitude = $2\sqrt{2}$ or $\sqrt{8}$ or 2.83 (3 sf) Direction = −45° or 315°	**B1** **B1** **B1** **[3]**	**3.1a** **1.1** **1.1**	May be implied by correct magnitude or direction Accept any unambiguous indication of the direction of $\overrightarrow{PQ}$ e.g. "towards the x-axis along $x + y = 6$" OR an arrow on diagram OR stating direction together with the column vector $\overrightarrow{PQ} = \begin{pmatrix}2\\-2\end{pmatrix}$ Condone 135° as a bearing (but must state "bearing")

2	**(c)**		$\begin{pmatrix}4\\3\end{pmatrix}$ and $\begin{pmatrix}0\\5\end{pmatrix}$	**B1** **B1** **[2]**	**3.1a** **1.1**	SC. Either or both "correct" but coordinates: max **SCB1**

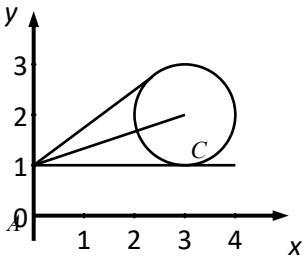
Question			Answer	Mark	AO	Guidance
3	**(a)**		Straight line starting at $(0, k)$ where $k < 0$ with positive gradient throughout cutting or touching x-axis vertically below minimum	**B1** **B1** **B1** **[3]**	**1.1a** **1.2** **2.2a**	Line must intersect y-axis for this mark Mark the intention All three marks are independent
3	**(b)**		0	**B1** **[1]**	**1.1**	Condone "there would be no gradient"

Question			Answer	Mark	AO	Guidance
4	**(a)**		$10 = e^{3x}$ $3x = \ln 10$ $x = \frac{1}{3}\ln 10$ or 0.768	**M1** **A1** **[2]**	**1.1a** **1.1**	Attempt to take logs of $10 = e^{3x}$ 0.767528… Allow answer in range [0.767, 0.768] Answer only (without working) **SCB1**
4	**(b)**		Gradient = $3e^{3x}$ Gradient of tangent at $x = 2$ is $3e^6$ or 1210	**M1** **A1** **[2]**	**1.1a** **1.1**	soi. Allow ke^{3x} for this mark ($k \neq 1$) or sight of $3e^{3(2)}$ 1210.286… isw if numerical form inaccurate (but do not accept -1/m if the perpendicular gradient is given as the final answer) Answer only (without working) **SCB1**

Question			Answer	Mark	AO	Guidance
5						**DR**
			$x(x^2-4)=0$	**B1**	**3.1a**	Evidence of factorising or otherwise attempting to solve (=0 not required for this mark)
			$x = 0, -2, 2$	**B1**	**1.1**	This mark may be implied by correct limits
			$A_1 = \int_0^2 \left(x^3 - 4x\right) \mathrm{d}x$	**M1***	**1.1**	Ignore limits for this mark
			$= \left[\frac{x^4}{4} - 2x^2\right]_0^2 = -4$	**A1**	**1.1**	Must be seen for this mark (or clear indication of taking modulus) Condone area from [0,-2] as -4 or from [2,0] as +4 but must be consistent with their limits
			$A_2 = \lvert A_1 \rvert = 4$ or $A_2 = -A_1 = 4$	**dM1**	**2.1**	By symmetry: Total area = 2 × (their A_1) or adding together two areas of the same sign from their two integrals (or just 4 + 4)
			Total area = 8	**A1**	**1.1**	www, Area must be positive
			Alternative method for final M1*A1dM1A1			
			$\int_{-2}^{0} \left(x^3 - 4x\right) \mathrm{d}x - \int_{0}^{2} \left(x^3 - 4x\right) \mathrm{d}x$	**M1***		Ignore limits for this mark
			$= 4 - (-4)$	**A1**		Correct area of -4 seen
				dM1		Attempt combine the two areas, with correct signs
			$= 8$	**A1**		www, Area must be positive
						NB $\int_{-2}^{2} \left(x^3 - 4x\right) \mathrm{d}x = 0$ scores B1B1M1A0M0A0 if working seen
						SC, no working or inadequate working: One area = 4: **SCB3** or Total area = 8: **SCB4**
				[6]		

Question			Answer	Mark	AO	Guidance
6	(a)		$x^3 = -1$ or $\frac{1}{8}$	M1	1.1	For attempting to solve as a quadratic in x^3 (May be implied by these correct answers for x^3)
			$x = -1$	A1	1.1	(Must be explicitly, separately, stated following $x^3 = -1$) Some working must be seen
			or $x = \frac{1}{2}$	A1	1.1	Answers only (no working or inadequate working) **SCB1** for each (max 2/3)
				[3]		
6	(b)		$\frac{dy}{dx} = 56x^6 + 49x^3 - 7$	M1 A1	3.1a 1.1	Attempt differentiate, at least two terms correct All correct
			$56x^6 + 49x^3 - 7 = 0$	M1	1.1	Setting their $\frac{dy}{dx} = 0$ and attempting to solve (must show attempt at solving the quadratic in x^3 or reach x=… from part (a)) Must see =0 here (may be implied by fully correct solutions only)
			$(8x^6 + 7x^3 - 1 = 0,\ x = -1$ or $x = \frac{1}{2})$			
			SPs are $(-1, 11.25)$ and $(0.5, -\frac{171}{64})$ or $(0.5, -2.67)$ (3sf)	A1	1.1	(Accept 11.3 or $\frac{45}{4}$) Coordinates must be correctly paired
				[4]		
6	(c)		$\frac{d^2y}{dx^2} = 336x^5 + 147x^2$	M1*	1.1	Attempt differentiate their $\frac{dy}{dx}$, allow one error only
			$x = \frac{1}{2} \Rightarrow \frac{d^2y}{dx^2} > 0$			$\frac{d^2y}{dx^2} = \frac{189}{4} = 47.25$ (not required but if given then must be correct for their value of x)
			Hence $x = \frac{1}{2}$ gives a minimum	A1ft	1.1	Must see both statements; no need to see calculation ft their 2nd derivative and their positive x
			$x = -1 \Rightarrow \frac{d^2y}{dx^2} < 0$	dM1	1.1	Substitute their −ve x into their $\frac{d^2y}{dx^2}$; may be implied by –189
			Hence $x = -1$ gives a maximum	A1ft	2.2a	www in this part, ft their -ve x value (-189 not required but if given then must be correct for their value of x)
				[4]		NB differentiating $8x^6 + 7x^3 - 1$ can achieve M1A0dM1A0 (max 2/4)

Question			Answer	Mark	AO	Guidance
7	(a)	(i)	$\frac{a^2+b^2}{2}, \left(\frac{a+b}{2}\right)^2$	B1 [1]	1.1	Both oe (NOT $\frac{(a+b)^2}{2}$) isw any multiplying out in this part
7	(a)	(ii)	$\frac{a^2+b^2}{2}-\left(\frac{a+b}{2}\right)^2$ $=\frac{2a^2+2b^2-(a^2+2ab+b^2)}{4}$ $=\frac{(a-b)^2}{4} \geq 0$	M1* dM1 A1	3.1a 1.1 2.2a	Difference between two expressions from **(a)(i)** oe, attempt collect over denominator of 4 Must see $\frac{(a-b)^2}{4}$ and "≥ 0"
			Alternative method: $\left(\frac{a+b}{2}\right)^2 = \frac{a^2+2ab+b^2}{4}$ For the statement to be true: $\frac{a^2+b^2}{2} \geq \frac{a^2+2ab+b^2}{4}$ $2a^2+2b^2 \geq a^2+2ab+b^2$ $a^2+b^2 \geq 2ab$ $a^2+b^2-2ab \geq 0$ Which is true because $(a-b)^2 \geq 0$	M1* dM1 A1		Multiplying out their expression for the square of the mean of the form $(c+d)^2$ to reach $c^2+2cd+d^2$ (need not include the denominator). May be seen in part (a)(i). If two such expressions are present they must both be correctly multiplied out. Comparing their two expressions (condone <,>,= but expressions must be of the correct form i.e. not Σ) and attempting to manipulate (must include denominators) (for any real values of *a* and *b*) Must see this or an equivalent statement
				[3]		
7	(b)		Variance is ≥ 0	B1 [1]	3.2a	Condone Variance is positive or 'never negative' (because Variance is the difference between the mean of the squares and the square of the mean)
Question			**Answer**	**Mark**	**AO**	**Guidance**

8			$(x-3)^2+(y-2)^2=(1)$	**M1**	**3.1a**	**DR** Attempt rearrange to this form
			Centre (3, 2), radius 1	**A1** **A1**	**1.1** **1.1**	soi but nfww soi but nfww
				**M1**	**2.1**	Attempt at a correct diagram seen (allow e.g. a slip in labelling) or geometrical understanding clearly implied (e.g. by giving gradient of AC or the gradient of the radius along AC as $\frac{1}{3}$ oe) Diagram must show the circle, tangents and either axes or labelled coordinates to be adequate on its own (but may be implied by later correct working).
			$(AC=\sqrt{10})$ $\sin\alpha=\frac{1}{\sqrt{10}}$	**B1**	**1.1**	or $\tan\alpha=\frac{1}{3}$
			$2\times\sin^{-1}\frac{1}{\sqrt{10}}$	**M1**	**2.1**	or $\tan 2\alpha=\frac{2\times\frac{1}{3}}{1-\left(\frac{1}{3}\right)^2}$ $\left(=\frac{3}{4}\right)$
			Angle between tangents = 36.9° (3 sf)	**A1**	**3.2a**	Angle between tangents = $\tan^{-1}\frac{3}{4}$ or 36.9° (3 sf)
			Alternative method $y=mx+1$ $x^2+(mx+1)^2-6x-4(mx+1)+12=0.$ $(1+m^2)x^2-(6+2m)x+9=0$ $(6+2m)^2-36(1+m^2)=0$ $24m-32m^2=0$	 **B1** **M1*** **A1** **dM1** **dM1**		 soi Substitute their line equation into circle equation (circle equation may be rearranged first) Attempt $b^2-4ac=0$ (must be =0 or ≥ 0) Rearrange and attempt to solve quadratic equation in m (must reach a value for m)

			$m = 0$ or $\frac{3}{4}$ Angle between tangents = $\tan^{-1}\frac{3}{4}$ or 36.9°	**A1** **A1**		Both needed or 0.644 (radians)
				[7]		(If two partial solutions given, apply whichever scheme gains the most marks)

Question			Answer	Mark	AO	Guidance
9	**(a)**		$\frac{20}{50}$ or $\frac{2}{5}$ or 0.4	**B1** **[1]**	**1.1**	isw
9	**(b)**		$\frac{20}{45}$ oe $\frac{20}{45}\times\frac{19}{44}$ $= \frac{19}{99}$ or 0.192 (3 sf)	**B1** **M1** **A1** **[3]**	**1.1a** **2.1** **1.1**	May be implied e.g. by $\frac{5}{45}+\frac{15}{45}$ M1 for subtracting 1 from numerator and denominator and multiplying oe (e.g. $\frac{380}{1980}$)

Question			Answer	Mark	AO	Guidance
10	**(a)**		eg $120 \times \frac{6}{24}$ or $120 \times \frac{150}{600}$ = 30	**M1** **A1** **[2]**	**3.1a** **1.1**	Attempt $120 \times \frac{\text{Area of 60-65 block}}{\text{Total area}}$, using any units (must see 120 used for this mark, but may be implied by '30') cao
10	**(b)**	**(i)**	Attempt areas of other blocks 57.7 (3 sf) 6.20 (3 sf) Allow 6.2	**M1** **A1** **A1** **[3]**	**1.1** **2.1** **1.1**	May be implied by $\bar{x} \in [55,60]$ OR $\sigma \in [5,7]$ OR $\sigma^2 \in [30,40]$ **BC** **BC**
10	**(b)**	**(ii)**	Distribution of masses in classes unknown	**B1** **[1]**	**3.2b**	Not just "Because midpoints used." Or "actual masses not known" or similar.

10	**(c)**		$57.7 - 2 \times 6.20$ = 45.3 or 45, hence 4 outliers	**M1** **A1ft** **[2]**	**2.1** **2.2a**	Attempting $\mu \pm 2\sigma$ Allow 4 outliers ft their values from (b)(i) but must be consistent Allow 'whole classes' or appropriate interpolation here (NB frequencies by class are: 4,10,20,22,20,30,14) Allow 14 from the sum of the first two classes (10+4)
10	**(d)**		Can obtain actual frequencies from histogram	**B1** **[1]**	**1.2**	or similar; eg pie chart only shows relative frequencies or "histogram has figures while pie chart shows a percentage" Acceptable answers must be specific to the question (finding actual frequencies to estimate mean/standard deviation) Not just "show spread of data" or "easier to read" or "easier to see distribution" etc.

Question			**Answer**	**Mark**	**AO**	**Guidance**
11	**(a)**		Need to find P($X \geq 50$)	**B1** **[1]**	**1.2**	OR $1 - \text{P}(X \leq 49)$ Condone just $X \geq 50$ Ignore all else (but do not accept just 'cumulative')
11	**(b)**		X~B(60, 0.75) and $X \geq 50$ P($X \geq 50$) = 0.0859 0.0859 > 0.05 Do not reject H_0 Insufficient evidence (at 5% level) that more than 75% have BR as favourite band	**M1** **A1** **A1ft** **M1** **A1** **[5]**	**3.3** **3.4** **1.1** **1.1** **2.2b**	Allow $X > 50$, $X \leq 50$, $X < 50$, $X = 50$ May be implied by P($X \geq 50$) = 0.0859 (or P($X > 50$) = 0.0452) **BC** (accept awrt 0.086 (2sf)) ft correct comparison of their value with 0.05 (OR 0.95 as appropriate – but must see the value being compared) Must be correct based on their value comparison Condone 'Accept H_0' or 'Reject H_1' In context, not definite Condone 'no evidence', 'not likely that' etc. From correct working only

11	**(c)**	**(i)**	B(60, 0.75)	**B1** **[1]**	**3.3**	OR Binomial, n=60, p=0.75 (must have all three)
11	**(c)**	**(ii)**	Yes. Whether a student's favourite is BR is not independent of other students.	**B1** **[1]**	**3.5b**	Must be in context or As students are chosen in turn, the probability changes Allow any of: • P(a chosen student's favourite is BR) is affected by previously chosen students • P(a student's favourite is BR) changes Do not accept: • "Risk of picking the same student again"

Question			Answer	Mark	AO	Guidance
12	(a)		**Fig 1**: Positive. **Fig 2**: Negative	**B1** **[1]**	**1.2**	Ignore all else
12	(b)		**Fig. 1**: 25-44s have children so proportion of 0-4 is directly related to proportion of 25-44. **Fig. 2**: High proportion of older people means lower proportion of families with young children	**B1** **B1** **[2]**	**2.4** **2.4**	oe e.g. "25-44s more likely to be parents" Must be in context so do not accept generic descriptions of the correlation. Oe e.g. ">60s less likely to live with young children" Must be in context so do not accept generic descriptions of the correlation. In both parts: - Need not refer to proportion but may not refer to amount (i.e. do not accept answers including references to 'amount' or 'number') - SC Max [1/2] for correct description in context but referencing 'amount' or 'number' or 'population' - Ignore irrelevant statements Condone 'children' as shorthand for the 0-4 age group in this question (and 'elderly' as shorthand for the >60 age group)
12	(c)		This LA has a similar number of >60s to many other LAs, but these represent by far the lowest proportion of its population. OR This LA has a large number of 0-4s, but its proportion of 0-4s is similar to several other LAs. (Hence must have large number in total.)	**B1** **[1]**	**2.4**	oe. Must make a correct connection between number and proportion and compare to other LAs to show that this is one of the largest Do not accept statements referring to 25-44 (from Fig. 1)

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