Oxford Cambridge and RSA

GCSE

Mathematics - Paper 6

J560/06: Paper 6 (Higher tier)

General Certificate of Secondary Education

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.

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 available in RM Assessor.

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

MARKING

4. Mark strictly to the mark scheme.

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

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

7. If you are in any doubt about applying the mark scheme, consult your Team Leader via the RM Assessor messaging system.

8. Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners should give candidates the benefit of the doubt and mark the crossed out response where legible.

9. When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

10. On each blank page the annotation **BP** must be inserted to confirm that the page has been checked. For additional objects (if present), a tick must be inserted on each page to confirm that it has been checked.

11. There is a NR (No Response) option. Award NR (No Response)
    - if there is nothing written at all in the answer space
    - 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) which is not an attempt at the question.

    The hash key (#) on your keyboard will enter NR.

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

12. The RM Assessor **comments box** is used by the Principal Examiner or your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

    If you have any questions or comments for your Team Leader, use the RM Assessor messaging system.

13. Assistant Examiners should send a brief report on the performance of candidates to their Team Leader (Supervisor) by the end of the marking period. Please follow the direction of your Team Leader about which questions you should report on and how to submit your report. Your report should contain notes on particular strengths displayed as well as common errors or weaknesses.

14. Annotations available in RM Assessor. These **must** be used whenever appropriate during your marking.

Annotation	Meaning
	Correct
	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed
M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1

B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign
BP	Blank page
SEEN	Seen

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.

Subject-Specific Marking Instructions

15. **M** marks are for using a correct method and are not lost for purely numerical errors.
A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for special cases that are worthy of some credit.

16. The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point e.g. 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
- **isw** means **ignore subsequent working** after correct answer obtained and applies as a default.
- **nfww** means **not from wrong working**.
- **oe** means **or equivalent**.
- **rot** means **rounded or truncated**.
- **soi** means **seen or implied**.
- **dep** means that the marks are **dependent** on the marks indicated. You must check that the candidate has met all the criteria specified for the mark to be awarded.
- **with correct working** means that full marks **must not** be awarded without some working. The required minimum amount of working will be defined in the guidance column and **SC** marks given for unsupported answers.

17. Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

18. Unless the command word requires that working is shown and the working required is stated in the mark scheme, then if the correct answer is clearly given and is not from wrong working **full marks** should be awarded.

    Do not award the marks if the answer was obtained from an incorrect method, i.e. incorrect working is seen and the correct answer clearly follows from it.

19. Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct. For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

    Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, e.g. FT 180 × (*their* '37' + 16), or FT 300 – √(*their* '52 + 72'). Answers to part questions which are being followed through are indicated by e.g. FT 3 × *their* (a).

20. In questions **with no final answer line**, make no deductions for wrong work after an acceptable answer (i.e. **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.

21. In questions **with a final answer line and incorrect answer given**:

(i) If the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.

(ii) If the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.

(iii) If the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded if there is no other method leading to the incorrect answer. Use the **M0**, **M1**, **M2** annotations as appropriate and place the annotation ✗ next to the wrong answer.

22. In questions **with a final answer line**:

(i) If one answer is provided on the answer line, mark the method that leads to that answer. A correct step, value or statement that is not part of the method that leads to the given answer should be awarded **M0** and/or **B0**.

(ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.

(iii) If more than one answer is provided on the answer line and there is more than one method provided, award marks for the poorer response unless the candidate has clearly indicated which method is to be marked.

23. In questions with **no final answer line**:

(i) If a single response is provided, mark as usual.

(ii) If more than one response is provided, award marks for the poorer response unless the candidate has clearly indicated which response is to be marked.

24. When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the **MR** annotation. **M** marks are not deducted for misreads. If a candidate corrects the misread in a later part, do not continue to follow through, but award **A** and **B** marks for the correct answer only.

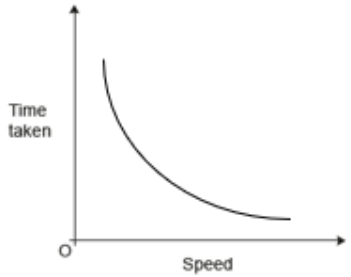
25. Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.

26. Ranges of answers given in the mark scheme are always inclusive.

27. For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.

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

Question			Answer	Marks	Part marks and guidance	
1			The [age] groups overlap oe	1		See appendix Mark the best part of a single statement provided no contradiction or incorrect statements If more than one criticism, mark the worst Allow describing one or more common values or giving correct scales
2	(a)		$u = [\pm]\sqrt{v^2 - 2as}$ as final answer	2	**M1** for [u^2 =] $v^2 - 2as$	Mark intent eg $u = \sqrt{v^2 - 2as}$ as 2bod but not $u = \sqrt{v^2} - 2as$
	(b)		3924 to 3924.3	3	**M2** for $\sqrt{8000^2 - 2 \times 90 \times 270000}$ or **M1** for $\sqrt{8000^2 - 2 \times 90 \times figs\ 27}$ or $8000^2 - 2 \times 90 \times 270000$ or $8000^2 = u^2 + 2 \times 90 \times 270000$ or for correct substitution seen of $v = 8000$, $a = 90$ and $s =$ figs 27 in *their* final answer to part (a) If **0** scored **SC1** for 7996 to 7997 as final answer	Condone 3920 as final answer for full marks, following **M2** For **SC1**, condone 8000 following 7996 to 7997.

Question			Answer	Marks	Part marks and guidance	
3	(a)		83 or 84	3	**M2** for $150 \times \frac{5}{9}$ oe implied by answer 83.3… or **M1** for $\frac{5}{9}$ or for $\frac{150}{9}$	Non calculator methods must be fully correct, see appendix, and would lead to 83.3 May be implied by 0.55 to 0.56 or 55% to 56% May be implied by 16.6 to 16.7
	(b)		$\frac{3}{5}$	2	**B1** for $\frac{12}{20}$ oe	For **B1** accept 0.6 or 60% or $\frac{12}{20} \times 150$
	(c)		[Ling has] more results [than Riley] oe	1		See appendix Accept he/they/she as reference to Ling May be inverse: [Riley has] fewer results [than Ling] oe Do not accept comments about more/less in the bag
4	(a)		Correct shape, not touching the axes  	2	Condone slight curvature away from axes at the extremes **B1** for correct curve but touching, not crossing, one or both axes	Ignore scales

Question			Answer	Marks	Part marks and guidance	
	(b)		100	2	**M1** for $\frac{40 \times 5}{2}$ oe or **B1** for 200 or 2.5 or 0.4	
5			Accurate ruled perpendicular bisector of AB with two correct pairs of supporting arcs	2	**B1** for accurate ruled bisector perpendicular bisector of AB with no or incorrect arcs	Use overlay as a guide Put ruler on screen to check 2 cm if needed Tolerance ±2 mm and ±2°. Line length at least 2 cm Bisector crosses between circles of overlay but does not cut them and perpendicular by eye
			Accurate ruled bisector of angle ABC with two correct pairs of supporting arcs	2	**B1** for accurate ruled bisector of angle ABC with no or incorrect arcs	Tolerance ±2°. Line length at least 2 cm Bisector between or on red lines of overlay arcs
			Correct position of boat clearly identified at point of intersection of two straight lines	1 dep	Dep on at least **B1** and **B1**	
6	(a)		[They should have] divided by 1.25 or multiplied by 0.8 oe or 2625 increased by 25% is 3281.25/not 3500	1		See appendix Mark the best part of the statement unless there is contradiction or an incorrect statement

Question			Answer	Marks	Part marks and guidance	
	(b)		3304	**4**	**M3** for 3500 ÷ 1.25 × 1.18 oe or **M2** for [k ×] 1.18 ÷ 1.25 soi by 0.944 or for 3500 ÷ 1.25 soi 2800 or for m × 1.18 where m is *their* value for 2020 or **M1** for 1.25 or 1.18 seen	For non-calculator methods see appendix May be 1.25 ÷ 1.18 soi 1.059... m can be 2625 (which gives 3097.5) May be implied by 1.475 NC 1.25 may be e.g. $k \div 4 + k$, k = a number
7	**(a)**		Correct substitution of (x, y) from integer point on curve into equation leading to $k = 3$ e.g. (2, 4) $4 = 2k – 2^2 + 2$ or $4 = 2k – 4 + 2$ leading to $k = 3$ with at least one correct intermediate step	**2**	**M1** for correct substitution of (x, y) from integer point on curve into $y = kx – x^2 + 2$ or $y = 3x – x^2 + 2$ OR **M1** for e.g. $x = 2$ correctly substituted in $y = 3x–x^2+2$ and finding $y = 4$ Max **M1** if $k = 3$ substituted	(-1, -2) : $-2 = -[1]k – (-1)^2 + 2$ (1, 4) : $4 = [1]k – 1^2 + 2$ (2, 4) : $4 = 2k – 2^2 + 2$ (3, 2): $2 = 3k – 3^2 + 2$ (4, -2): $-2 = 4k – 4^2 + 2$ Use of (0, 2) scores 0 but may be replaced with another point (ie do not treat as a choice) <u>Examples of intermediate steps</u> $4 = 2k – 2^2 + 2$ then $4 = 2k – 4 + 2$ is a sufficient int step or $4 = 2k – 2$ is a sufficient int step or $6 = 2k$ is a sufficient int step $3 = k$

Question			Answer	Marks	Part marks and guidance	
	(b)		0.4 and 2.6	2	**B1** for 0.4 or 2.6 or **M1** for line $y = 3$ drawn or for (0.4, 3) and (2.6, 3) indicated	Line to cut curve twice Treat $x = 3$ drawn or multiple horizontal lines as choice unless $y = 3$ clearly chosen Condone good freehand line eg circled or lines drawn down to x-axis

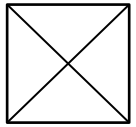
Question			Answer	Marks	Part marks and guidance	
8			2.1[0…] nfww	4	**M1** for $\frac{360}{60}$ oe soi by 6 AND **Method 1 using tan:** **M2** for [*h* =] 20 tan(*their* 6) oe or **M1** for correct use of tan(*their* 6) oe or **Method 2 using sine rule:** **M2** for [*h* =] $\frac{20\sin(their\ 6)}{\sin(90-their\ 6)}$ or **M1** for $\frac{\sin(their\ 6)}{h} = \frac{\sin(90-their\ 6)}{20}$ oe or **Method 3 using cos and Pythagoras:** **M2** for $\sqrt{(\frac{20}{\cos(their\ 6)})^2 - 20^2}$ or **M1** for $(\frac{20}{\cos(their\ 6)})^2 - 20^2$	May be on diagram In all methods, if their angle is not 6 then method must be seen, not implied by interim answers unless stated otherwise Accept any acute angle used for *their* 6 eg [*h* =] $\frac{20}{\tan(90-their\ 6)}$ eg tan(*their* 6) = $\frac{h}{20}$ NBs $\frac{\text{approx. circumference}}{60} = \frac{40\pi}{60}$ = 2.1 scores **0** 20sin6 = 2.1 scores **M1** for 6 Solution from scale drawing scores a maximum of **M1** if 6 seen

9			78	**4**	**Ratios:** **B3** for 32 : 48 and 30 : 48 identified or for 32 : 48 : 30 or **M2** for 16*k* : 24*k* and 15*k* : 24*k* or for 16*k* : 24*k* : 15*k* where *k* is a positive integer or for $\frac{2}{3}-\frac{5}{8}$ oe implied by $\frac{1}{24}$ or **M1** for 16*k* : 24*k* or 15*k* : 24*k* where *k* is a positive integer or for $\frac{2}{3}$ or $\frac{5}{8}$ or $\frac{2}{5}$ or $\frac{3}{5}$ or $\frac{5}{13}$ or $\frac{8}{13}$ or their reciprocals seen or used **Listing:** **M3** for multiples of 13 reaching at least 78 and multiples of 5 reaching at least 80 or for reaching 39 and 40 and then doubling or **M2** for listing multiples of 13 and 5 reaching at least 39 and 40 or **M1** for listing at least three multiples of 13 and 5 **Fractions and ratios:** **B3** for $\frac{32}{80}:\frac{48}{80}$ and $\frac{30}{78}:\frac{48}{78}$ identified or **M2** for $\frac{16}{40}:\frac{24}{40}$ and $\frac{15}{39}:\frac{24}{39}$ or **M1** for $\frac{16}{40}:\frac{24}{40}$ or $\frac{15}{39}:\frac{24}{39}$ **All methods:** If **0** scored **SC1** for answer 30, 32, 48 or 80	**Alternative methods using equations:** **M2** for correct unsimplified equation(s) to find original or new numbers of fiction, non-fiction or total **A1** for correct solution(s) of the equation(s), no FT or **M1** for one correct equation involving two variables eg using ***t* as new total** **M2**: $\frac{3}{5}(t+2)=\frac{8}{13}t$ oe $\frac{2}{5}(t+2)-\frac{5}{13}t=2$ oe should lead to [*t* =] 78, full marks eg using ***t* as old total** **M2**: $\frac{3}{5}t=\frac{8}{13}(t-2)$ oe $\frac{2}{5}t-\frac{5}{13}(t-2)=2$ oe **A1**: [*t* =] 80 eg using ***f* as new number of fiction**, *n* as number of non-fiction **M2**: 8*f* = 5*n* and 3(*f* + 2) = 2*n* **A1**: *f* = 30 and *n* = 48 eg **using *f* as old number of fiction**, *n* as number of non-fiction **M2**: 8(*f* – 2) = 5*n* and 3*f* = 2*n* **A1**: *f* = 32 and *n* = 48 eg **M**1: 8*f* = 5*n* or 3(*f* + 2) = 2*n* or 8(*f* – 2) = 5*n* or 3*f* = 2*n*

Question			Answer	Marks	Part marks and guidance	
10	(a)		Divisible by 5 or divisible by 19 or 95 ÷ 5 = 19 or 95 ÷ 19 = 5 or 5 × 19	1		Accept factor tree showing 95, 5 and 19 Accept 5 and 19 are factors of 95 Do not accept 5 and 19 are multiples of 95
	(b)	(i)	250	2	**B1** for 2 [×] 5^3	Venn diagram on its own scores 0 unless 2 and 5^3 selected
		(ii)	$2^{13} \times 5^{12}$	2	**M1** for $10^k = 2^k \times 5^k$ where k is a positive integer implied by final answer of the form $2^{k+1} \times 5^k$ or **SC1** for $2^{12} \times 5^{12}$	e.g. $10 = 2 \times 5$

Question			Answer	Marks	Part marks and guidance	
11			$\frac{A}{10} - 3$ or $\frac{1}{10}(A - 30)$ or $\frac{A-30}{10}$ with correct working or other simplified equivalents	5	**B4** for $\frac{A\text{cm}^2}{10} - 3$ etc with correct working OR The below assumes PQ = *x*. Mark similarly use of SR = *x*. **M2** for $10x + \frac{1}{2} \times 6 \times 10$ or $\frac{10(x+x+6)}{2}$ oe or for $10x$ and 30, may be indicated on diagram **A1** for [*A* =] $10x + 30$ or $10(x + 3)$ or **M1** for lengths *x* and *x* + 6 oe or for area $10x$ or area 30 AND **M1FT** for $10x = A - 30$ or $x + 3 = \frac{A}{10}$ If **0** or **1** scored, instead award **SC2** for $\frac{A}{10} - 3$ or $\frac{1}{10}(A - 30)$ or $\frac{A-30}{10}$ with no or insufficient working	'Correct working' requires evidence of at least **M2** Condone use of PQ, PQ + 6 etc instead of *x* and *x* + 6 Working may be on diagram For **M2** accept area *A* – 30 for area 10x For **A1** accept equivalents such as $\frac{A}{5} = 2x + 6$, $2A = 20x + 60$ For **M** and **A** marks, both lengths must be in terms of the same variable eg PQ and PQ + 6, not *x* and *y* unless *y* = *x* + 6 subsequently seen FT $ax + b = A$ or $a(x + b) = A$ ($a \neq \pm 1$ or 0, $b \neq 0$)
12	(a)		195 [≤ *n* ≤] 204	2	**B1** for 195 or 204 in correct position or for both 195 and 204 but in wrong position	Do not accept < 205 where ≤ has been crossed out and replaced

Question			Answer	Marks	Part marks and guidance	
	(b)		$\frac{247.5}{7.5 \times 5.5} = 6$	3	Max 2 marks if answer is incorrect **B1** for 247.5 **B1** for 7.5 and 5.5 **M1** for $\frac{their247.5}{their7.5 \times their5.5}$ where 247.5 ≤ *their*247.5 ≤ 248.5, 6.5 ≤ *their*7.5 ≤ 7.5 and 4.5 ≤ *their*5.5 ≤ 5.5	May be done in stages. 6 must not come from a rounded answer or other wrong working. If choice, mark the bounds used in the calculation. If no calculation, then 0 each time upper and lower bounds are both given 7.5 × 5.5 × 6 = 247.5 scores just the second mark. If they then explicitly state that 247.5 is the lower bound of 248 they also get the first mark but not for "247.5 rounds to 248"
13	(a)	(i)	32	3	**M1** for 18 ÷ 20 soi by 0.9 **M1** for 2*k* × 10 [+] 0.3*k* × 40 implied by 20 and 12 may be on diagram	May be soi on the vertical axis (eg. labelling the scale with [0.5,]1, [1.5, 2]. Where *k* is a consistent scaling of the height of the bars eg 4 × 10 [+] 0.6 × 40, 40 × 10 [+] 6 × 40 etc Ignore extras
		(ii)	Unlikely the largest value will be 80 oe or The longest distance could be anywhere between 40 and 80 oe or Unlikely the smallest value will be 0 oe or The shortest distance could be anywhere between 0 and 20 oe	1		Accept: Exact distances are not known The data is in groups

Question			Answer	Marks	Part marks and guidance	
	(b)		Median for July = 26 July distances were lower [on average] oe	**1** **1dep**	Condone mean or average for July = 26	See appendix Condone not repeating the given values for December Need figures in comment/work space Comparison comment must be general and have context for second and fourth marks Accept for first mark "median is 4 more in Dec" oe Accept for third mark "IQR is 16 less in Dec" oe
			IQR for July = 36 July distances were more varied oe	**1** **1dep**		
					If **0** scored overall **SC1** for two correct comparisons lacking values	eg **SC1** for "median for July was lower" and "IQR for July was higher" oe
14	**(a)**		 with side 5 cm	**2**	**B1** for a square drawn with side 5 cm or for a square of any length with two diagonals	Mark intention 2mm tolerance radially on centre point by eye

Question			Answer	Marks	Part marks and guidance	
	(b)		$\frac{200\sqrt{41}}{3}$ or 426.6 to 427 with correct working	5	**M3** for $\sqrt{14.5^2 - 10^2 - 10^2}$ oe or **M2** for $14.5^2 - 10^2 - 10^2$ oe or **M1** for $14.5^2 = 10^2 + 10^2 + h^2$ or for $10^2 + 10^2$ oe implied by 200 or for $\sqrt{10^2 + 10^2}$ oe implied by 14.1…or $10\sqrt{2}$ or for $20^2 + 20^2$ oe implied by 800 or for $\sqrt{20^2 + 20^2}$ oe implied by 28.2[8..], 28.3 …or $20\sqrt{2}$ AND **M1** for $\frac{1}{3} \times 20 \times 20 \times$ *their* 3.2[0] or for $\frac{1}{3} \times 400 \times$ *their* 3.2[0] If **0** or **1** scored, instead award **SC2** for $\frac{200\sqrt{41}}{3}$ or 426.6 to 427 with no or insufficient working If **0** scored, **SC1** for $\frac{\sqrt{41}}{2}$ or $\sqrt{10.25}$ or 3.2[0] to 3.211 with no or insufficient working	'Correct working' requires evidence of at least three **M** marks Working may be on diagram May be seen in stages Method must be seen for **M3** (3.2[0] to 3.211 or $\frac{\sqrt{41}}{2}$ or $\sqrt{10.25}$) (10.25) May be seen in stages For **M3** and **M2** condone $10\sqrt{2}^{\,2}$ for $(10\sqrt{2})^2$ which may lead to wrong answer for **M2** of 190.25 or for **M3** of 13.79… *Their* 3.2[0] must be in the range 3.2[0] to 3.211 and must come from an attempt at 3D trig or 3D Pythagoras

Question			Answer	Marks	Part marks and guidance	
15			55.5 to 55.6 nfww	4	**M3** for $35 \times \sqrt[3]{\frac{2}{0.5}}$ oe or $35 \div \sqrt[3]{\frac{0.5}{2}}$ oe or **M2** for $\sqrt[3]{\frac{2}{0.5}}$ oe soi by 1.58 to 1.59 or $\sqrt[3]{\frac{0.5}{2}}$ oe soi by 0.62 to 0.63 or $\frac{h^3}{35^3} = \frac{2}{0.5}$ oe or **M1** for $\frac{2}{0.5}$ oe soi by 4 or $\frac{0.5}{2}$ oe soi by $\frac{1}{4}$ If **0** scored then **SC1** for 140 as final answer	Accept 56 as final answer after **M3** May see as length ratio, eg **M2** for $\sqrt[3]{2}$: $\sqrt[3]{0.5}$ soi by 1.2599(…) to 1.26 : 0.7937(…) to 0.794 May see as volume ratio, eg. **M1** for 2 : 0.5 oe May also be seen as part of wrong approach eg. 35×4 scores **M1**
16	(a)		[0].9	1		
	(b)		49×1.009^{39} = 69.49… or 69.5[0]	2	**M1** for [49 ×] 1.009^{39}	Accept 69 after correct method

Question			Answer	Marks	Part marks and guidance	
17			1.316	4	**B3** for answer 1.3160 to 1.3161 OR **M3** for [r =] $\sqrt[4]{3}$ oe or **M2** for $r^4 = 3$ or **M1** for $r^6 = 3r^2$ <u>Trials or insufficient method:</u> **B4** for answer 1.316 or **B3** for answer 1.3160 to 1.3161 or **M2** for at least three correct trials of r^4 oe or of r^6 <u>and</u> $3r^2$ oe or **M1** for at least two correct trials of r^4 oe or of r^6 <u>and</u> $3r^2$ oe	eg **M3** for $\sqrt{3}$ = 1.73[2…] and $\sqrt{1.73[2\ldots]}$ Accept evaluations to 2sf rot Accept evaluations to 2sf rot
18	(a)		Circle Centre (0, 0) oe Radius $\sqrt{20}$ or $2\sqrt{5}$ or 4.47[2..] or 4.5	1 1 1		Accept circular graph Accept origin or O for (0, 0) but not turning point (0, 0) If their description uniquely defines the circle then award full marks eg After “circle” and “centre (0, 0)”, passes through one correct stated point, scores 3 “circle” and ($\pm\sqrt{20}$, 0) and (0, $\pm\sqrt{20}$), scores 3 “circle” and two correct stated points, scores 1

Question	Answer	Marks	Part marks and guidance	
(b)	(-2, 4) and (-4, -2) with correct working	6		'Correct working' requires evidence of at least **M1M1M1**
			M1 for $x^2 + (3x + 10)^2 = 20$	Award equivalent marks if working in terms of y
			M1 for expanding *their* square term e.g. $9x^2 + 30x + 30x + 100$	May be in a grid May be implied by subsequent working
			M1 for simplifying *their* quadratic equation e.g. $10x^2 + 60x + 100 = 20$ or better	*Their* quadratic must include an x term Simplified: $10x^2 + 60x + 80$ [= 0] or $x^2 + 6x + 8$ [= 0]
			M1 for correctly factorising *their* 3-term quadratic equation or for correct use of quadratic formula for *their* 3-term quadratic equation	e.g. $(x + 2)(x + 4)$, $(5x + 10)(2x + 8)$
			or for correct completing the square	e.g. reaching $d(x + e)^2 + f$
			A1 for one correct point or two correct x-values	
			If **0** or **1** scored, instead award **SC2** for 2 correct points with no or insufficient working	
			If **0** scored **SC1** for 1 correct point or 2 correct x-coordinates or 2 correct y-coordinates with no or insufficient working	

Question			Answer	Marks	Part marks and guidance	
19	(a)		$[\sqrt{11}\sqrt{22} =]$ $\sqrt{242} = \sqrt{121 \times 2}$ or $\sqrt{121} \times \sqrt{2}$ $[= 11\sqrt{2}]$ or $[\sqrt{11}\sqrt{22} =]$ $\sqrt{11} \times \sqrt{11}\sqrt{2}$ or $\sqrt{11} \times \sqrt{11 \times 2}$ or $\sqrt{11 \times 11 \times 2}$ $[= 11\sqrt{2}]$	1		
	(b)		$\dfrac{\sqrt{11}(13 - \sqrt{22})}{(13 + \sqrt{22})(13 - \sqrt{22})}$	M1	Condone missing bracket for this **M1** if recovered later in numerator or denominator	Multiplying by $\sqrt{22} - 13$ is eligible for **M1** and then FT but **A1** must be correct form Multiplying by 13 + $\sqrt{22}$ scores **0**
			$13\sqrt{11} - \sqrt{11}\sqrt{22}$ oe or better	M1	May be in a grid	Equivalents likely to be seen for $\sqrt{11}\sqrt{22}$ include $\sqrt{242}$ and $11\sqrt{2}$
			$169\ [+13\sqrt{22} - 13\sqrt{22}] - 22$	M1	May be in a grid	
			$\dfrac{13\sqrt{11} - 11\sqrt{2}}{147}$	A1	Dep on **M1M1M1** and no errors seen	An error is eg missing bracket in first **M1**

20	**(a)**		$2\left(x+\frac{3}{4}\right)^2-\frac{169}{8}$ as final answer with correct working	**5**		'Correct working' requires evidence of at least **M1** Accept decimal and mixed number equivalents throughout eg. $2(x + 0.75)^2 – 21.125$ $2\left(x+\frac{3}{4}\right)^2-21\frac{1}{8}$
					Method 1: **B3** for $2\left(x+\frac{3}{4}\right)^2$ in final answer with correct working or **M1** for $2x^2 – 5x + 8x – 20$ oe **M1** for $2\left(x^2+\frac{3}{2}x\right)$ [– 20] oe AND **M1** for [-*b* =] $-2\left(their\frac{3}{4}\right)^2$ – 20 soi by $-\frac{169}{8}$	May be in a grid
					Method 2: **B3** for $2\left(x+\frac{3}{4}\right)^2$ in final answer with correct working or **M1** for $2x^2 – 5x + 8x – 20$ oe or for $2(x^2 + ax + ax + a^2) – b$ oe **M1** for $4ax = 3x$ soi by [a =] $\frac{3}{4}$ AND **M1** for [-*b* =] $-2\left(their\frac{3}{4}\right)^2$ – 20 soi by $-\frac{169}{8}$	May be in a grid

Question	Answer	Marks	Part marks and guidance	
			Method 3: **B3** for $2\left(x+\frac{3}{4}\right)^2$ in final answer with correct working or **M1** for roots -4 and 2.5 **M1** for turning point at [x =] $\frac{-4+2.5}{2}$ soi by $-\frac{3}{4}$ AND **M1** for [-b =] $(2(their-\frac{3}{4})-5))((their-\frac{3}{4})+4)$ soi by $-\frac{169}{8}$ If no or insufficient working **SC2** for $2\left(x+\frac{3}{4}\right)^2-\frac{169}{8}$ or **SC1** for $2\left(x+\frac{3}{4}\right)^2$ [+k]	

Question			Answer	Marks	Part marks and guidance	
	(b)		Charlie with at least one bullet point and no incorrect statements: • The roots are ⁻4 and 2.5 • The turning point is at [x =] $-\frac{3}{4}$ oe and only one root is positive/negative • The turning point is at [x =] $-\frac{3}{4}$ oe and y-intercept is ⁻20 or negative	**2**	**B1** for Charlie with one bullet point and no incorrect statements: • Turning point is at [x =] $-\frac{3}{4}$ oe • y-intercept is ⁻20 or negative or **SC1** for any of the following with no incorrect statements: Dev and y-intercept is ⁻20 or negative or Eve and turning point is at [x =] $-\frac{3}{4}$ oe or A person linked correctly to a FT turning point from (a)	Turning point position may **FT** from **(a)**

Non Calculator methods for percentages.

Labels only

This is when labels such as 10% = are used.

If only labels are used the final answer scores full marks if it is correct.
Condone a numerical slip if the answer is correct.
If there is an error in the values and so the **final answer is incorrect** this cannot score method marks
e.g. Find 65% of 60

Method scoring M1A1

10% = 6
5% = 3
50% = 30
65% = 39 ✓ M1A1

10% = 6
5% = 4 ✖ condone this slip as answer correct
50% = 30
65% = 39 ✓ M1A1

Method scoring M0A0

10% = 6
5% = 4 ✖ M0 Do not condone this slip as answer incorrect
50% = 30
65% = 40 ✖

Build up method

This is where the candidate finds the percentages to build up to the required value but shows the operations used.

e.g. Find 65% of 60
10% = 60 ÷ 10 = x
5% = $x \div 2 = y$
50% = $x \times 5 = z$
65% = $x + z + y$
Because the operations have been shown and they are correct, if there is an error in one of x, y or z, method marks can still be earned

Q1

Appendix

It has overlapping numbers.		1
Some numbers appear twice.		1
Should be 0-5, 6-10 etc.	or 0 – 4 then 5 – 9 etc	1
Should be 0≤ h< 5, 5 ≤ h< 10 etc	Condone 0< h≤ 5, 5<h≤ 10 etc	1
The labels for the bars overlap		1bod
10 is in both sets	Repeated value	1
the age is confusing because there's 2 bars that 10 can go into	Repeated value	1
The age section of the graph use the previous number in each bar.	Repeated value	1
he uses the same age twice	Accept BOD to mean value repeated in two groups	1
he doesn't need to put the same number that was at the end in the beginning	BOD repeated value	1
Some people could claim to be in two different bar charts (5, 10, 15)	BOD inclusion of charts and intention 5 – 10 and 10 - 15	1
Should be 0≤ h≤ 5, 5 ≤ h≤10 etc	This does not resolve the issue of overlapping values	0
it didn't have to go up in two's as the number of people attending were all odd	False	0
you should not go if your 0 – 5 as it is very young to go to a youth club	Irrelevant	0
the bars aren't all the same width	They are	0
The age gaps are too big	No criticism of the end points of the scale	0
There are gaps between the bars		0
Age doesn't start at 0.		0
The categories could be more specific/are not accurate.		0
Some young people are older than 20.		0
Age is not a linear scale		0

Question 3c

Appendix

Ling chose more counters		1
There is more counters	BOD as does not say “in the bag” and could mean “in the sample”	1 bod
Lin picked more times		1
Ling took more samples		1
Ling took a larger sample	Could mention numbers such as “more than 9”	1
She has more in the tally	BOD	1
Ling did it 20 times and Riley did it 9 times	BOD a comparison (would be better if “only” included)	1
There are more counters in the bag	This is untrue	0
Ling did it multiple times	Not a comparison (we have to do the comparing)	0
Ling did it 20 times	Not a comparison (we have to do the comparing)	0

Question 6a

Appendix

He needs the multiplier by 0.8	As this is described as a multiplier it is assumed that $\times$ 0.8 is the correct operation and equivalent to $\div$ 1.25	1
3500 $\div$ 1.25 oe = 2800	Award the mark for [ ] $\div$ 1.25 oe	1
He should have reduced 3500 by 20%	Equivalent to $\times$ 0.8	1
It should be 2800	Does not show the calculation	0
Because it is 25% more of 2020 not 25% less of 2022	“It” is vague. They appear to be saying that the distance in 2022 is 25% more than that in 2020 (repeats line 3 of question) but then does not comment on Kai’s error	0
3500 is equal to 125% not 100%	Does not explain the error	0
Because in 2022 the distance drove is 125% of the distance in 2020, so 0.75 would be inaccurate	First line does not comment on Kai’s error Second line is incorrect (Comments on accuracy are insufficient)	0
Because they do 2022 is 125% of 2020 so they would have to get rid of 25% by the actual number	And to get rid of 25% they would multiply by 0.75 as Kai has done	0
You would need to divide it by 1.25 to get a 25% decrease	Contradiction; first is correct, second is wrong	0
x 0.75 is a 25% reduction	True but does not explain the error	0
Does not reverse the percentage	It is unclear what is meant	0
He needs the multiplier to be 1.25	Does not say how this is to be used	0
Because that would be 25% of 3500 which is 125% so that wouldn’t be the same as 25% of 100%	Does not say divide by 1.25	0
He took 25% of the wrong amount	Does not say divide by 1.25	0

Question 13b

Appendix

The median in Dec is 30 compared to July 26. This means on average people ran further in December. The IQR in Dec is 20 compared to July 36. This means the distances run were more variable in July.	Value. Compare the meaning of “on average” with “average” in the ninth example. We want a general interpretation in context. Value. Interpretation in context.	1 1 1 1
The median in Dec is 30 compared to July 26. This means the distances run in December were greater. The IQR in Dec is 20 compared to July 36. More people tended to run similar distances in December.	Value. A general interpretation in context. Value. Interpretation in context.	1 1 1 1
In July the runners on average ran shorter distances at 26km, while in December they ran further at 30km. In July the runners had a much larger IQR of distances at 36km, while in December they had a smaller IQR.	Value. Comparison in context. “on average” is a general comparison, which is what is looked for. Value. IQR not interpreted as a measure of variation.	1 1 1 0
December has a higher median distance run (26km < 30km). December has a smaller IQR compared to July (20km < 36km). This means December has a smaller spread of distances compared to July.	Value. Not an interpretation. Value. Interpretation in context.	1 0 1 1
The mean in July is 26. The range in July is 36.	Condone mean for value mark. Condone range for value mark.	1 0 1 0
The mean in July is 26. The IQR in July is 36. This means there is a bigger range of distances in July.	Condone mean for value mark. Not accepting “range” in the interpretation as it also has a technical meaning.	1 0 1 0
The median distance run in July was 26 compared to 30 in December The IQR in July is 36 compared to 20 in December	Value. Not an interpretation. Value. Not an interpretation.	1 0 1 0
The median distance in December was 4km more than in July. The IQR is 16km higher in July than in December.	Implies July is 26km. Not an interpretation. Implies July is 36km. Not an interpretation.	1 0 1 0
The median distance run in Dec is 30km compared to July 26km. This means their average is more than July. The IQR for December is less than July so it’s more consistent.	Value. ”average” being used as another word for “median” rather than as a general descriptor. No value. No context; dependent on the previous mark in any case.	1 0 0 0
There was a higher average of km in December. More spread out results in July.	No values. Comparison marks are dependent on value marks. However, they have two correct comparisons lacking values and context.	SC1
December had a higher median meaning people were running further. July had a larger average compared to December.	No value. Correct comparison in context but mark is dependent on value mark. The second statement contradicts the first and is not about IQR. Therefore, SC1 cannot be awarded.	0 0 0 0
The distance run in July was more than the distance run in December. More people run further in July than December.	No value. Incorrect and dependent on value in any case. Not about IQR.	0 0 0 0

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