OCR
Oxford Cambridge and RSA

# Higher

## GCSE

## Mathematics - Paper 5

### J560/05: Paper 5 (Higher tier)

General Certificate of Secondary Education

## Mark Scheme for June 2022

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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 then mark and annotate the **required number** of practice responses ("scripts") and the **required number** of 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% 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 via the RM Assessor messaging system.

5. 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.

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

7. 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.

8. 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).

9. 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.

10. 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.

11. 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**

12. **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.

13. 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.

14. 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.

15. 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.

16. 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).

17. 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'.

18. 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.

19. 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.

20. 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.

21. 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.

22. 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.

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

24. 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.

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

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 1 | (a) | | Two correct different observations from these three categories<br>**No values shown**<br>e.g. Pie chart only shows proportions not totals<br><br>**3D aspect**<br>e.g. 3D distorts perspective oe<br><br>**Colours/key unclear**<br>e.g. The colour/key are too similar oe | 2 | **B1** for one correct observation | e.g. We have no total/numbers/figures/frequency<br><br>e.g. It's tilted, slanted, seen from an angle etc<br><br>Where more than two reasons are given, mark the best unless contradicted e.g. ignore all references to missing angles<br>Do not allow 2 marks for two reasons that refer to the same category<br>Two reasons may appear in the same statement<br>e.g. Its slanted and it does not show the total number [gets 2 marks]<br>See Appendix |
| 1 | (b) | | 75 | 4 | **B1** for 0.8 and 1.4 **or** 3 [rows] and 4 [rows] oe<br><br>AND<br>**M2** for $\frac{their\ 1.4 - their\ 0.8}{their\ 0.8}$ or $\frac{their\ 1.4 - their\ 0.8}{their\ 0.8} \times 100$<br><br>or for $\frac{their\ 1.4}{their\ 0.8} \times 100$ [ –100] oe<br><br>or **M1** for $\frac{their\ 1.4}{their\ 0.8}$ | Accept work in billions for B and M marks i.e 800 000 000 and 1 400 000 000<br><br>M2 soi by 0.75 or 175<br><br>M1 soi by 1.75 |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 2 | | | Answer in range 11.8 to 14.2 | 4dep | **Dep on B1B1**<br>**B1** for bearing of 072˚<br>**B1** for bearing of 116˚<br><br>**M1dep** for 2 × *their* JT ±0.1cm soi | Use overlay as a guide, bearings must be inside or on the boundary lines – they can be short lines. If no lines then T labelled can imply the bearings<br><br>**Dep** on T marked oe e.g. with cross etc or on 2 intersecting lines<br>Use ruler to measure JT<br>(Do not allow JK measured if no T) |
| 3 | (a) | | Correct comment about large numbers or too many zeros oe | 1 | | e.g.<br>Standard form is used for [very] large/long numbers [or very small numbers]<br>Writing out all the zeros may lead to errors<br>See Appendix |
| 3 | (b) | | $1.7 \times 10^8$ | 3 | **M2** for figs 17 in final answer<br>or<br>**B1** for 240 000 000 or 70 000 000 or $24 \times 10^7$ or $0.7 \times 10^8$<br><br>or **M1** for $2.4 \times 10^8 - 7 \times 10^7$ oe | <br><br><br>Accept both converted to same power of 10 e.g. $240 \times 10^6$ and $70 \times 10^6$<br><br>For M1, if standard form subtraction written correctly, isw incorrect conversion to values |
| 4 | (a) | | 4 | 1 | | |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 4 | (b) | | 28 | 2 | **B1** for answer that is a multiple of 7 (not 7 or 14) but not a multiple of 49 and is less than 784<br><br>or $n \times 7$ seen leading to the answer | 28 scores 2 marks from any method<br>Allow B1 for a correct equivalent to 28 of form $a\sqrt{b}$ ($a \neq 1$) e.g. $7\sqrt{16}$, $4\sqrt{49}$, $2\sqrt{196}$<br><br>$n = 2^k$ where $k$ is an integer > 1 |
| 5 | | | 4 | 3 | **M2** for 3 : 12 oe or for $3 \div \frac{3}{4}$ oe seen<br>or **M1** for $\frac{3}{4}$ : 3 oe ratio seen<br><br>**<u>Alternative method in tablespoons:</u>**<br>**M2** for $\frac{1}{4}$ : 1 oe seen<br>or **M1** for $\frac{3}{4} \times \frac{1}{3}$ [: 1] oe seen | For M1 e.g. 0.75 : 3<br><br>M2 for e.g. 1 : 4 oe<br>If in decimal form allow 0.33 for $\frac{1}{3}$ |
| 6 | (a) | | [0].12 oe | 2 | **M1** for 1 – (0.08 + 0.42 + 0.38) oe | Accept e.g. 12%, 12/100 oe<br><br>M1 implied by 1 – 0.88 |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 6 | (b) | | 154 [points] | | **B3** for 154 or 118 + 3 × *their* 0.12 × 100 correctly evaluated<br>or | |
| | | | **and** | **4FT** | **M2** for [0.08 × 0 × 100 + ] ([1 × ]0.42 × 100) + (2 × 0.38 ×100) + (3 × *their* 0.12 × 100) or better<br>or | **M2** for full method implied by 42 + 76 + 36 or 1.54 × 100 |
| | | | | | **M1** for 2 × 0.38 **and** 3 × *their* 0.12<br>**or** for one of ([1×]0.42 × 100), (2 × 0.38 × 100), (3 × *their* 0.12 × 100) | **M1** implied by [0].76 and [0].36 or 1.54 or one of 42, 76, 36 |
| | | | No/Morgan is not correct oe | | **FT dep** on B3 for correct conclusion from *their* 0.12 | For conclusion accept e.g.<br>154 and No,<br>154 < 160<br><br>If FT from e.g. 0.22 in (a) then 184 and yes gets 4FT |
| 7 | (a) | | $s$ = 230 with 4, 3 and 10 or 100 seen | 4 | **B2** for 4, 3 and 10 or 100<br>or **B1** for two correct<br><br>AND | For all marks condone e.g. 3.00, 4.0, 10.0 used<br>These values may be written in the stem of the question |
| | | | | | **M1** for (3 × 10) + ½(4 × $10^2$) or correct substitution of unrounded or incorrectly rounded values<br><br>If **0** scored then **SC1** for sight of 230 | For M1 e.g. allow a mixture (2.93 × 10.1) + ½(4.1 × $10^2$) |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 7 | (b) | | $t = [\pm]\sqrt{\frac{2s}{a}}$ oe final answer | 3 | | Square root must dip below fraction line in final answer unless $\left(\frac{2s}{a}\right)$ bracketed<br>For 3 marks oe e.g. $t = [\pm]\sqrt{\frac{2\times s}{a}}$, $t = \sqrt{\frac{s}{\frac{1}{2}a}}$ |
| | | | | | **M2** for first two steps correctly completed e.g. $\frac{2s}{a} = t^2$<br>or answer $[\pm]\sqrt{\frac{2s}{a}}$ (no $t =$ ) | **M2** for e.g. $\frac{s}{\frac{a}{2}} = t^2$, $\frac{s}{\frac{1}{2}a} = t^2$, $\frac{s}{0.5a} = t^2$ |
| | | | | | or **M1** for first step correctly completed e.g. $2s = at^2$ or $\frac{s}{a} = \frac{1}{2}t^2$ | Allow **M1** for $\frac{s}{0.5} = at^2$ oe |
| | | | | | If **0** scored, **SC1** for final answer<br>$t = [\pm]\sqrt{\frac{\frac{1}{2}s}{a}}$ oe | oe for **SC1** e.g. $t = [\pm]\sqrt{\frac{s}{2a}}$ |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 8 | | | 60 with correct working | 5 | | "correct working" requires at least **M2** |
| | | | | | **M4** for 36 × $\frac{5}{3}$ oe or 9 × $\frac{20}{3}$ oe or 27 × $\frac{20}{9}$ oe or 24 × $\frac{5}{2}$ oe | M4 for any fully correct method |
| | | | | | or **M3** for $\frac{2}{5}+\frac{9}{n}+\frac{3\times9}{n}$ [= 1] oe or $\frac{3}{5}=\frac{9+3\times9}{n}$ oe or $\frac{1}{4}$ of $\frac{3}{5}=\frac{9}{n}$ oe or $\frac{3}{4}$ of $\frac{3}{5}=\frac{3\times9}{n}$ oe | e.g. For M3 accept e.g. $\frac{3}{5}$ = 36, $\frac{3}{20}=9$, $\frac{9}{20}$ = 27 or $\frac{2}{5}=24$ oe, $x=\frac{3}{20}$ oe ( where $x$ is probability of Y) |
| | | | | | or **M2** for $\frac{3\times9}{n}+\frac{9}{n}$ oe | M2 for $3x + x = \frac{3}{5}$ oe (from $x$ = P(Y)) |
| | | | | | or **M1** for $\frac{3\times9}{n}$ oe | |
| | | | | | **OR** | |
| | | | | | **M2** for [no. of B + Y =] 9 + 3 × 9 oe<br>or **M1** for [no. of B =] 3 × 9 oe<br>**B2** for no. of red = 24<br>or **M1** for ratio of R : B + Y = 2 : 3 oe | M2 implied by [no. B + Y =] 9 + 27 or 36<br>M1 for e.g. R = $\frac{2}{5}$, B + Y = $\frac{3}{5}$ |
| | | | | | **OR** | |
| | | | | | **M2** for [no. of B + Y =] 9 + 3 × 9 oe<br>or **M1** for [no. of B = ] 3 × 9 oe<br>**M1** $\frac{3}{5}[n]$ is 9 + 3 × 9 oe<br>**A1** $\frac{1}{5}[n]$ is 12 oe | M2 implied by [no. B + Y =] 9 + 27 or 36<br>May work in equivalent decimals or percentages eg 60% is 36, 20% is 12 |
| | | | | | If 0 or **M1** scored, instead award **SC2** for answer 60 with no or insufficient working.<br>If 0 scored, **SC1** for $\frac{1}{5}[n]$ oe is 12 with no working. | |

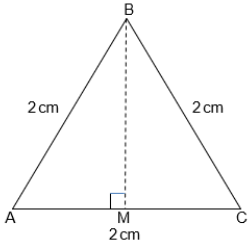
| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 9 | | | | | | Use overlay as a guide, bisectors should lie within or on the lines |
| | | | Accurate ruled angle bisector with two pairs of supporting arcs isw | **B2** | **B1** for accurate angle bisector at least 2 cm long with no/incorrect arcs isw | For **B2** allow use of the arc around A as one pair – at least 2 cm long for B2<br>Tolerance ±2˚ |
| | | | Accurate ruled perpendicular bisector with two correct pairs of intersecting arcs isw | **B2** | **B1** for accurate perpendicular bisector at least 2 cm long with no/incorrect arcs isw | Tolerance ±2° and ±2 mm<br>At least 2 cm long for B2 but must remain in tolerance if extended within shape for B1 and B2 |
| | | | 2 correct regions shaded/clearly indicated with no extras | **B2 dep** | Dep on at least **B1B1**<br>**B1dep** for 1 correct region with no extras or 2 correct regions and one extra | **B1dep** on B1 for angle bisector for region bounded by angle bisector<br>or dep on **B1B1** for region bounded by both bisectors and arc<br><br>See Appendix for solution |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 10 | (a) | | Triangle drawn with vertices at (1, 0), (1, 6), (4, 6) | 3 | **B2** for scale factor 1.5 but wrong centre or for correct centre but wrong scale factor or for 3 correct plots but no triangle drawn<br><br>OR<br><br>**B1** for 2 vertices correct | Condone freehand mark intention<br>e.g. B2 for a translation of the correct image<br><br>For B2 and B1 image must fit entirely on grid |
| 10 | (b) | | Rotation<br><br>180<br><br>(1, 3) | 2<br><br>1<br><br>1 | or **B1** for triangle or vertices at (2, 2), (4, 2), (4, 6) | Not turn, **must be** rotate or rotation<br><br>**Accept:**<br>Enlargement **2**<br>[Scale factor =] $^{-}1$ **1**<br>[Centre] (1, 3) **1**<br><br>Condone 1, 3<br>Allow as answer [full and part marks]<br>Rotation, 180, (1, 3)<br>followed by/and reflection in *x*-axis<br>(repeat of info in question)<br><br>**but in other cases**<br>If more than one other transformation given then B1 maximum if the triangle drawn on the grid<br>e.g. Rotation 180 then move 1 across, up 2 is two transformations<br>Extra properties treat as choice |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 11 | | | 0.36 oe final answer | 3 | **B1** for $y = \frac{k}{x^2}$ oe soi by $9 = \frac{k}{2^2}$ or $k$ =36<br>**M1** for $y = \frac{their\ k}{10^2}$<br>OR<br>**M2** for $2^2 \times 9 = 10^2 \times y$ oe | oe e.g. for 3 marks $\frac{36}{100}$ oe |
| 12 | (a) | | 0 | 1 | | |
| 12 | (b) | | 3 with correct working | 5 | **M3** for method for three areas correct or for 3600 **or** 800 and 2400 and 400 nfww<br><br>or **M2** for method for two areas correct (method towards two from 800, 2400, 400)<br><br>or **M1** for method for one area correct (method towards 800 or 2400 or 400) or for 2400 seen<br><br>AND<br><br>**M1dep** for *their* 3600 ÷ 1200, dep on at least M2<br><br>If 0 or 1 scored instead award **SC2** for 3 with no or insufficient working but not from wrong working | "correct working" requires at least M3<br><br>Treat as three separate areas, so trapezium from 0 to 1200 is three areas, trapezium from 0 to 1000 is 2 areas, trapezium from 400 to 1200 is 2 areas.<br><br>For M marks, mark method not accuracy, so M1 for $\frac{400 \times 4}{2}$ even if not evaluated as 800. |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 13 | (a) | (i) | 5 | 1 | | |
| 13 | (a) | (ii) | At $x = 0$ oe<br>**and**<br>$y < 0$ or $y$ is negative or $y = -2$<br>or curve is below $x$-axis<br>and at $x = 1$ , $y$ is positive or $y > 0$ or $y = 5$ or curve is above the $x$ - axis<br>**and**<br>change of sign oe<br>[between $x = 0$ and $x = 1$]<br>or the curve crosses the $x$-axis between 0 and 1<br>or solution/q lies between 0 and 1 | 1<br><br>1dep | If $y$ value evaluated then must be correct for 2 marks or 1 mark<br><br>Dep on first mark<br><br>If **0** scored, **SC1** for change of sign oe or the curve crosses the $x$-axis between 0 and 1 oe | For 2 marks needs to refer<br><u>$x = 0$ negative oe</u> and <u>$x = 1$ positive oe and change of sign/graph crosses axis/solution between 0 and 1 oe</u><br>e.g.<br>For 2 marks<br>At $x = 0$ the curve is below the $x$–axis, at $x = 1$ the curve is above the $x$–axis so there is a change of sign<br><br>See Appendix |
| 13 | (a) | (iii) | Correct response concerning accuracy/time taken/refer to specific more efficient methods<br>e.g.<br>Iteration gives an estimate oe<br><br>Iteration can be a lengthy process oe [to get an accurate result] | 1 | | e.g. The quadratic formula/complete the square is quicker/more accurate/easier<br>Trial and improvement is less efficient/takes too long<br>You can always go to more decimal places<br>It will not give an exact/accurate answer<br>It will take many iterations<br>There are two solutions, iteration is used to find one at a time<br>Mark the best if more than one answer given<br><br>Do not accept incorrect statement<br>e.g. It would be quicker/easier to factorise the equation |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 13 | (b) | | $^-3 + \sqrt{11}$ final answer | 3 | **B2** for answer $p + \sqrt{11}$<br>or **M1** for [$\sqrt{44}$ =] $2\sqrt{11}$ seen or $\frac{\sqrt{44}}{\sqrt{4}}$ seen<br><br>**B1** for answer $^-3 + \sqrt{k}$ | $p \neq 0$<br><br>$k > 0$ but not 44 |
| 14 | (a) | | 59 | 4 | **B3** for $x = 17$<br>or<br>**M2** for $2(x + 28) = 5(x + 1)$ oe or better or for 45 : 18 seen<br><br>or<br>**M1** $(x + 28)$ **and** $(x + 1)$ seen or better | For M2 accept [P =] 45 and [R =] 18 (An answer of 76 may indicate this but check working for 45 and 18)<br><br>For M1, could appear as $\frac{5}{x+28}$ $\frac{2}{x+1}$ or e.g. $5y = 28 + x$ and $2y = x + 1$ |
| 14 | (b) | | $\frac{28}{45}$ oe | 2FT | **B2FT** for $\frac{28}{their(a)-14}$ dep on 0 < answer < 1<br><br>or **B1** for numerator 28<br>or for denominator 45 or *their* (a) – 14 | isw cancelling/conversion<br>For FT - if fraction is simplified or given as a decimal check for equivalents for B2FT or B1<br><br>**B1** must be part of a proper fraction<br>$0 < P < 1$ |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 15 | | | Correctly shows tan 30° = $\frac{1}{\sqrt{3}}$ with supporting working<br>  <br> | 4 | Using triangle MBC (mark similarly for use of triangle MBA):<br>**B1** for MBC = 30° or MC = 1 [cm] soi by use in Pythagoras<br>**M2** for [BM =] $\sqrt{2^2 - 1^{[2]}}$ or $\sqrt{4-1}$ [= $\sqrt{3}$ ] or for [BM² =] $2^2 - 1^{[2]}$ oe and $\sqrt{3}$<br>or **M1** for BM² + 1[2] = 2² oe<br>OR<br>**B1** for MCB = 60° or MC = 1 [cm] soi by use in cos rule<br>**M2** for $\sqrt{2^2 + 1^{[2]} - 2 \times 2 \times 1 \times \cos 60}$ **and** cos 60 = $\frac{1}{2}$ soi [= $\sqrt{3}$ ]<br>or **M1** for $2^2 + 1^{[2]} - 2 \times 2 \times 1 \times \cos 60$<br>OR<br>**B1** for MCB = 60° soi by use in sine ratio or sine rule<br>**M2** for [$x$ = ] 2sin 60 oe **and** sin 60 = $\frac{\sqrt{3}}{2}$ soi [= $\sqrt{3}$ ]<br>or **M1** for $\frac{\sin 60}{x} = \frac{\sin 90}{2}$ oe<br>**AND**<br>**A1dep** for MBC = 30° stated/on diagram and tan 30° = $\frac{1}{\sqrt{3}}$ and with no errors seen leading to the answer | If 0 or 1 scored,<br>**SC2** for $\frac{\sin 30}{\cos 30} = \frac{\frac{1}{2}}{\frac{\sqrt{3}}{2}}$ and tan 30 = $\frac{1}{\sqrt{3}}$<br>May be on diagram<br>For M2 must show the subtraction, do not allow BM² + 1[2] = 2² and then $\sqrt{3}$ , this gets M1 only<br>M2 accept [$x$ = ] $\frac{2\sin 60}{\sin 90}$ **and** sin 60 = $\frac{\sqrt{3}}{2}$<br>**Dep** on **B1M2**<br>A0 for tan = $\frac{1}{\sqrt{3}}$ (without the 30) |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 16 | | | $\frac{4}{11}$ final answer<br>with correct working | 5 | | "Correct working" requires $\frac{6}{9}$ oe fraction seen and $\frac{54}{99}$ oe fraction seen<br>or B1 and B2 if alt method |
| | | | | | **B4** for $\frac{324}{891}$ oe with correct working<br>isw cancelling | e.g. $\frac{36}{99}$ with correct working gets B4 |
| | | | | | or<br>**B1** for $[0.\dot{6} =]\ \frac{6}{9}$ oe fraction | |
| | | | | | **B2** for $\frac{54}{99}$ oe fraction | |
| | | | | | or **M1** for $[100n =]$ 54.54… oe or better | oe any correct method for conversion |
| | | | | | **Alternative method:**<br>**B4** for $\frac{324}{891}$ oe with correct working | e.g. $\frac{36}{99}$ with correct working gets B4 |
| | | | | | or<br>**B1** for $[0.\dot{6} =]\ \frac{6}{9}$ oe fraction | |
| | | | | | **B2** for $[100n =]$ 36.36… or better | |
| | | | | | or **M1** for $[\frac{2}{3} \times\ 0.\dot{5}\dot{4} =]\ 0.\dot{3}\dot{6}$ | |
| | | | | | If 0, 1 or 2 scored, instead award **SC3** for $\frac{4}{11}$ with no or insufficient working<br>If 0 or 1 scored, instead award **SC2** for answer $\frac{324}{891}$ oe with no or insufficient working | |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 17 | | | 3 frames with correct working | 6 | **Algebraic method:**<br>**B5** for [one frame =] 52 [cm] with $x = 10$ and $2x^2 - 12x - 80$ [= 0] or better<br>or<br>**M3** for $2x^2 - 12x - 80$ [= 0] or better<br>**A1** for [$x$ =] 10<br>or<br>**M2** for $(2x - 4)(x - 4)$ [= 96] oe or better seen<br>or<br>**B1** for $2x - 4$ or $x - 4$ seen<br><br>OR<br><br>**Trial and improvement:**<br>**B5** for [one frame =] 52 [cm] with $x = 10$ and 16 by 6 [= 96] shown<br>or<br>**B4** for $x = 10$ and 16 by 6 [= 96] selected<br>or<br>**B3** for **selects** 6 by 16 [= 96]<br><br>If 0, 1 or 2 scored, instead award **SC3** for [one frame =] 52 [cm] with no or insufficient working<br>If 0 or 1 scored, instead award **SC2** for $x = 10$ with no or insufficient working | "Correct working" requires B5<br><br>For **B5** and **M3A1** isw for use of $x = {}^{-}4$<br><br>For B5 or M3 allow equivalent 3 term quadratic e.g. $2x^2 - 12x = 80$<br><br>Allow equivalents for M2<br>e.g. $2 \times 2 \times 2x + 2 \times 2(x - 4) + 96 = 2x^2$<br><br>May be on diagram<br><br>B3 not just for seeing 6 by 16 it must be selected in some way e.g. ringed, underlined, used |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 18 | | | $\frac{5\pi r}{6}$ with correct working | 5 | **B4** for correct unsimplified answer with correct working<br><br>OR<br>**M1** for $\frac{60}{360}$ ×[2×] $\pi k$ oe<br><br>**A1** for $\frac{60}{360}$ × $2\pi r$ oe or better isw incorrect cancelling/simplification<br><br>AND<br><br>**M1** for $\frac{60}{360}$ × [2×] $\pi\frac{3k}{2}$<br><br>**A1** for $\frac{60}{360}$ × $\pi 3r$ oe or better isw incorrect cancelling/simplification<br><br>If 0 or 1 scored, instead award **SC2** for final answer $\frac{5\pi r}{6}$ oe simplified answer with no or insufficient working | Condone '×' sign oe in simplified answer if otherwise correct e.g. $\frac{5}{6} \times \pi r$<br>"correct working" requires **M1A1M1A1**<br>Condone *R* for *r* throughout<br>For method marks, allow use of 3.14, 3.142, 22/7 for $\pi$<br><br>Where *k* is numeric or algebraic **but does not** come from squaring<br>Allow e.g. *k* = 2, *r*, *d*, 0.4 , 0.4*x*<br><br>For A1 accept e.g. 0.333 $\pi r$<br>Correct expression implies M1A1<br><br>For M1 must use *their* previous *k*<br>e.g. uses *k* = 10 for first M1 then uses 15 here for $\frac{3k}{2}$ gets 2nd M1<br>**unless** the expression is correctly stated as $\frac{60}{360}$ × $\pi 3r$ oe which gets M1A1<br><br>Correct expression implies M1A1 |

| Question | | | Answer | Marks | Part marks and guidance | |
|---|---|---|---|---|---|---|
| 19 | (a) | | $([-]12)^2 + 5^2$ | 1 | Accept equivalent reasoning<br>e.g. For first mark $13^2 - ([-]12)^2$ | If $-12^2 + 5^2$ do not allow first mark |
| | | | $144 + 25 = 169$<br>or $\sqrt{144+25} = 13$ and $\sqrt{169} = 13$ | 1 | e.g. For second mark $169 - 144 = 25$<br>$\sqrt{25} = 5$ | If $\sqrt{169}$ evaluated then it must be 13<br>For 2 marks there must be no errors leading to the answer |
| 19 | (b) | | $y = \frac{12}{5}x + \frac{169}{5}$ final answer | 5 | **B4** for answer $\frac{12}{5}x + \frac{169}{5}$ oe (no $y =$ )<br>or correct 3 – term answer in different form<br>e.g. $5y - 12x = 169$<br>OR<br>**M1** for $-\frac{5}{12}$ oe<br>and<br>**M1** [tangent gradient = ] $-1 \div$ *their* $-\frac{5}{12}$ oe<br>AND<br>**M1dep** for $y - 5 =$ *their* $\frac{12}{5}(x - (-12))$ oe<br>or **M1dep** for $y =$ *their* $\frac{12}{5}x + c$ | Accept e.g. $y = 2.4x + 33.8$<br>$\frac{12}{5}$ oe implies M1M1 unless contradicted<br>**Dep on at least M1**<br>oe e.g. $5 =$ *their* $\frac{12}{5} \times -12 + c$<br>Do not allow M1 for e.g. grad $-\frac{5}{12}$ used if the gradient is then changed subsequently to e.g. $\frac{12}{5}$<br>**Dep on at least M1**<br>Allow '$c$' or any value including 0<br>Answer $y = \frac{12}{5}x$ [$+ c$] oe implies M1M1M1 |

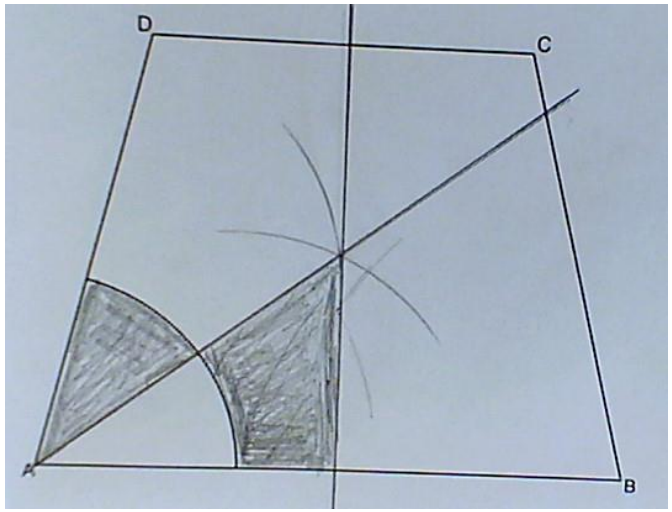
**APPENDIX**
**Additional Guidance Q1(a)**

| | | |
|---|---|---|
| | **Comments about no numbers** | |
| 1 | There are no numbers/figures/scale [to indicate total or numbers in sector] | **1** |
| 2 | You don't know what its out of. You need to total [frequency] | **1** |
| 3 | Its difficult to tell the size of each fraction of the pie chart and we need the total *(we need the total gets the mark)* | **1** |
| 4 | We need to know the angle sizes and what its out of *(and what its out of gets the mark provided they don't say its out of 360)* | **1** |
| 5 | Pie charts show proportions/fractions/%'s but do not show quantities | **1** |
| | | |
| | **Comments about 3D aspect** | |
| 6 | She is viewing the chart from the side not the front | **1** |
| 7 | Its 3D | **1** |
| 8 | It is hard to see the fractions/proportions | **1** |
| 9 | The sections at the front look larger than those at the back | **1** |
| 10 | Its slanted so its hard to measure the angles *(Its slanted gets the mark)* | **1** |
| 11 | Not able to measure angles owing to the positioning of the pie chart *(gets it for the underlined part)* | **1** |
| | | |
| | **Comments about key/colours** | |
| 12 | Segments are not clearly labelled (ref to colour reason) | **1** |
| 13 | The colours look the same. Some of the years are the same colour. | **1** |
| 14 | The parts need to be clearly labelled *BOD related to colour* | **1** |
| 15 | The colours are confusing | |
| | | |
| 16 | It does not tell us the size of each sector *(size does not imply number – could be angles)* | **0** |
| 17 | Pie charts are for discrete data only | **0** |
| 18 | It might not be accurate | **0** |
| 19 | We need to know the angle sizes | **0** |
| 20 | There are better ways to present the data | **0** |
| 21 | It doesn't have any labels *(Not true – there are labels but not very clear)* | **0** |
| 22 | It is an estimated number of users | **0** |
| 23 | The data is not in percentages. | **0** |
| 24 | The sectors have no angles/percentages/fractions | **0** |
| 25 | The sections are similar in size making it unclear | **0** |
| 26 | Not exact figures/data lost | **0** |

**Additional guidance for Question 3(a)**

| | Response | Mark |
|---|---|---|
| 1 | Writing all the 0's out is very long/difficult to read/may lead to errors | **1** |
| 2 | As they contain a lot of 0s | **1** |
| 3 | Because there are too many zeros | **1** |
| 4 | Because the numbers are extremely long/high/large, shortening the number. | **1** |
| 5 | Because of how long/high/large the number will be | **1** |
| 6 | The numbers are too long to write down eg $7 \times 10^7 = 70\,000\,000$ | **1** |
| 7 | It shortens the numbers due to them having so many 0s | **1** |
| 8 | Because they're too big *(Given the wording of the demand – refers to numbers)* | **1** |
| 9 | It takes too long to write it all out | **1** |
| 10 | Because the digits will be too long *(BOD infers numbers are too long)* | **BOD 1** |
| 11 | Wastes time writing out the digits, this is simple shorthand *(similar to above)* | **BOD 1** |
| | | |
| 12 | To makes it easier to read *(no reason given as to why)* | **0** |
| 13 | To make the numbers more simpler *(no reason given e.g. numbers too large, too many zeros)* | **0** |
| 14 | Its easier to understand *(no reason given as to why)* | **0** |
| 15 | Because otherwise you need to write 2.4 billion years ago so $2.4 \times 10^8$ is easier to say in standard form *(Contains error in number, if 240 million years this would be OK)* | **0** |
| 16 | Because the numbers are billions so it's easier to read them in standard form *(see above)* | **0** |
| 17 | It shortens the numbers *(no reason given why e.g. too large, too many zeros)* | **0** |

**Correct answer for Question 9**



**Additional guidance Question 13(a)(ii)**

| | Response | Mark |
|---|---|---|
| 1 | The graph is below the $x$-axis at $x = 0$ and above the $x$ – axis at $x = 1$ so the solution lies between 0 and 1 | **2** |
| 2 | $0^2 – (6 \times 0) – 2 = -2$ and $1^2 + (6 \times 1) – 2 = 5$ so there is a sign change from -2 to 5<br>*BOD x = 0 and x = 1 implied in reasoning and a correct statement regarding sign change* | **2** |
| 3 | Because at $q$, $y = 0$, but at 1 $y = 5$ and at 0 $y$ is negative. So the solution is in between 0 and 1<br>*(BOD x = 0 and x = 1 implied in reasoning similar to above and correct conclusion stated)* | **2** |
| 4 | When $q = 0$ graph is negative, when $q = 1$ graph is positive so there is a sign change<br>*(BOD q is on the x-axis so take q as x here)* | **BOD2** |
| 5 | The graph is positive at 1 and negative at zero so the solution lies in between 0 and 1<br>*[BOD first mark allow as 1 and 0 imply x = 1 and x = 0 and the conclusion is correct for 2nd mark)* | **BOD2** |
| 6 | When $x = 1$, $y = 5$ and the graph intersects the $x$- axis between 0 and 1 so that is where the solution lies<br>*[Does not mention x = 0 and negative and second mark dep on first but gets SC1]* | **SC1** |
| 7 | The graph crosses the $x$-axis between 0 and 1 *[ 2nd mark dep on 1st mark and does not specifically mention x = 0 and x = 1 being negative and positive so zero but gets SC1]* | **SC1** |
| 8 | There is a change of sign *(2nd mark dep on first mark buts gets SC1)* | **SC1** |
| 9 | The root lies between 0 and 1 *(not adding to question asked – no reasons given for this)* | **0** |

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