# GCSE
# MATHEMATICS
# 8300/2H

Higher Tier Paper 2 Calculator

**Mark scheme**

November 2022

Version: 1.0 Final

22BG8300/2H/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

**Glossary for Mark Schemes**

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

| | |
|---|---|
| **M** | Method marks are awarded for a correct method which could lead to a correct answer. |
| **A** | Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied. |
| **B** | Marks awarded independent of method. |
| **ft** | Follow through marks. Marks awarded for correct working following a mistake in an earlier step. |
| **SC** | Special case. Marks awarded for a common misinterpretation which has some mathematical worth. |
| **M dep** | A method mark dependent on a previous method mark being awarded. |
| **B dep** | A mark that can only be awarded if a previous independent mark has been awarded. |
| **oe** | Or equivalent. Accept answers that are equivalent.<br>eg accept 0.5 as well as $\frac{1}{2}$ |
| **[a, b]** | Accept values between a and b inclusive. |
| **[a, b)** | Accept values a $\leqslant$ value $<$ b |
| **3.14 …** | Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416 |
| **Use of brackets** | It is not necessary to see the bracketed work to award the marks. |

Examiners should consistently apply the following principles.

**Diagrams**

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

**Responses which appear to come from incorrect methods**

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

**Questions which ask students to show working**

Instructions on marking will be given but usually marks are not awarded to students who show no working.

**Questions which do not ask students to show working**

As a general principle, a correct response is awarded full marks.

**Misread or miscopy**

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

**Further work**

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

**Choice**

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

**Work not replaced**

Erased or crossed out work that is still legible should be marked.

**Work replaced**

Erased or crossed out work that has been replaced is not awarded marks.

**Premature approximation**

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

**Continental notation**

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **1** | –20.425 | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **2** | $9.61 \times 10^{18}$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **3** | (0, –6) | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| **4** | $\frac{c}{b^4}$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5 | At least two of $2^3$, $3^2$, 7 selected<br>eg $2^3 \times 3^2 \times 7$<br>or 2 2 2 3 3 7 7<br>or $2^2 + 3^2 + 7$<br>or $2^3 \times 3^2$ or $2^3 + 7$ or $3^2 . 7$ | M1 | allow $2^3$ to be $2 \times 2 \times 2$ or 8<br>allow $3^2$ to be $3 \times 3$ or 9<br>allow 7 to be $7^1$<br>selection is implied by inclusion in intersection of overlapping circles<br>M0 inclusion of 5 in selection |
| | 504 | A1 | |
| | **Additional Guidance** | | |
| | $8 \times 9 \times 7$ | | M1 |
| | 8, 9, 49 | | M1 |
| | $4 + 9 + 7$ | | M1 |
| | Intersecting circles with eg only 9 and 7 in the intersection | | M1 |
| | Allow inclusion of 1 for up to M1<br>eg $1 \times 2^3 \times 3^2 \times 7$ | | M1 |
| | $2^3 \times 3^2 \times 5 \times 7$ | | M0 |
| | Answer 504 | | M1A1 |
| | M1 seen with answer the LCM | | M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(a) | $\frac{90-42}{100} \times 24\,000$<br>or<br>$\frac{48}{100} \times 24\,000$ or 11 520<br>or<br>$\frac{42}{100} \times 24\,000$ or 10 080<br>or<br>$\frac{48-42}{100} \times 24\,000$<br>or<br>6 and 48 and 42 seen | M1 | oe |
| | 1440 | A1 | SC1 1920 or answer with digits 144 |
| | **Additional Guidance** | | |
| | Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Build-up to 48% or 42% must be correct or full method must be shown | | |
| | eg only 48% × 24 000 with no or incorrect evaluation | | M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(b) | Ticks Cannot tell<br>and<br>valid reason | B1 | eg ticks Cannot tell and We don't know the number sold (in 2019) |
| | **Additional Guidance** | | |
| | Ignore calculations using percentages from the bar chart | | |
| | Allow any unambiguous indication of Cannot tell with a valid reason | | |
| | Ticks Cannot tell and They might have sold fewer drinks (in 2019) | B1 | |
| | Ticks Cannot tell and It (only) gives percentages | B1 | |
| | Ticks Cannot tell and It doesn't tell you how many coffees were sold | B1 | |
| | Ticks Cannot tell and Don't have enough information | B1 | |
| | Ticks Cannot tell and Both bars the same height | B0 | |
| | Ticks Yes or ticks No | B0 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7(a) | Correct evaluation of the cube root of an integer [40, 50]<br>or<br>correct evaluation of the cube of a decimal or fraction (3, 3.5] | M1 | eg $\sqrt[3]{40} = 3.4$ or $40 \rightarrow 3.4$<br>eg $3.5^3 = 42.8$ or $3.5 \rightarrow 42.8$ |
| | 42 | A1 | SC1 answer given as $\sqrt[3]{42}$ |

**Additional Guidance**

| | |
|---|---|
| Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | |
| Condone eg $40 = 3.4$ or $\sqrt{40} = 3.4$ to mean $\sqrt[3]{40} = 3.4$ | |
| Answer only 42 | M1A1 |
| Must select 42 as final answer for M1A1 ie 42 as the last in a list with a blank answer line is not enough for A1 unless 42 selected | |
| If $\sqrt[3]{42}$ or $3.5^3$ is evaluated then it must be correct to award the A1 for 42 | |
| **NB** 42 only from incorrect method eg listing multiples of 3 or 42 ÷ 3 seen or 42 is divisible by 3 as the working | M0A0 |

Acceptable values for cube roots of integers in range

| | |
|---|---|
| 40 | 3.4(19…) or 3.42(0) |
| 41 | 3.4(48…) or 3.45 |
| 42 | 3.4(76…) or 3.48 or 3.5 |
| 43 | 3.5(03…) |
| 44 | 3.5(30…) |
| 45 | 3.5(56…) or 3.557 or 3.56 or 3.6 |

| | |
|---|---|
| 46 | 3.5(83…) or 3.6 |
| 47 | 3.6(08…) or 3.609 or 3.61 |
| 48 | 3.6(34…) |
| 49 | 3.6(59…) or 3.66 or 3.7 |
| 50 | 3.6(84…) or 3.7 |

Examples of cubes of numbers in range with their acceptable values

| | |
|---|---|
| 3.1 | 29(.791) or 29.8 or 30 |
| 3.2 | 32(.768) or 32.77 or 32.8 or 33 |
| 3.3 | 35(.937) or 35.94 or 36 |

| | |
|---|---|
| 3.4 | 39(.304) |
| 3.5 or $3.4\dot{9}$ | 42(.875) or 42.88 or 42.9 or 43 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7(b) | Valid response that indicates there is one (negative) answer missing | B1 | eg $-10$ (is also an answer)<br>or there is a negative value as well<br>or square roots have two answers<br>or answer is 10 and $-10$ |
| | **Additional Guidance** | | |
| | $-10 \times -10$ (= 100) | | B1 |
| | Another number can square to make 100 (implies exactly two) | | B1 |
| | She has forgotten the other value (implies exactly two) | | B1 |
| | There is another value it could be (implies exactly two) | | B1 |
| | It could be a different number (implies exactly two) | | B1 |
| | It could be negative (bod means 10 could be $-10$) | | B1 |
| | $-10^2$ (= 100) (condone missing brackets around $-10$) | | B1 |
| | $\pm \sqrt{100}$ | | B1 |
| | Indication that there might be **more** than two possible values for $x$<br>eg There are other possible numbers<br>eg There could be other values<br>eg Other numbers square to make 100<br>eg She hasn't included negatives | | <br>B0<br>B0<br>B0<br>B0 |
| | Repeating the question<br>eg There is more than 1 possible value<br>eg 10 is not the only possible value<br>eg More than 1 number works | | <br>B0<br>B0<br>B0 |
| | A partially correct statement<br>eg $x$ could be negative or decimal<br>eg $-10 \times -10 = -100$<br>eg $x^2 = -10$ | | <br>B0<br>B0<br>B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8(a) | 11 5 4<br>or<br>10 7 3<br>or<br>10 6 4<br>or<br>9 8 3<br>or<br>9 7 4<br>or<br>9 6 5<br>or<br>8 7 5 | B2 | any order<br>B1 answer of three positive numbers in any order with sum 20<br>eg 17 2 1<br>or $9\frac{1}{2}$ $8\frac{1}{2}$ 2<br>or 10 5 5<br>or $6\frac{2}{3}$ $6\frac{2}{3}$ $6\frac{2}{3}$<br>or<br>correct equation in $w$, $x$ and $y$<br>eg $4w + 4x + 4y = 80$ or $w + x + y = 20$ |

| Additional Guidance | |
|---|---|
| Ignore attempts to work out the volume or surface area<br>eg 10 5 5 volume calculated as 500 | B1 |
| Negative numbers and/or zero used | B0 |
| $wxy > 200$ or $wxy = 200$ | B0 |
| Allow $6.\dot{6}$ for $6\frac{2}{3}$ | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8(b) | $54a^2$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 9 | 1225 | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 10 | **Alternative method 1** Works out $n$th term of new sequence | | |
| | Common difference of 5 identified | M1 | implied by $5n$ … |
| | $5n + 3$ | A1 | oe eg $8 + 5(n - 1)$ |
| | their $(5n + 3) - (n + 1)$ | M1 | oe<br>their $(5n + 3)$ must be a linear expression<br>condone missing brackets |
| | $4n + 2$ | A1ft | oe eg $6 + 4(n - 1)$<br>ft their $5n + 3$ which must be a linear expression<br>missing brackets must be recovered |
| | **Alternative method 2** Works out terms of sequence A and sequence B | | |
| | 2, 3, 4 | M1 | sequence A |
| | 6, 10, 14 | A1 | sequence B |
| | Common difference of 4 identified | M1 | ft their 6, 10, 14 which must be a linear sequence for B |
| | $4n + 2$ | A1ft | oe eg $6 + 4(n - 1)$<br>ft their 6, 10, 14 which must be a linear sequence for B |
| | **Additional Guidance** | | |
| | Choose the scheme that favours the student | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11(a) | $1.2 \times 20 = 24$ and $40 - 24 = 16$ | B1 | oe eg $1.2 \times 20 = 24$ and $24 + 16 = 40$<br>or $40 - 16 = 24$ and $24 \div 20 = 1.2$<br>or $24 + 16 = 40$ and $24 \div 1.2 = 20$<br>may be seen as one calculation<br>eg $40 - 1.2 \times 20 = 16$<br>or $16 + 1.2 \times 20 = 40$<br>or $40 - 16 = 1.2 \times 20$ |
| | **Additional Guidance** | | |
| | $40 - 24 = 16$ and $40 - 16 = 24$ and $24 + 16 = 40$ are equivalent | | |
| | $1.2 \times 20 = 24$ and $24 \div 1.2 = 20$ and $24 \div 20 = 1.2$ are equivalent | | |
| | $40 - 24 = 16$ or $16 + 24 = 40$ or $40 - 16 = 24$ | | B0 |
| | (20 minutes =) 24 litres leak out $40 - 24 = 16$ | | B0 |
| | $1.2 \times 20 = 24$ 16 litres left | | B0 |
| | Allow unambiguous working in ml and/or seconds | | |
| | For eg $40 - 24 = 16$ condone $24 - 40 = 16$ or $24 - 40 = -16$ | | |
| | Condone incorrect use of equals sign<br>eg $1.2 \times 20 = 24 + 16 = 40$ or $1.2 \times 20 = 24 - 40 = 16$ | | B1 |
| | Correct response with irrelevant work | | B1 |
| | 16 from two different ways with one way incorrect is choice<br>eg $1.2 \times 20 = 24$ and $40 - 24 = 16$ and $20 \div 1.2 = 16$ | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11(b) | 3 | B1 | |
| | Correct method for gradient<br>eg $\frac{40-16}{15-\text{their } 3}$ or $\frac{24}{12}$ | M1 | oe eg $\frac{30-25}{10-7.5}$ or $\frac{10}{5}$ or $40-38$ |
| | 2 | A1ft | correct or ft their 3 |
| | **Additional Guidance** | | |
| | Note that their 3 can be used to work out the rate but does not have to be | | |
| | Values seen on graph must be used correctly<br>eg 24 and 12 seen on the graph is M0 unless subsequently used correctly in attempt to work out the gradient | | |
| | A1ft answers must be to 1 dp or better<br>eg 3.5<br>$\frac{40-16}{15-3.5}$<br>2.1 (accept 2.08…) | | B0<br>M1<br>A1ft |
| | After B0 the method may be implied (use $\frac{40-16}{15-\text{their } 3}$ to check)<br>eg 6<br>2.7 (accept 2.66…) | | B0<br>M1A1ft |
| | If the report is blank, 3 and 2 must be unambiguously identified in working to be acceptable | | |
| | Allow 2 to be written as $\frac{2}{1}$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12 | **Alternative method 1** | | |
| | $6x + x + 5x + 6x + x + 6x + x$<br>or $26x$<br>or<br>$6 + 1 + 5 + 6 + 1 + 6 + 1$ or 26 | M1 | oe eg $7x + 6x - x + 6x + x + 6x + x$<br>$26x$ or 26 is implied by 3.8 oe if addition not seen |
| | their $26x = 98.8$<br>or<br>98.8 ÷ their 26<br>or<br>3.8 or $\frac{19}{5}$ | M1 | oe<br>equation must have terms collected<br>if 1st M1 **not** awarded their $26x$ must be $24x$ or $25x$ or $27x$<br>if 1st M1 **not** awarded their 26 must be 24 or 25 or 27 |
| | their 3.8 × 14 | M1dep | dep on 2nd M1<br>oe eg 45.6 + 7.6 |
| | 53.2 | A1ft | oe<br>ft their 3.8 if M0M2 awarded |

**Mark scheme and Additional Guidance continue on the next page**

| | | | |
|---|---|---|---|
| **12 cont** | **Alternative method 2** | | |
| | $6x + x + 6x$ or $13x$<br>or<br>$6 + 1 + 6$ or $13$ | M1 | oe eg $6x + x + 5x + x$<br>$13x$ or 13 is implied by 3.8 oe if addition not seen |
| | their $13x = 98.8 \div 2$<br>or<br>$49.4 \div$ their 13<br>or<br>3.8 or $\frac{19}{5}$ | M1 | oe<br>equation must have terms collected<br>if 1st M1 **not** awarded their $13x$ must be $12x$<br>if 1st M1 **not** awarded their 13 must be 12 |
| | their $3.8 \times 14$ | M1dep | dep on 2nd M1<br>oe eg $49.4 + 3.8$ |
| | 53.2 | A1ft | oe<br>ft their 3.8 if M0M2 awarded |
| | **Additional Guidance** | | |
| | Up to M3 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Follow through must be to at least 1 dp and their 26 or their 13 must be seen<br>For information: 24 → 57.6… 25 → 55.3… 27 → 51.2… 12 → 57.6… | | M0M1M1A1ft |
| | Both 2nd and 3rd method marks may be implied by their answer. If not using 24, 25, 26, 27, 12 or 13 you must have seen the first M1. | | |
| | $27x = 98.8$ (1st M0, no addition seen, but $27x$ allowed)<br>$\frac{98.8}{27} \times 14$, answer 51.2 | | M0M1<br>M1A1ft |
| | $7x + 5x + 6x + x + 6x + x = 20x$ (correct terms added with incorrect total)<br>$98.8 \div 20 = 4.94$<br>69.16 (multiplication by 14 implied) | | M1<br>M1<br>M1A0 |
| | $98.8 \div 20 = 4.94$ (1st M0, no addition seen, and 20 not allowed)<br>$4.94 \times 14$, answer 69.16 | | M0M0<br>M0A0 |
| | $6x + x + 5x + 6x + x + 6x + x = 26x^7$ | | M1M0M0A0 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 13 | **Alternative method 1** Works out *BC* using Pythagoras then works out *EH* | | |
| | $7^2$ or 49<br>and<br>$4.2^2$ or 17.64 | M1 | oe |
| | $\sqrt{7^2 - 4.2^2}$ or $\sqrt{49 - 17.64}$<br>or $\sqrt{31.36}$ or 5.6 | M1dep | oe<br>implied by 11.76 as the area of the smaller triangle<br>may be on diagram |
| | 6 ÷ 4.2 × their 5.6 or 8 | M1dep | oe<br>full method to work out *EH*<br>may be on diagram as *EH* or *FG*<br>implied by 24 as the area of the larger triangle or 60 as the area of the rectangle |
| | 0.5 × their 8 × 6 or 24<br>and<br>their 8 × 7.5 or 60 | M1dep | oe eg 0.5 × their 5.6 × 4.2 × $(6 \div 4.2)^2$<br>and<br>their 8 × 7.5<br>**or**<br>0.5 × their 8 × (7.5 + 13.5) |
| | 84 | A1 | |

**Mark scheme and Additional Guidance continues on the next two pages**

| | | | |
|---|---|---|---|
| **13 cont** | **Alternative method 2** Works out *ED* using similar triangles then works out *EH* | | |
| | 6 ÷ 4.2 × 7 or 10 | M1 | oe<br>may be on diagram |
| | (their 10)$^2$ or 100<br>and<br>$6^2$ or 36 | M1dep | oe |
| | $\sqrt{(\text{their } 10)^2 - 6^2}$ or $\sqrt{100 - 36}$<br>or $\sqrt{64}$ or 8 | M1dep | oe<br>full method to work out *EH*<br>may be on diagram as *EH* or FG<br>implied by 24 as the area of the larger triangle or 60 as the area of the rectangle |
| | 0.5 × their 8 × 6 or 24<br>and<br>their 8 × 7.5 or 60 | M1dep | oe eg 0.5 × their 5.6 × 4.2 × (6 ÷ 4.2)$^2$<br>and<br>their 8 × 7.5<br>**or**<br>0.5 × their 8 × (7.5 + 13.5) |
| | 84 | A1 | |

**Mark scheme and Additional Guidance continue on the next page**

| | | | |
|---|---|---|---|
| **13 cont** | **Alternative method 3** Uses trigonometry to work out *BC* then works out *EH*<br>or uses trigonometry to work out *EH* | | |
| | (angle *ABC* =) $\sin^{-1}\left(\frac{4.2}{7}\right)$<br>or (angle *ABC* =) [36.8, 36.9]<br>or<br>(angle *BAC* =) $\cos^{-1}\left(\frac{4.2}{7}\right)$<br>or (angle *BAC* =) [53.1, 53.2] | M1 | oe<br>full method to work out *ABC* or *BAC* |
| | 7 × cos (their [36.8, 36.9])<br>or 7 × sin (their [53.1, 53.2])<br>or 5.6<br>or<br>tan (their [36.8, 36.9]) = $\frac{6}{EH}$<br>or tan (their [53.1, 53.2]) = $\frac{EH}{6}$ | M1dep | oe<br>full method to work out *BC*<br>or<br>partial method to work out *EH* |
| | 6 ÷ 4.2 × their 5.6 or 8<br>or<br>6 ÷ tan (their [36.8, 36.9])<br>or<br>6 × tan (their [53.1, 53.2]) | M1dep | oe<br>full method to work out *EH*<br>may be on diagram as *EH* or FG<br>implied by 24 as the area of the larger triangle or 60 as the area of the rectangle |
| | 0.5 × their 8 × 6 or 24<br>and<br>their 8 × 7.5 or 60 | M1dep | oe eg 0.5 × their 5.6 × 4.2 × $(6 \div 4.2)^2$<br>and<br>their 8 × 7.5<br>**or**<br>0.5 × their 8 × (7.5 + 13.5) |
| | 84 | A1 | |
| | **Additional Guidance** | | |
| | Up to M3 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 14 | 137 500 × 0.08 or 11 000 | M1 | oe eg 137 500 × 1.08 − 137 500 |
| | their 11 000 ÷ 0.4 or 27 500 | M1dep | oe<br>may be seen in stages<br>eg 11 000 ÷ 40 = 275 and 275 × 100 |
| | their 27 500 × 6 | M1dep | oe eg 137 500 + 27 500 |
| | 165 000 | A1 | SC2 2 227 500 |
| | **Additional Guidance** | | |
| | Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | SC2 is from starting with 137 500 × 1.08 | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15 | 1 $cm^2$ = 100 $mm^2$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 16 | $y = x^3 + 1$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 17 | $\frac{5}{2}$ | B1 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 18(a) | Median = 99 | B1 | implied by correct line on box plot |
| | Lower quartile = 96 | B1 | implied by correct start of box |
| | Upper quartile = 109 | B1 | implied by correct end of box |
| | Fully correct box plot | B1ft | ft their stated median, LQ and UQ<br>whiskers must be correct |
| | **Additional Guidance** | | |
| | First 3 marks can be awarded even if a box plot is not drawn | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 18(b) | Home and valid reason referring to median | B1ft | eg Home and median is higher (in home games)<br>ft their box plot or their values |
| | **Additional Guidance** | | |
| | Strict ft | | |
| | Values for the medians do not need to be stated, but if stated they must be 106 and correct for their box plot | | |
| | Use of any other measure along with correct response is B0<br>eg Home as median is higher and so is the biggest value | | B0 |
| | 106 is bigger than 99 so Home | | B1 |
| | Home matches as the average was 7 more | | B1 |
| | Median home 106 Median away is 99 So Home | | B1 |
| | Median home 106 Median away is 99 | | B0 |
| | Home as my box plot shows it | | B0 |
| | Home. The mean is 7 more | | B0 |
| | Home as the average is higher | | B0 |
| | They generally do better in home matches so Home | | B0 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 18(c) | Away and valid reason referring to interquartile range | B1ft | eg Away and interquartile range is lower (in away games)<br>ft their box plot or their values |
| | **Additional Guidance** | | |
| | Strict ft | | |
| | Values for the interquartile ranges do not need to be stated, but if stated they must be 22 and correct for their box plot | | |
| | Answer states that ranges are equal alongside a correct response | B1 | |
| | Answer based on range only | B0 | |
| | Use of any other measure (apart from range) along with correct response is B0<br>eg Away as IQR is lower and the upper quartile is also lower | B0 | |
| | 13 is lower than 22 so Away | B1 | |
| | Away matches as the spread was 9 less | B1 | |
| | Away matches as the spread was lower | B0 | |
| | Away because the box is narrower | B1 | |
| | IQR home 22 IQR away is 13 So Away | B1 | |
| | IQR home 22 IQR away is 13 | B0 | |
| | Away as my box plot shows it | B0 | |
| | Away. The LQ is bigger | B0 | |
| | Away as the average is lower | B0 | |
| | They generally do worse in away matches so Away | B0 | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 19 | $\frac{-1\pm\sqrt{1^2-4\times3\times-5}}{2\times3}$ or $-\frac{1}{6}\pm\sqrt{\frac{5}{3}+\frac{1}{36}}$ | M1 | oe eg $\frac{-1\pm\sqrt{1+60}}{6}$ or $-\frac{1}{6}\pm\sqrt{\frac{60}{36}+\frac{1}{36}}$ |
| | $\frac{-1\pm\sqrt{61}}{6}$ or $-\frac{1}{6}\pm\sqrt{\frac{61}{36}}$ or 1.135… and $-1.468…$ | A1 | oe two solutions<br>eg $-\frac{1}{6}+\frac{1}{6}\sqrt{61}$ and $-\frac{1}{6}-\frac{1}{6}\sqrt{61}$<br>allow decimal solutions rounded to at least 1 dp<br>eg allow 1.14 and $-1.5$ |

| Additional Guidance | |
|---|---|
| Both solutions correct | M1A1 |
| Both solutions seen in working but only one on answer line | M1A0 |
| Ignore conversion attempt after correct surd form solutions seen unless only one solution is subsequently selected | |
| Working must be for two solutions to score<br>eg $\frac{-1+\sqrt{1^2-4\times3\times-5}}{2\times3}$ not recovered | M0 |
| Square root sign should cover all appropriate work unless recovered<br>eg $-\frac{1}{6}\pm\sqrt{\frac{5}{3}}+\frac{1}{36}$ not recovered | M0 |
| Fraction line should be under all appropriate work unless recovered<br>eg $-1\pm\frac{\sqrt{61}}{6}$ not recovered | M0 |
| One solution correct does not imply M1 | |
| Both solutions seen in working but signs transposed on answer line | M1A0 |
| $\sqrt{(1^2-4\times3\times-5)}$ is correct for $\sqrt{1^2-4\times3\times-5}$ | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 20 | **Alternative method 1** | | |
| | $7 \times 5 \times 11$ or 385<br>or<br>$3 \times 2 \times 4$ or 24<br>or<br>$\frac{3}{7}$ or $\frac{2}{5}$ or $\frac{4}{11}$ | M1 | oe |
| | $\frac{3\times2\times4}{7\times5\times11}$ or $\frac{24}{385}$ or 0.062(…) | M1dep | oe eg $\frac{3}{7} \times \frac{2}{5} \times \frac{4}{11}$ |
| | 6.2(...)<br>**or**<br>0.062(…) and 0.05 | A1 | allow 6 with M2 scored<br>**or**<br>allow 0.06 and 0.05 with M2 scored |
| | **Alternative method 2** | | |
| | $3 \times 2 \times 4$ or 24 | M1 | oe |
| | $0.05 \times 7 \times 5 \times 11$ or $0.05 \times 385$<br>or 19(.25) or 19.3 | M1 | oe |
| | 24 and 19(.25)<br>**or**<br>24 and 19.3 | A1 | |
| | **Additional Guidance** | | |
| | Up to M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Alt 1 6 or 0.06 without M2 scored is A0 | | |
| | Alt 1 6.2(...) with no working | | M2A1 |
| | Alt 2 24 and 19 with no working | | M2A1 |
| | Do not allow any misreads | | |

| Q | Answer | Mark | Comment | |
|---|---|---|---|---|
| 21(a) | **Alternative method 1** | | | |
| | $6\left(\frac{3x+9}{5}\right)-1$ | M1 | oe eg $\frac{18x+49}{5}$ | |
| | 17 | A1 | SC1 8.4 oe value | |
| | **Alternative method 2** | | | |
| | $\frac{3\times2+9}{5}$ or 3 or g(3) | M1 | oe eg $6 \times 3 - 1$ | |
| | 17 | A1 | SC1 8.4 oe value | |
| | **Additional Guidance** | | | |
| | Answer 17 | | | M1A1 |
| | Working out f(2) and g(2) is M0 unless recovered<br>eg1 $\frac{3\times2+9}{5}=3$ $6 \times 2 - 1 = 11$<br>eg2 $3 \times 11 = 33$ | | | M0A0<br>M0A0 |
| | 17 followed by further work eg $17 \times 3 = 51$ | | | M1A0 |
| | SC1 is for fg(2) | | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 21(b) | **Alternative method 1** | | |
| | $\frac{5x-9}{3}$ or $\frac{5y-9}{3}$ or $\frac{5\times 8-9}{3}$ | M1 | oe |
| | $\frac{31}{3}$ or $10\frac{1}{3}$ or 10.3(…) | A1 | |
| | **Alternative method 2** | | |
| | $\frac{3x+9}{5}=8$ | M1 | oe equation |
| | $\frac{31}{3}$ or $10\frac{1}{3}$ or 10.3(…) | A1 | |
| | **Additional Guidance** | | |
| | $\frac{31}{3}$ or $10\frac{1}{3}$ or 10.3(…) | | M1A1 |
| | Ignore conversion attempt after correct answer seen | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 22 | $x(x^2 - 49)$<br>or $(x^2 + 7x)(x - 7)$<br>or $(x^2 - 7x)(x + 7)$ | M1 | oe partial factorisation eg $x(x^2 - 7^2)$<br>any order eg $(x^2 - 49)x$ |
| | $x(x + 7)(x - 7)$ | A1 | oe full factorisation<br>any order eg $(x + 7)x(x - 7)$ |
| | **Additional Guidance** | | |
| | M1 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Ignore correctly placed multiplication signs | | |
| | Ignore missing final bracket eg $x(x - 7)(x + 7$ | | M1A1 |
| | Allow $x$ to be $1x$ throughout | | |
| | Allow $x$ to be $(x + 0)$ or $(x - 0)$ throughout | | |
| | Ignore any equating to zero | | |
| | Ignore any attempt to 'solve' | | |
| | $x(-7 + x)(7 + x)$ | | M1A1 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 23(a) | 1.5 × 6 or 9<br>or 3.5 × 4 or 14<br>or 5 × 2 or 10<br>or 4.5 × 4 or 18<br>or 2.5 × 4 or 10 | M1 | oe<br>values 9, 14, 10 or 18 must be in the correct row in the table or linked to the correct bar on the histogram |
| | 1.5 × 6 × 3 or 9 × 3 or 27<br>or<br>3.5 × 4 × 8 or 14 × 8 or 112<br>or<br>5 × 2 × 11 or 10 × 11 or 110<br>or<br>4.5 × 4 × 14 or 18 × 14 or 252<br>or<br>2.5 × 4 × 18 or 10 × 18 or 180<br>or<br>681 | M1dep | oe<br>values 27, 112, 110, 252 or 180 must be in the correct row in the table |
| | (their 27 + their 112 + their 110 + their 252 + their 180) ÷ (their 9 + their 14 + their 10 + their 18 + their 10)<br>or<br>681 ÷ 61 | M1dep | oe full correct method<br>eg (their 27 + their 112 + their 110 + their 252 + their 180) ÷ 61 |
| | [11.16, 11.2] | A1 | accept 11 with M3 scored and no errors |

**Additional Guidance is on the next page**

**Additional Guidance**

Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts

**23(a) cont**

| Time, $x$, (hours) | Frequency | Midpoint | |
|---|---|---|---|
| $0 \leqslant x < 6$ | 9 | 3 | 27 |
| $6 \leqslant x < 10$ | 14 | 8 | 112 |
| $10 \leqslant x < 12$ | 10 | 11 | 110 |
| $12 \leqslant x < 16$ | 18 | 14 | 252 |
| $16 \leqslant x < 20$ | 10 | 18 | 180 |

M1M1

| Time, $x$, (hours) | Frequency | Midpoint | |
|---|---|---|---|
| $0 \leqslant x < 6$ | 9 | 3 | 27 |
| $6 \leqslant x < 10$ | 16 | 8 | 128 |
| $10 \leqslant x < 12$ | 10 | 11 | 110 |
| $12 \leqslant x < 16$ | 20 | 14 | 280 |
| $16 \leqslant x < 20$ | 10 | 18 | 180 |

M1M1

| Time, $x$, (hours) | Frequency | Midpoint | |
|---|---|---|---|
| $0 \leqslant x < 6$ | 1.5 | 3 | 4.5 |
| $6 \leqslant x < 10$ | 3.5 | 8 | 28 |
| $10 \leqslant x < 12$ | 5 | 11 | 55 |
| $12 \leqslant x < 16$ | 4.5 | 14 | 63 |
| $16 \leqslant x < 20$ | 2.5 | 18 | 45 |

M0M0

$(4.5 + 28 + 55 + 63 + 45) \div (1.5 + 3.5 + 5 + 4.5 + 2.5)$

$= 195.5 \div 17 = 11.5$

M0A0

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 23(b) | Valid reason | B1 | eg the data is grouped<br>or the exact values are not used<br>or the midpoints are estimates |
| | **Additional Guidance** | | |
| | Because we are using midpoints | | B1 |
| | Midpoint is an average | | B1 |
| | There are no raw data | | B1 |
| | Numbers are rounded | | B0 |
| | There are no data to use | | B0 |
| | The answer is a decimal | | B0 |
| | Valid reason with an irrelevant statement | | B1 |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 24 | $247 - 170$ or 77 | M1 | oe<br>may be on diagram |
| | $23 \times 1\frac{1}{2}$ or 34.5 | M1 | oe eg $23 + 11.5$ or $23 \times 90 \div 60$<br>or $23 \times 1.5$<br>may be on diagram |
| | (their 34.5)$^2 + 60^2 - 2 \times$ their 34.5 $\times$ 60 $\times$ cos (their 77)<br>or [3858, 3859] | M1dep | oe<br>dep on at least one M scored |
| | $\sqrt{\text{their } [3858, 3859]}$ or 62.1(…) | M1dep | oe<br>eg $\sqrt{34.5^2 + 60^2 - 2 \times 34.5 \times 60 \times \cos 77}$<br>dep on 3rd M1 |
| | No and 62.1(…) | A1 | oe eg 62.1 and the ship is further away<br>accept No and 62 with M4 scored |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |
| | 2nd M1 Do not accept 23 × 1.30 unless recovered | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 25 | Any one of<br>$(\overrightarrow{QW} =) \mathbf{a} + \mathbf{b} - \frac{1}{3}\mathbf{a}$<br>$(\overrightarrow{WX} =) \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$<br>$(\overrightarrow{QX} =) \mathbf{a} + \mathbf{b} + \frac{1}{2}\mathbf{b}$ | M1 | oe eg $(\overrightarrow{QW} =) \frac{2}{3}\mathbf{a} + \mathbf{b}$<br>or $(\overrightarrow{WX} =) -\frac{2}{3}\mathbf{a} + \mathbf{b} + \mathbf{a} - \frac{1}{2}\mathbf{b}$<br>or $(\overrightarrow{QX} =) \mathbf{a} + \frac{3}{2}\mathbf{b}$<br>allow use of $\overrightarrow{WQ}$ and/or $\overrightarrow{XW}$ and/or $\overrightarrow{XQ}$ |
| | Any two of<br>$(\overrightarrow{QW} =) \mathbf{a} + \mathbf{b} - \frac{1}{3}\mathbf{a}$<br>$(\overrightarrow{WX} =) \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$<br>$(\overrightarrow{QX} =) \mathbf{a} + \mathbf{b} + \frac{1}{2}\mathbf{b}$ | M1dep | oe<br>allow use of $\overrightarrow{WQ}$ and/or $\overrightarrow{XW}$ and/or $\overrightarrow{XQ}$ |
| | Any valid pair of vectors and indication that one vector is a multiple of the other<br>eg $\overrightarrow{QW} = \frac{2}{3}\mathbf{a} + \mathbf{b}$<br>and $\overrightarrow{WX} = \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$<br>and $\frac{2}{3}\mathbf{a} + \mathbf{b} = 2\left(\frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}\right)$ | A1 | eg $\overrightarrow{QW} = \frac{2}{3}\mathbf{a} + \mathbf{b}$ and $\overrightarrow{XQ} = -\mathbf{a} - \frac{3}{2}\mathbf{b}$<br>and $3\overrightarrow{QW} = -2\overrightarrow{XQ}$<br>**or**<br>$\overrightarrow{QX} = \mathbf{a} + \frac{3}{2}\mathbf{b}$ and $\overrightarrow{WX} = \frac{1}{3}\mathbf{a} + \frac{1}{2}\mathbf{b}$<br>and $WX$ is $\frac{1}{3}$ of $QX$<br>and<br>$WX$ is parallel to $QX$ |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 26 | $6 \times 10 \div 2$ or 30<br>or $6 \times 90$ or 540<br>or 570 | M1 | oe eg $\frac{1}{2} \times \frac{6}{10} \times 10^2$<br>or $\frac{1}{2} \times (100 + 90) \times 6$<br>may be on diagram |
| | $800 - 6 \times 10 \div 2 - 6 \times 90$<br>or 800 – their 30 – their 540<br>or 800 – their 570<br>or 230 | M1dep | oe full method for remaining distance<br>may be on diagram<br>may be embedded eg $230 \div 40$ |
| | $\frac{1}{2} \times (v + 6) \times 40 =$ their 230<br>$2 \times$ their $230 \div 40 - 6$ | M1dep | oe eg $20v + 120 =$ their 230<br>any letter |
| | 5.5 | A1 | oe value |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work with no answer, or incorrect answer, even if this is seen amongst multiple attempts | | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 27 | $\frac{n}{25}$ and $\frac{n-1}{24}$ | M1 | oe<br>may be implied eg $\frac{n(n-1)}{600}$ |
| | $n^2 - n - 210$ (= 0) | M1dep | oe with all terms fully simplified<br>eg $n^2 - n = 210$ |
| | $(n - 15)(n + 14)$<br>or $\frac{-(-1) \pm \sqrt{(-1)^2 - 4 \times 1 \times -210}}{2 \times 1}$<br>or $\frac{1}{2} \pm \sqrt{210 + \frac{1}{4}}$ | M1 | oe eg $\frac{1 \pm \sqrt{841}}{2}$ or $\frac{1 \pm 29}{2}$<br>or $0.5 \pm 14.5$<br>ft their 3-term quadratic |
| | 15 | A1 | 15 and –14 is A0 |

| Additional Guidance | |
|---|---|
| Answer 15 with no working or from trial | M3A1 |
| Beware Answer 15 from incorrect working<br>eg $\frac{n}{25} \times \frac{n}{25} = \frac{7}{20}$ $n^2 = 218.75$ $n = 15$ | M0M0M0A0 |
| Allow $n$ to be $N$ or $x$ etc | |
| 3rd M1 Allow $(-1)^2$ to be $1^2$ | |
| 3rd M1 Do not allow $(-1)^2$ to be $-1^2$ unless recovered | |
| 3rd M1 Allow $\pm$ to be $+$ | |
| 3rd M1 Square root sign should cover all appropriate work unless recovered eg $\frac{1 \pm \sqrt{1} + 840}{2}$ not recovered | M0 |
| 3rd M1 Fraction line should be under all appropriate work unless recovered eg $1 \pm \frac{\sqrt{841}}{2}$ not recovered | M0 |
| 3rd M1 $\sqrt{((-1)^2 - 4 \times 1 \times -210)}$ is correct for $\sqrt{(-1)^2 - 4 \times 1 \times -210}$ | |

| Q | Answer | Mark | Comment |
|---|---|---|---|
| 28 | $\frac{EP}{\sin 35} = \frac{29}{\sin 114}$ or $\frac{29 \sin 35}{\sin 114}$ | M1 | oe eg $\frac{\sin 35}{EP} = \frac{\sin 114}{29}$ or $\frac{EP}{\sin 35} =$ [31.7, 31.7445] |
| | [18.2, 18,21] | A1 | accept 18 with M1 scored |
| | **Additional Guidance** | | |
| | *EP* may be *PE* or $x$ etc | | |
| | Do not regard 31 as a misread of 35 | | |