# GCSE
# MATHEMATICS
# 8300/3H

Higher Tier Paper 3 Calculator

**Mark scheme**

June 2022

Version: 1.0 Final

2 2 6 G 8 3 0 0 / 3 H / M S

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.

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**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 | Comments |
|---|---|---|---|
| **1** | 4.301 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2** | $\begin{pmatrix} -7 \\ 10 \end{pmatrix}$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **3(a)** | D | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **3(b)** | B | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 4 | **Alternative method 1** | | |
| | tan identified | M1 | oe eg $\tan^{-1}$ |
| | $\tan x = \frac{10}{4}$ or $\tan x = \frac{5}{2}$<br>or $\tan x = 2.5$ | M1dep | oe eg $\tan^{-1}\frac{10}{4}$<br>or $90 - \tan^{-1}\frac{4}{10}$ |
| | [68, 68.2] | A1 | SC1 [21.8, 22] |
| | **Alternative method 2** | | |
| | $\sin x = \frac{10}{\sqrt{4^2+10^2}}$<br>or<br>$\cos x = \frac{4}{\sqrt{4^2+10^2}}$ | M2 | oe eg $\sin x = \frac{10}{\sqrt{116}}$<br>or $\sin^{-1}\frac{10}{\sqrt{4^2+10^2}}$<br>or $\cos x = \frac{4}{\sqrt{116}}$ or $\cos^{-1}\frac{4}{\sqrt{4^2+10^2}}$<br>or $90 - \sin^{-1}\frac{4}{\sqrt{4^2+10^2}}$<br>or $90 - \cos^{-1}\frac{10}{\sqrt{4^2+10^2}}$ |
| | [68, 68.2] | A1 | SC1 [21.8, 22] |
| | **Additional Guidance** | | |
| | Accept 10.77 or 10.8 or $2\sqrt{29}$ for $\sqrt{116}$ | | |
| | Tan can be identified by, for example, circling TOA in SOHCAHTOA | | |
| | Answer from accurate drawing | | M0M0A0 |
| | $\sin x = \frac{10 \sin 90}{\sqrt{116}}$ | | M2 |
| | ($x$ =) tan 2.5 or ($x$ =) tan 0.4 or ($x$ =) $\tan\left(\frac{10}{4}\right)^{-1}$ unless recovered | | M1M0A0 |
| | $\tan = \frac{10}{4}$ or $\tan = \frac{4}{10}$ or $\tan x = \frac{4}{10}$ with no further correct working | | M1M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5 | $3 + 2$ or $5$<br>and<br>$5\frac{1}{2} + 3\frac{1}{2}$ or $9$<br>**or**<br>$5\frac{1}{2} - 3$ or $2\frac{1}{2}$<br>and<br>$3\frac{1}{2} - 2$ or $1\frac{1}{2}$<br>**or**<br>$4$ | M1 | oe eg $180 + 120$ or $300$<br>and<br>$330 + 210$ or $540$<br>implied by $5\frac{1}{2} + 3\frac{1}{2} - 3 - 2$ |
| | $\frac{9-5}{5}$ or $\frac{2\frac{1}{2}+1\frac{1}{2}}{3+2}$ or $\frac{4}{5}$ or $0.8$<br>or<br>$\frac{5\frac{1}{2}+3\frac{1}{2}}{3+2}$ $(\times 100)$ or $\frac{9}{5}$ $(\times 100)$<br>or $1.8$ $(\times 100)$<br>or $180$ | M1dep | oe eg $\frac{5\frac{1}{2}+3\frac{1}{2}-3-2}{3+2}$<br>eg $\frac{540-300}{300}$ or $\frac{240}{300}$<br>or $1.8 - 1$ |
| | 80 | A1 | |

**Additional Guidance**

| | |
|---|---|
| Allow working fully in minutes but units must be consistent in a single calculation | |
| eg $2$ h $30$ and $1$ h $30$ | M1 |
| eg $3 + 2 = 5$ and $330 + 210 = 540$ | M1 |
| eg $3 + 120$ and $330 + 3\frac{1}{2}$ unless recovered | M0 |
| $3 + 2 = 6$, $5\frac{1}{2} + 3\frac{1}{2} = 9$, $9 - 6 = 3$, $3 = 50\%$ | M1M1A0 |
| $3 + 2 = 6$, $5\frac{1}{2} + 3\frac{1}{2} = 9$, answer 50% (3 is implied) | M1M1A0 |
| $9 - 6 = 3$, $3 = 50\%$ (no method shown for 6) | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(a) | –1 and 5 | B1 | either order |
| | **Additional Guidance** | | |
| | Ignore $x =$ written before answers | | |
| | (–1, 0) or (5, 0) | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 6(b) | (2, –9) | B2 | B1 $x = 2$ or (2, …)<br>or $y = -9$ or (…, –9)<br>or $(x-2)^2 - 9$<br>B1ft correct $y$-coordinate for their $x$-coordinate with $x \neq -1$, 0 or 5<br>SC1 (–9, 2) |
| | **Additional Guidance** | | |
| | If answer line is blank, check diagram for indication of $x$ or $y$ values | | |
| | (3, –9) | | B1 |
| | (3, –8) | | B1ft |
| | (1, –8) | | B1ft |
| | (2.5, –8.75) | | B1ft |
| | (0, –5) | | B0ft |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 7 | (8th term =) $2^8$ or 256 | M1 | oe<br>may be implied |
| | Common difference of A indicated as 3 | M1 | may be implied<br>eg $3n$ … or … + $3(n-1)$ |
| | $3n + 10$ = their 256<br>or<br>(their 256 – 10) ÷ 3<br>or<br>(their 256 – 13) ÷ 3 or 81 | M1dep | oe equation eg $13 + 3(n-1) = 2^8$<br>dep on 2nd M1<br>their 256 may be any number and may be in index form |
| | 82 | A1 | |
| | **Additional Guidance** | | |
| | $n$ + 3 implies 2nd M1 | | |
| | Do not award M1 for 256 if it is in a list of powers of 2 unless it is indicated or it is the highest power evaluated | | |
| | Common difference of 3 may be shown on the progression for the 2nd M1 | | |
| | 10, (13, 16, 19, 22), 25 without common difference of 3 shown does not imply 2nd M1 | | |
| | 82 from trial and improvement | | M3A1 |
| | Embedded answer $3 \times 82 + 10 = 256$ | | M3A0 |
| | $3n + 10 = 256$ or $3n + 10 = 2^8$ or $3n = 246$ | | M1M1M1 |
| | $3n - 10 = 256$ | | M1M1M0 |
| | $3n + 10 = 16$ ($2^8$ not seen) | | M0M1M1 |
| | $3n + 6 = 2^8$ | | M1M1M0 |
| | 256 – 22 = 234, 234 ÷ 3 (indicating common difference of 3) | | M1M1M0 |
| | $3n - 8 = 128$ ($2^8$ not seen) | | M0M1M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8 | 330 ÷ (3 + 2) or 330 ÷ 5 or 66 | M1 | oe eg $\frac{330}{5}$ |
| | their 66 × 2 or 132 | M1dep | oe<br>$\frac{2}{5}$ × 330 scores M2 |
| | 294 ÷ 7 or 42<br>or<br>294 ÷ 7 × 3 or 126 | M1 | oe eg $\frac{294}{7}$<br>or $\frac{3}{7}$ × 294 |
| | 132 and 126 and A | A1 | |
| | **Additional Guidance** | | |
| | 132 and 88.2 and A | | M1M1M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | **Alternative method 1 – compares speeds in m/s** | | |
| | 200 ÷ 24 or 8.3(3…) | M1 | oe eg $\frac{200}{24}$ or $8\frac{1}{3}$ |
| | 28.8 × 1000 ÷ 60 ÷ 60 or 8 | M1 | oe eg 28 800 ÷ 3600 or 28.8 ÷ 3.6 |
| | 8 and 8.3(3…) and Tom | A1 | oe eg 8 and $8\frac{1}{3}$ and Tom |
| | **Alternative method 2 – compares speeds in km/h** | | |
| | 200 ÷ 24 or 8.3(3…) | M1 | oe eg $\frac{200}{24}$ or $8\frac{1}{3}$ |
| | their 8.3(3…) ÷ 1000 × 60 × 60 or 30 | M1dep | oe eg 0.008 3(3…) × 3600 |
| | 30 and Tom | A1 | |
| | **Alternative method 3 – time for Adil starting with m/s** | | |
| | 28.8 × 1000 ÷ 60 ÷ 60 or 8 | M1 | oe eg 28 800 ÷ 3600 |
| | 200 ÷ their 8 or 25 | M1dep | oe eg $\frac{200}{8}$ |
| | 25 and Tom | A1 | oe eg Tom by 1s |
| | **Alternative method 4 – time for Adil starting with km/h** | | |
| | $\frac{200 \div 1000}{28.8}$ or [0.0069, 0.007] or $\frac{200}{28.8}$ or [6.9, 7] | M1 | oe eg $\frac{0.2}{28.8}$ eg $\frac{125}{18}$ |
| | their [0.0069, 0.007] × 60 × 60 or their [6.9, 7] ÷ 1000 × 60 × 60 or 25 | M1dep | oe eg $\frac{0.2}{28.8}$ × 3600 |
| | 25 and Tom | A1 | oe eg Tom by 1s |

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

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 cont | **Alternative method 5 – distance for Adil in 24s** | | |
| | 28 800 × 24 or 691 200<br>or<br>28.8 ÷ 60 ÷ 60 or 0.008<br>or<br>28.8 × 24 or 691.2 | M1 | oe eg $\frac{3456}{5}$ |
| | their 691 200 ÷ 60 ÷ 60<br>or<br>their 0.008 × 1000 × 24<br>or<br>their 691.2 × 1000 ÷ 60 ÷ 60<br>or<br>192 | M1dep | oe eg 28 800 × 24 ÷ 3600 |
| | 192 and Tom | A1 | |
| | **Additional Guidance** | | |
| | Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts | | |
| | Ignore all units | | |
| | Allow other correct comparisons<br>eg 500 and 480 (this is metres per minute)<br>eg 500 and 480 and Tom | | M1M1<br>M1M1A1 |
| | 200 m = 0.2 km, 24 s = 24 ÷ 60 ÷ 60 = $\frac{1}{150}$ hour, 0.2 ÷ $\frac{1}{150}$ = 30 and Tom | | M1M1A1 |
| | $\frac{200 \div 1000}{24} = \frac{1}{120}$ (or 0.0083…) | | M1 |

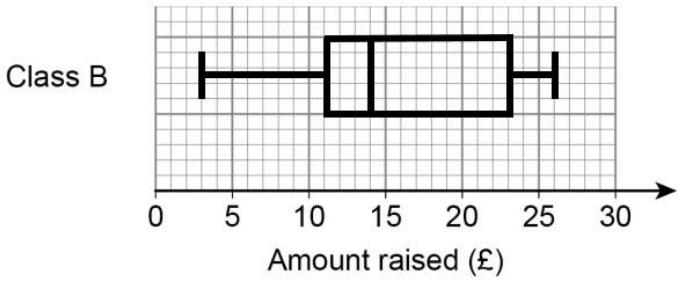
| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | $3.55 \leqslant$ mass $< 3.65$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 11 | trapezium | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12(a) | $\frac{180-90}{2}$ or $\tan^{-1}\frac{6}{6}$ or 45 | M1 | oe<br>may be seen on diagram<br>eg $\sin^{-1}\left(\frac{6}{\sqrt{72}}\right)$ |
| | 315 | A1 | SC1 answer of 135 (bearing of *C* from *A*) |
| | **Additional Guidance** | | |
| | $\tan\frac{6}{6}$ unless recovered | | M0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 12(b) | Correct explanation that the ship would be on land<br>or<br>068° is the bearing of *D* from *E*<br>or<br>the bearing must be over 180°<br>or<br>the actual bearing is [246, 250]° | B1 | eg that would take the ship over land<br>068° is from *E*<br>068° is the bearing from *E* to *D*<br>the bearing is 248° |
| | **Additional Guidance** | | |
| | Ignore irrelevant statements and compass points eg bearings go clockwise, bearings are measured from north, NE, south west | | |
| | Do not accept incorrect statement or bearing alongside a correct statement | | |
| | Bearings measured or stated outside of [246, 250]° range | | B0 |
| | Examples of statements | | |
| | Must be over 180° | | B1 |
| | Should be reflex | | B1 |
| | This is going from *E* | | B1 |
| | Makes the ship go in the opposite direction | | B1 |
| | 68° needs to be 248° | | B1 |
| | Should be 248° | | B1 |
| | Her bearing cannot be acute | | B1 |
| | Bearings cannot be acute | | B0 |
| | 248° without a statement | | B0 |
| | Ship would not land at *E* | | B0 |
| | She needs to go south west | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **13** | $2\sqrt{5}\,a$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **14** | Rectangular boxplot with whiskers to 3 and 26 | B1 | must have a rectangular box with whiskers |
| | Lower quartile at 11 | B1 | must be first vertical line of a box with three vertical lines |
| | Median at 14 | B1 | must be second vertical line of a box with three vertical lines |
| | Upper quartile at 23 | B1ft | ft their LQ + 12<br>must be vertical line at right side of their box |
| | **Additional Guidance** | | |
| | Correct boxplot<br><br> | | |
| | Mark intention eg any height and allow horizontal line through centre of box | | |
| | Allow ends of whiskers to be vertical lines of any length, dots, crosses or missing | | |
| | $\pm\frac{1}{2}$ small square tolerance | | |
| | Only vertical lines or points plotted | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15 | **Alternative method 1** | | |
| | 158 460 ÷ 278 or 570 | M1 | |
| | 168 720 ÷ their 570 | M1dep | |
| | 296 | A1 | |
| | **Alternative method 2** | | |
| | 158 460 ÷ 168 720<br>or 0.939… or 0.94 | M1 | |
| | 278 ÷ their 0.939… | M1dep | |
| | 296 | A1 | |
| | **Alternative method 3** | | |
| | 168 720 ÷ 158 460<br>or 1.0647… or 1.065 or 1.06 | M1 | oe eg $1+\frac{168720-158460}{158460}$<br>or $1+\frac{10260}{158460}$ |
| | 278 × their 1.0647… | M1dep | |
| | 296 | A1 | |
| | **Additional Guidance** | | |
| | 278 × 1.065 = 296 | | M1M1A1 |
| | 278 × 1.065 = 296.07 with 296 on answer line is evidence of premature rounding in their working | | M1M1A0 |
| | 168720 ÷ 158460 = 1.06, 278 × 1.06 = 294.68 with answer 294 | | M1M1A0 |
| | Embedded answer eg 168720 ÷ 296 = 570 | | M1M1A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(a) | $3 \times 500$ or 1500 | M1 | actual radius of circle in metres |
| | (their 1500)$^2 \times \pi \times 17$<br>or $38\,250\,000\pi$ | M1dep | |
| | [120 000 000, 120 200 000]<br>or [$1.2 \times 10^8$, $1.202 \times 10^8$] | A1 | accept in words eg 120 million<br>SC1 [480, 481] or [0.048, 0.0481] |
| | **Additional Guidance** | | |
| | Do not award A mark if incorrect further work is seen | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(b) | It could be less than or greater than Virat's estimate (3rd box ticked)<br>and<br>statement that area is larger but depth is smaller | B2 | B1<br>It is less than Virat's estimate (1st box ticked)<br>and statement that depth is smaller<br>or<br>It is greater than Virat's estimate (2nd box ticked)<br>and statement that area is larger<br>or<br>It could be less than or greater than Virat's estimate (3rd box ticked)<br>and statement that depth is smaller<br>or<br>It could be less than or greater than Virat's estimate (3rd box ticked)<br>and statement that area is larger |

| Additional Guidance | |
|---|---|
| For B2 their statement must refer to larger area and smaller depth | |
| For B1 their statement must correctly refer to larger area or smaller depth for their box ticked | |
| Examples of statements implying actual depth is smaller:<br>height is less<br>depth is lower<br>it is shallower<br>Virat's estimate of the depth is bigger | |
| Examples of statements implying actual area is larger:<br>the width is bigger<br>cross section is bigger<br>shape is greater<br>Virat's estimate of the area is smaller | |
| The reservoir could be bigger or smaller | B0 |
| The reservoir is larger | B0 |
| We do not know the depth | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17(a) | $8 \times 4 \times 5$ | M1 | |
| | 160 | A1 | |
| | **Additional Guidance** | | |
| | $\frac{1}{8} \times \frac{1}{4} \times \frac{1}{5}$ = 160 (recovered) | | M1A1 |
| | $\frac{1}{8} \times \frac{1}{4} \times \frac{1}{5}$ | | M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 17(b) | $\frac{1}{160}$ or 0.00625 or 0.625%<br>or $6.25 \times 10^{-3}$ | B1ft | oe fraction, decimal or percentage<br>ft $\frac{1}{\text{their answer to (a)}}$ |
| | **Additional Guidance** | | |
| | Accept decimal or percentage answers rounded to 2 sf or better for ft<br>eg ft 17 gives 0.058823529… so accept 0.059 or better | | |
| | Ignore an attempt to convert a fraction to a decimal or round a decimal or percentage after a correct value is seen | | |
| | 1 : 160 or 1 in 160 or 1 out of 160 | | B0 |
| | $\frac{1}{160} + \frac{1}{160} = \frac{2}{320} = \frac{1}{160}$ | | B0 |
| | $\frac{1}{160} \times \frac{1}{160} = \frac{2}{320} = \frac{1}{160}$ | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 18 | **Alternative method 1 – using angles around *O* and angles inside arrowhead** | | |
| | *ACO* = 90 – 83 or *ACO* = 7 | M1 | may be seen on diagram |
| | Acute *BOC* = 2 × 28<br>or acute *BOC* = 56 | M1 | may be seen on diagram |
| | Reflex *BOC* = 360 – their 56<br>or reflex *BOC* = 304 | M1dep | may be seen on diagram<br>dep on 2nd M1 |
| | *ABO* = 360 – their 304 – their 7 – 28<br>or<br>*ABO* = 21 | M1dep | may be seen on diagram<br>dep on M3 |
| | *ABO* = 21 and *ACO* = 7<br>and 21 : 7 = 3 : 1 | A1 | all angle values must be seen |
| | **Alternative method 2 – with line *OA* added** | | |
| | *ACO* = 90 – 83 or *ACO* = 7 | M1 | may be seen on diagram |
| | *OAC* = 7<br>or<br>*ABO* + *ACO* = 28 | M1dep | may be seen on diagram |
| | *OAB* = 28 – 7 or *OAB* = 21<br>or<br>*ABO* = 28 – 7 | M1dep | may be seen on diagram<br>dep on M2 |
| | *ABO* = 21 | M1dep | may be seen on diagram<br>dep on M3 |
| | *ABO* = 21 and *ACO* = 7<br>and 21 : 7 = 3 : 1 | A1 | all angle values must be seen |

**Mark scheme continues on the next page**

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **18 cont** | **Alternative method 3 – using alternate segment theorem** | | |
| | $ACO = 90 - 83$ or $ACO = 7$ | M1 | may be seen on diagram |
| | Acute $BOC = 2 \times 28$<br>or acute $BOC = 56$ | M1 | may be seen on diagram |
| | $ABC = 83$ | M1 | may be seen on diagram |
| | $OBC = \frac{180 - \text{their } 56}{2}$<br>or $OBC = 62$<br>and<br>$ABO = 83 -$ their 62 or $ABO = 21$ | M1dep | may be seen on diagram,<br>dep on 2nd and 3rd M1 |
| | $ABO = 21$ and $ACO = 7$<br>and $21 : 7 = 3 : 1$ | A1 | all angle values must be seen |

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

| Q | Answer | Mark | Comments | |
|---|---|---|---|---|
| 18 cont | **Alternative method 4 – using triangles *OBC* and *ABC*** | | | |
| | $ACO = 90 - 83$ or $ACO = 7$ | M1 | may be seen on diagram | |
| | Acute $BOC = 2 \times 28$<br>or acute $BOC = 56$ | M1 | may be seen on diagram | |
| | $OBC = \frac{180 - \text{their } 56}{2}$<br>or $OBC = 62$ | M1dep | may be seen on diagram<br>or angle *OCB*<br>dep on 2nd M1 | |
| | $ABO = 180 - 28 - 62 - 62 - 7$<br>or $ABO = 21$ | M1dep | oe<br>may be seen on diagram<br>dep on M3 | |
| | $ABO = 21$ and $ACO = 7$<br>and $21 : 7 = 3 : 1$ | A1 | all angle values must be seen | |
| | **Additional Guidance** | | | |
| | If angles are not correctly positioned on the diagram they must be correctly identified in the working, eg $BOC = 56$ is M0 if not correctly positioned on the diagram and not identified as acute | | | |
| | $ACO = 7$ and $ABO : ACO = 21 : 7$ with no other correct working | | | M1M0M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19(a) | **Alternative method 1 – horizontal split** | | |
| | $x(x-2)$ and $3(x-5)$ | M1 | oe may be seen as two areas |
| | $x^2-2x+3x-15$ (= 75) | M1dep | oe expression with all brackets expanded |
| | $x^2-2x+3x-15=75$ and $x^2+x-90=0$ or $x^2+x-15=75$ and $x^2+x-90=0$ | A1 | with full working seen |
| | **Alternative method 2 – vertical split** | | |
| | $(x-5)(x+1)$ and $5(x-2)$ | M1 | oe may be seen as two areas |
| | $x^2-5x+x-5+5x-10$ (= 75) or $x^2-4x-5+5x-10$ (= 75) | M1dep | oe expression with all brackets expanded |
| | $x^2-5x+x-5+5x-10=75$ and $x^2+x-90=0$ or $x^2-4x-5+5x-10=75$ and $x^2+x-90=0$ | A1 | with full working seen |
| | **Alternative method 3 – large rectangle subtract 3 × 5** | | |
| | $x(x+1)$ and $3\times5$ | M1 | oe may be seen as two areas |
| | $x^2+x-15$ (= 75) | M1dep | oe expression with brackets expanded and $3\times5$ evaluated |
| | $x^2+x-15=75$ and $x^2+x-90=0$ | A1 | with full working seen |

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

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19(a) cont | **Alternative method 4 – split into three areas** | | |
| | $3(x-5)$ and $(x-2)(x-5)$ and $5(x-2)$ | M1 | oe may be seen as three areas |
| | $3x-15+x^2-2x-5x+10+5x-10$ (= 75)<br>or<br>$3x-15+x^2-7x+10+5x-10$ (= 75) | M1dep | oe expression with all brackets expanded |
| | $3x-15+x^2-2x-5x+10+5x-10=75$<br>and $x^2+x-90=0$<br>or<br>$3x-15+x^2-7x+10+5x-10=75$<br>and $x^2+x-90=0$ | A1 | with full working seen |
| | **Additional Guidance** | | |
| | Ignore attempts to solve the equation or substituting values for $x$ | | |
| | Condone missing end bracket for M1 | | |
| | Condone missing pairs of brackets if recovered<br>eg $3\times x-5$ recovered to $3x-15$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 19(b) | $(x - 9)(x + 10)$ (= 0)<br>and answer 9 | B2 | B1 $(x - 9)(x + 10)$ (= 0)<br>and answer 9 and –10<br>SC1 $(x + 9)(x - 10)$ (= 0)<br>and answer 10 |
| | **Additional Guidance** | | |
| | If no response is seen, check part (a) for any creditworthy work | | |
| | Answer 9 with no working can be awarded up to B2 from correct factorising seen in part (a) | | |
| | Answer 9 from quadratic formula or completing the square | | B1 |
| | Answer 9 and –10 from quadratic formula or completing the square | | B0 |
| | Answer from trial and improvement only | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 20 | **Alternative method 1** | | |
| | 2496.96 ÷ 2448 or 1.02 | M1 | implied by correct value for 2, 3 or 4 years |
| | 2496.96 × (their 1.02)$^3$<br>or<br>2448 × (their 1.02)$^4$<br>or<br>2649.79… | M1dep | oe eg full year by year method shown |
| | 2649.77 or 2649.78 or 2649.79 or 2649.8(0) | A1 | accept 2650(.00) with M2 awarded<br>SC2 2702.78 or 2702.79 or 2702.8(0) |
| | **Alternative method 2** | | |
| | (2496.96 – 2448) ÷ 2448<br>or 48.96 ÷ 2448 or 0.02 or 2% | M1 | |
| | 2496.96 × $(1 + \frac{\text{their } 2}{100})^3$<br>or<br>2448 × $(1 + \frac{\text{their } 2}{100})^4$<br>or 2649.79… | M1dep | oe eg full year by year method shown |
| | 2649.77 or 2649.78 or 2649.79 or 2649.8(0) | A1 | accept 2650(.00) with M2 awarded<br>SC2 2702.78 or 2702.79 or 2702.8(0) |
| | **Additional Guidance** | | |
| | Calculated by year, the amounts would be:<br>2 years 2546.89 or 2546.90<br>3 years 2597.82 or 2597.83 or 2597.84 | | |
| | Condone 2650.0 | | M1M1A1 |
| | 2546.89, 2597.83, 2649.78, 2702.77 do not award A mark if further work seen after correct answer | | M1M1A0 |
| | $\frac{48.96}{2496.96} \times 100 = 2\%$ is incorrect working | | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 21 | $\frac{\sin x}{17} = \frac{\sin 64}{23}$<br>or $\sin x = \frac{17\sin 64}{23}$<br>or $\sin x = \frac{15.279...}{23}$<br>or $\frac{\sin x}{17} = 0.039\ldots$<br>or $\sin x = 0.66(4\ldots)$ | M1 | oe $\frac{17}{\sin x} = \frac{23}{\sin 64}$<br>or $\frac{17}{\sin x}$ = [25.58, 25.6] |
| | $(x =) \sin^{-1} \frac{17\sin 64}{23}$<br>or<br>$(x =) \sin^{-1} 0.66(4\ldots)$ | M1dep | |
| | [41.29, 41.64] or 42<br>or 41 from correct working | A1 | |
| | **Additional Guidance** | | |
| | Answer from accurate drawing | | M0M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 22 | $3x^2$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 23 | **Alternative method 1** | | |
| | $5^2 + 7 \times 5 - c$ or $60 - c$<br>and<br>$3 \times 5 + d$ or $15 + d$ | M1 | oe |
| | $25 + 35 - c = 15 + d$<br>or $60 - c = 15 + d$<br>or<br>$c = 60 - y$ and $d = y - 15$<br>and $c + d = 60 - y + y - 15$ | M1dep | oe equation with squaring and multiplications correctly completed |
| | 45 | A1 | |
| | **Alternative method 2** | | |
| | $x^2 + 7x - c = 3x + d$<br>or<br>$x^2 + 7x - c - (3x + d) = 0$<br>or $x^2 + 7x - c - 3x - d = 0$<br>or<br>$3x + d - (x^2 + 7x - c) = 0$<br>or $3x + d - x^2 - 7x + c = 0$ | M1 | oe |
| | $(c + d =)\ x^2 + 7x - 3x$<br>or $(c + d =)\ x^2 + 4x$<br>and<br>substitutes $x = 5$ | M1dep | oe |
| | 45 | A1 | |
| | **Additional Guidance** | | |
| | Once $c + d = 45$ is seen, ignore further attempts to find values for $c$ or $d$ | | |
| | 45 on answer line with no working or no incorrect working | | M1M1A1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 24 | $\sqrt[4]{81}$ or $81^{\frac{1}{4}}$ or $k = 3$ | M1 | may be seen on diagram and is implied by $p = 9$ |
| | (their value for $k$)$^2 = 2^2 + c$<br>or $9 = 4 + c$<br>or $c = 5$ | M1 | does not need to be evaluated |
| | $r^2$ + their 5 = 43.44<br>or<br>$\sqrt{43.44 - \text{their } 5}$ or $\sqrt{38.44}$ | M1dep | oe equation<br>dep on previous mark |
| | 6.2 | A1 | |
| | **Additional Guidance** | | |
| | Coordinate (2, 9) implies $p = 9$ | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 25 | $0.6 \times 10$ or 6<br>or<br>$4 \times 5$ or 20<br>or<br>$7.6 \times 5$ or 38<br>or<br>$1.6 \times 10$ or 16<br>or<br>$4 \times 2$ or 8<br>or<br>$4 \times 3$ or 12 | M1 | may be seen written on correct bar<br>correct method for any frequency |
| | $0.6 \times 10 + (122 - 120) \times 4$<br>or $0.6 \times 10 + 2 \times 4$<br>or<br>$0.6 \times 10 + \frac{2}{5} \times 4 \times 5$<br>or $6 + 8$ or 14<br>or<br>$16 + 38 + \frac{3}{5} \times 4 \times 5$ or 66 | M1dep | oe |
| | $14 \times \frac{28\,000}{80}$<br>or<br>$28\,000 - 66 \times \frac{28\,000}{80}$ or 23 100 | M1dep | oe eg $14 \times 350$<br>$28\,000 - 66 \times 350$ |
| | 4900 | A1 | SC3 3850 or 6475 |
| | **Additional Guidance** | | |
| | $0.3 \times 10 + 2 \times 4 = 11$ and $\frac{11}{80} \times 28\,000 = 3850$ | | SC3 |
| | $1.3 \times 10 + 7.3 \times 5 + 4 \times 3 = 61.5$ and $28\,000 - \frac{61.5}{80} \times 28\,000 = 6475$ | | SC3 |
| | $\frac{6+8}{80} \times 28\,000$ or $\frac{14}{80} \times 28\,000$ | | M3 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26(a) | $2^3 \times 3 \times a^2$ or $24a^2$ (= 4056)<br>or<br>$(a^2 =) \frac{4056}{2^3 \times 3}$ or $(a^2 =)$ 169<br>or<br>$\sqrt{169}$ | M1 | oe eg $8 \times 3 \times a^2$ |
| | 13 | A1 | |
| | **Additional Guidance** | | |
| | Condone $a^2 \times 24$ for M1 | | |
| | Fully correct prime factor decomposition with values 2, 2, 2, 3, 13, 13 shown without 13 chosen as the final answer | | M1A0 |
| | Embedded answer $2^3 \times 3 \times 13^2$ | | M1A0 |
| | $\pm$ 13 or $-13$ | | M1A0 |
| | $4056 \div 2^3 \times 3$ unless recovered to 169 | | M0A0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 26(b) | $2^4 \times 3^2 \times a^3$ or $144a^3$<br>or<br>$2^4 \times 3^2 \times$ (their 13)$^3$<br>or<br>$13 \times 4056 \times 2 \times 3$<br>or<br>$52728 \times 6$<br>or<br>$24336 \times 13$ | M1 | oe<br><br>eg $144 \times$ (their 13)$^3$<br><br>$16 \times 9 \times 2197$ |
| | 316 368 | A1ft | ft their 13, which must be an integer > 13 |
| | **Additional Guidance** | | |
| | eg 14 on answer line in part (a) can follow through to $144 \times 14^3 =$ 395 136 | | M1A1ft |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 27 | **Alternative method 1: multiplies $(x-3)(x-4)$ first** | | |
| | $x^2-3x-4x+12$<br>or $x^2-7x+12$ | M1 | four terms with at least three correct<br>implied by $x^2-7x+k$ where $k$ is a non-zero constant |
| | $x^3-3x^2-4x^2+12x+8x^2-24x-32x+96$<br>or $x^3-7x^2+12x+8x^2-56x+96$ | M1dep | full expansion with correct multiplication of their 3 or 4 terms by $x$ and 8 |
| | $x^3+x^2-44x+96$ | A1 | |
| | **Alternative method 2: multiplies $(x-3)(x+8)$ first** | | |
| | $x^2-3x+8x-24$<br>or $x^2+5x-24$ | M1 | four terms with at least three correct<br>implied by $x^2+5x+k$ where $k$ is a non-zero constant |
| | $x^3-3x^2+8x^2-24x-4x^2+12x-32x+96$<br>or $x^3+5x^2-24x-4x^2-20x+96$ | M1dep | full expansion with correct multiplication of their 3 or 4 terms by $x$ and $-4$ |
| | $x^3+x^2-44x+96$ | A1 | |
| | **Alternative method 3: multiplies $(x-4)(x+8)$ first** | | |
| | $x^2-4x+8x-32$<br>or $x^2+4x-32$ | M1 | four terms with at least three correct<br>implied by $x^2+4x+k$ where $k$ is a non-zero constant |
| | $x^3-4x^2+8x^2-32x-3x^2+12x-24x+96$<br>or $x^3+4x^2-32x-3x^2-12x+96$ | M1dep | full expansion with correct multiplication of their 3 or 4 terms by $x$ and $-3$ |
| | $x^3+x^2-44x+96$ | A1 | |
| | **Additional Guidance** | | |
| | Do not award A mark if further incorrect simplification or attempt to solve after correct answer seen | | |
| | For method marks, terms may be given in a table with correct signs shown | | |