# GCSE

# Mathematics

Paper 2 43652H
Mark scheme

43652H
November 2013

Final version 1.0

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 Assessment Writer.

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.

| | |
|---|---|
| **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. |
| **Q** | Marks awarded for quality of written communication. |
| **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. |
| **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. |
| **oe** | Or equivalent. Accept answers that are equivalent. e.g. accept 0.5 as well as $\frac{1}{2}$ |
| **[a, b]** | Accept values between $a$ and $b$ inclusive. |
| **[a, b)** | Accept values $a \leq$ value $< b$ |
| **25.3 …** | Allow answers which begin 25.3  e.g.  25.3,  25.31,  25.378 |
| **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 candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

**Questions which ask candidates to show working**

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

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

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

**Misread or miscopy**

Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate 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.

# Paper 2 Higher Tier

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **1** | Two correct points calculated | B1 | May be implied from plotting<br>± ½ square |
| | At least 2 points plotted correctly | M1 | May be implied from straight line<br>± ½ square |
| | Fully correct straight ruled line from – 2 to 2 | A1 | ± ½ square<br><br>SC2　incorrect straight line (any length) of gradient 2<br><br>SC1　incorrect sloping straight line (any length) passing through (0, –1) |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **2(a)** | 495 ÷ 55 or 9<br>or 80 ÷ 55 or 1.45…<br>or 80 × 495 or 39 600 | M1 | $55 \div 495$ or $\dfrac{1}{9}$<br><br>or 55 ÷ 80 or 0.68… or 0.69 |
| | 495 ÷ 55 × 80<br>or 80 × their 9<br>or 495 × their 1.45…<br>or 80 × 495 ÷ 55<br><br>or 495 + (80 – 55) × their 9 | M1dep | oe<br><br>80 ÷ their $\dfrac{1}{9}$<br><br>or 495 ÷ their 0.68… |
| | 720 | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2(b) Alt 1** | $55 \div 495$ or $\dfrac{1}{9}$ <br><br> or $495 \div 55$ or 9 <br> or $160 \div 495$ or 0.32… <br> or $160 \times 55$ or 8800 | M1 | $495 \div 160$ or 3.09... |
| | $55 \div 495 \times 160$ <br> or $160 \div$ their 9 <br> or $160 \times$ their $\dfrac{1}{9}$ <br> or $55 \times$ their 0.32… <br> or $160 \times 55 \div 495$ | M1dep | oe <br><br><br> $55 \div$ their 3.09375 |
| | 17.7… or 17.8 | A1 | |
| | 18 | B1ft | Rounding to nearest whole number |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2(b) Alt 2** | $80 \div$ their 720 or $\dfrac{1}{9}$ <br><br> or their $720 \div 80$ or 9 <br> or $160 \div$ their 720 or 0.22… <br> or $160 \times 80$ or 8800 | M1 | their $720 \div 160$ or 4.5 |
| | $80 \div$ their $720 \times 160$ <br> or $160 \div$ their 9 <br> or $160 \times$ their $\dfrac{1}{9}$ <br> or $80 \times$ their 0.22… <br> or $160 \times 80 \div$ their 720 | M1dep | oe <br><br><br> $80 \div$ their 4.5 |
| | 17.7… or 17.8 | A1 | |
| | 18 | B1ft | Rounding to nearest whole number |

| Q | Answer | | Mark | Comments |
|---|--------|---|------|----------|
| **3(a)** | Continuous | | B1 | |
| **3(b)** | Discrete | | B1 | |
| **3(c)** | Continuous | | B1 | |
| **3(d)** | Discrete | | B1 | |
| **4** | Height of triangle = 4 seen or implied | | B1 | Identifies height of trapezium as 9 |
| | (Area of rectangle)<br><br>234 or 378 | | B1 | (Area of trapezium)<br><br>$\dfrac{(13 + 21) \times 9}{2}$ |
| | $\dfrac{1}{2} \times 18 \times$ their 4<br>or 36 | $\dfrac{1}{2} \times 9 \times$ their 4 or 18 | M1 | $17 \times 9$ or $\dfrac{34 \times 9}{2}$ or $\dfrac{306}{2}$ |
| | $\dfrac{1}{2} \times 18 \times$ their 4 $\times 2$<br>or 72 | $\dfrac{1}{2} \times 9 \times$ their 4 × 4<br>or 72 | M1dep | 153 |
| | 306 | | A1 | |
| **5(a)** | 4 + 3 + 5 + 2<br>or 20 – 5 – 1 | | M1 | oe |
| | 14 | | A1 | |
| **5(b)** | 4 + 5 or 9 | | M1 | $\dfrac{4}{20} \times 100$ or 20<br><br>or $\dfrac{5}{20} \times 100$ or 25 |
| | $\dfrac{4 + 5}{20} \times 100$ | | M1dep | oe<br>their 20 + their 25 |
| | 45 | | A1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **5(c)** | 3 out of 12   or   2 out of 8 <br> or $\dfrac{3}{12}$ or $\dfrac{2}{8}$ | M1 | oe <br> 3 : 12 or 2 : 8 |
| | 3 out of 12 **and** 2 out of 8 <br> or $\dfrac{3}{12}$ **and** $\dfrac{2}{8}$ <br><br> or $\dfrac{1}{4}$ or 25% or 0.25 | A1 | oe <br> 3 : 12 and 2 : 8 <br> All answers must be correct |
| | States the same | Q1ft | Strand (iii) <br> Must see a correct comparison from their relative frequencies dependent on M1 <br> SC1 for $\dfrac{3}{20}$ **and** $\dfrac{2}{20}$ and states boys larger oe |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **6(a)** | $6x + 4 - x - 7$ | M1 | Allow one error |
| | $6x + 4 - x - 7$ | A1 | |
| | $5x - 3$ | A1ft | ft their four terms <br> Do not ignore further work |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **6(b)** | 3 × 6 – 2 × –4 or 18 + 8 or 26<br><br>or 3 × 7 – 2 × –4 or 21 + 8 or 29<br><br>or 3 × 6 – 2 × –5 or 18 + 10 or 28<br><br>or 3 × 7 – 2 × –5 or 21 + 10 or 31 | M1 | |
| | Two correctly evaluated | A1 | 26   29   28   31 |
| | (Largest) 31 and (Smallest) 26 | Q2 | Strand (iii)<br>Fully correct<br><br>Q1 for their largest and smallest stated with largest 31 or smallest 26 with the four calculations seen<br><br>Note 7 and –5 give the answer 31<br>6 and –4 give the answer 26<br><br>SC2 for largest 31 or smallest 26<br><br>SC3 for three correct calculations with one incorrect calculation and their largest and smallest correct |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **7** | 180 – 56 – 56 or 68 | M1 | $2x$ + 56 + 56 + 90 = 360<br>oe |
| | 90 – their 68 or 22<br>360 – 56 – 56 – 90 | M1dep | $2x$ = 360 – 112 – 90 |
| | (180 – their  22) ÷ 2<br>or (360 – 56 – 56 – 90) ÷ 2 | M1dep | $2x$ = 158 |
| | 79 | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8(a) | $y - 8 = 3w$ <br> or $- 3w = 8 - y$ | M1 | $\dfrac{y}{3} = w + \dfrac{8}{3}$ |
| | $\dfrac{y-8}{3} = w$ <br><br> or $\dfrac{y}{3} - \dfrac{8}{3} = w$ | A1 | SC1 $\dfrac{y-8}{3}$ or $\dfrac{y}{3} - \dfrac{8}{3}$ <br> Do not ignore further work |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 8(b) | $5x + 20$ and $3x + 21$ (+ 2) | B1 | |
| | $5x - 3x$ or $2x$ <br><br> or $21 + 2 - 20$ or $23 - 20$ | M1 | their 21 + 2 – their 20 <br><br> or their 23 – their 20 |
| | $5x - 3x = 21 + 2 - 20$ <br> or $5x - 3x = 23 - 20$ <br> or $2x = 3$ | M1dep | $5x - 3x =$ their 23 – their 20 |
| | 1.5 | A1ft | oe |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 9 | 15.7 × 4 or 62.8 | M1 | |
| | their 62.8 = $\pi$ × diameter | M1dep | oe <br> their 62.8 = 2 × $\pi$ × radius |
| | their 62.8 ÷ $\pi$ | M1dep | their 62.8 ÷ 2$\pi$ <br> radius = [9.95, 10] |
| | [19.9, 20] | A1 | SC2 for [4.9, 5] |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10 | Triangle is correct with two equal arcs seen for angle of 60° | B3 | B2 Triangle correct but no arcs <br> B2 Fully correct constructions (3rd side missing) <br> B1 for either $AB$ = [7.4, 7.6] <br>        or   $AC$ = [6.2, 6.4] <br>        or   60° <br> tolerance [58°, 62°] |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **11** | 1.04 × 53 (000 000)<br>or 55.12 (million)<br>or 55.1 (million)<br>or 55 (million) | M1 | oe<br>57.24 (million) or 57.2 (million) |
| | 1.04 × 1.04 × 53 (000 000)<br>or 1.04 × their 55.12 (million) | M1dep | oe<br>M2 for $(1.04)^2$ × 53 seen |
| | 57 324 800 or 57 325 000<br>or 57 320 000<br>or 57 300 000 or 57.3 million | A1 | oe<br>Accept 57 million if working shown<br>Ignore further rounding of correct answer |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **12** | Fully correct enlargement with vertices at (–3, –4), (–4, –2) and (–4, –4) | B2 | B1 for any enlargement SF $\frac{1}{3}$<br>B1 for 2 correct vertices |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **13** | (Vertical scale) does not start at 0<br>or incorrect height bars<br>or vertical scale is incorrect<br>or Area not proportional to frequency | B1 | Any order |
| | Last bar (should be at height 1) | B1 | |
| | Label on vertical scale incorrect<br>e.g. should be frequency density | B1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **14(a)** | $2 < x \leq 6$ | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 14(b) | 1, 2, 3, 4, 5, 6 | B2 | B1 for 5 correct and 1 missing<br>B1 for 6 correct and 1 incorrect<br>B1 for $1 \leq x < 7$<br><br>B0 for 2 or more errors<br><br>1, 2, 3, 4, 5       B1<br>1, 2, 3, 4, 5, 6, 7    B1<br><br>2, 3, 4, 5, 6, 7     B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 15 | Sequence continued correctly horizontally for at least two terms | M1 | 128 and 256 (and 512) |
| | A calculation that leads to $x$ if evaluated correctly<br><br>or extending the sequence to at least row 3 | M1dep | $2^{24}$ or $4^{12}$<br><br>$16 \times 32^4$<br><br>$64^4$ |
| | 16 777 216 | A1 | |
| | their value in standard form<br>or their value to 3 s.f. | B1ft | $1.67(77216) \times 10^7$<br>or $1.6 \times 10^7$<br>or $1.7 \times 10^7$<br><br>or 16 800 000<br><br>For standard form allow rounding or truncation |
| | $1.68 \times 10^7$ | B1ft | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 16(a) | 150 | B1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **16(b)** | 360 – 150 or 210 <br><br> or 360 – their 150 | M1 | oe <br> *OCA* = 18 seen or implied <br> or 180 – 18 – 75 or 87 |
|  | 360 – 18 – 75 – 210 <br><br> or 360 – 18 – 75 – their 210 | M1dep | oe <br> *OCB* = 75 – 18 or 57 seen or implied <br> 180 – 93 – 30 or 87 – 30 |
|  | 57 | A1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **17(a)** | $14x^7y^7z^7$ or $14(xyz)^7$ | B3 | B2 for 3 correct terms <br> B1 for 2 correct terms <br> Do not ignore further work for final mark |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **17(b)** | $\dfrac{2(x-5)}{(x+4)}$ or $\dfrac{2x-10}{x+4}$ | B2 | B1 for $\dfrac{2(x-5)^2}{(x-5)(x+4)}$ <br><br> B1 for $\dfrac{6(x-5)}{3(x+4)}$ or $\dfrac{6x-30}{3x+12}$ <br><br> Do not ignore further work |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **17(c)** | $(x + 1)(x + 1 + 4)$ | M1 | $x^2 + x + x + 1 + 4x + 4$ <br> or $x^2 + 2x + 1 + 4x + 4$ <br> or $x^2 + 6x + 5$ |
|  | $(x + 1)(x + 5)$ | A1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **17(d)** | $2(x – 5y)(x + 5y)$ | B3 | B2 for $(2x – 10y)(x + 5y)$ <br> B2 for $(x – 5y)(2x + 10y)$ <br><br> B1 for $2(x^2 – 25y^2)$ <br><br> SC2 for $(\sqrt{2}x – \sqrt{50}y)(\sqrt{2}x + \sqrt{50}y)$ <br><br> SC2 for $(\sqrt{2}x – 5\sqrt{2}y)(\sqrt{2}x + 5\sqrt{2}y)$ <br><br> SC1 for $2(x – 5)(x + 5)$ <br> SC1 for $(x – 5y)(x + 5y)$ |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **18** | 2 × $\pi$ × 12 or [75.3, 75.4] | M1 | oe<br>$24\pi$ |
| | $\dfrac{135}{360}$ × 2 × $\pi$ × 12  (+ 24)<br><br>or [28.2, 28.3] | M1dep | oe<br>$9\pi$  (+24) |
| | [52.2, 52.3] | A1 | Do not award if $\pi$ = 3 used |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **19** | $\dfrac{6.9}{\sin A} = \dfrac{11.3}{\sin 71}$ | M1 | oe<br>$(\dfrac{h}{6.9} = \sin 71,\quad h = 6.52(4…))$<br>$\sin A = \dfrac{\text{their } 6.52}{11.3}$ |
| | $\dfrac{6.9 \sin 71}{11.3}$ or 0.57(7…) | M1dep | $\sin^{-1}(\dfrac{\text{their } 6.52}{11.3})$ |
| | 35.2(645…) | A1 | |
| | 35 or 35.3 | B1ft | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **20** | 0.65 seen | B1 | |
| | 4.8 × 1.2 × their 0.65 or  3.744<br>or 4.8 × their 0.65 or  3.12 | M1 | their 0.65 must be in range [0.65, 0.75] but not 0.7<br>$\dfrac{h}{4.8} = \dfrac{\text{their } 0.65}{2.8}$ |
| | their 3.744 ÷ (1.2 × 2.8)<br>or their 3.12 ÷ 2.8 | M1dep | $\dfrac{\text{their } 0.65 \times 4.8}{2.8}$ |
| | 1.11… | A1 | |
| | 1.1 | B1ft | SC2 for 1.2<br>ft their rounded value from 2 d.p. or more |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| | $8 \times \dfrac{1}{2}n(n+1)$     (+1) | M1 | |
| | $4n(n + 1)$     (+ 1) <br> or $4n^2 + 4n$     (+ 1) | M1dep | |
| | $(2n + 1)^2$ or $(2n + 1)(2n + 1)$ | A1 | |
| **21** | $(2n + 1)^2$ is a square number <br><br> or $2n + 1$ is odd <br> **and** odd × odd = odd <br><br> or multiple of 4 is even <br> **and** even + 1 = odd <br><br> or $4(n^2 + n)$ is even <br> **and** even + 1 = odd <br><br> or $4n^2$ is even **and** $4n$ is even <br> **and** even + 1 = odd | A1 | oe <br><br><br> odd$^2$ = odd <br><br><br> or <br> $n(n + 1)$ is odd × even or even × odd <br> so $n(n + 1)$ is even <br> **and** even × 4 = even <br> **and** even + 1 = odd |
| | $(2n + 1)^2$ is a square number <br> **and** <br> $2n + 1$ is odd <br> **and** odd × odd = odd <br><br> or multiple of 4 is even <br> **and** even + 1 = odd <br><br> or $4(n^2 + n)$ is even <br> **and** even + 1 = odd <br><br> or $4n^2$ is even **and** $4n$ is even <br> **and** even + 1 = odd | Q1 | Strand (ii) <br> Both parts of the proof required. <br><br> or <br> $n(n + 1)$ is odd × even or even × odd <br> so $n(n + 1)$ is even <br> **and** even × 4 = even <br> **and** even + 1 = odd <br><br><br> SC1 for 8 × $S$ = even <br> **and** even + 1 = odd |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **Alt 1** **22(a)** | $\dfrac{3}{4}$ or $\dfrac{4}{5}$ seen | M1 | oe  decimal or percentage |
| | $\dfrac{3}{4}$ × $\dfrac{4}{5}$ | M1dep | oe  decimal or percentage |
| | $\dfrac{3}{5}$ or $\dfrac{12}{20}$ | A1 | oe<br>0.6 or 60% |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **Alt 2** **22(b)** | $\dfrac{3}{4}$ × $\dfrac{1}{5}$ or $\dfrac{3}{20}$ | M1 | Hit then miss |
| | $\dfrac{1}{4}$ × $\dfrac{4}{5}$ or $\dfrac{4}{20}$ or $\dfrac{1}{5}$ | M1 | Miss then hit |
| | $\dfrac{3}{20}$ + $\dfrac{4}{20}$ | M1dep | dependent on both previous marks |
| | $\dfrac{7}{20}$ | A1 | oe<br>0.35 or 35% |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **Alt 3** **22(b)** | $\dfrac{1}{4}$ × $\dfrac{1}{5}$ or $\dfrac{1}{20}$ | M1 | Miss then miss |
| | $\dfrac{1}{20}$ + their $\dfrac{12}{20}$ | M1 | ft from their (a) |
| | $1 - \dfrac{1}{20}$ – their $\dfrac{12}{20}$ | M1dep | oe |
| | $\dfrac{7}{20}$ | A1 | oe<br>0.35 or 35% |