Version 1.0

# General Certificate Secondary of Education
# June 2012

## Methods in Mathematics (Pilot) 9365

## Unit 2 Higher Tier 93652H

# *Mark Scheme*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.

| | |
|---|---|
| **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. (QWC) |
| **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 following a mistake in an earlier step. |
| **SC** | Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth. |
| **oe** | Or equivalent. Accept answers that are equivalent.<br>eg, accept 0.5 as well as $\frac{1}{2}$ |

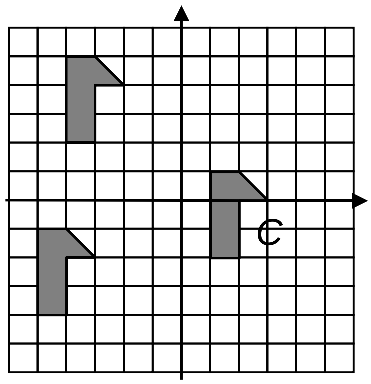
# M2 Higher Tier

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(a) | $4x - 12$ | B1 | |
| 1(b) | $y(y - 7)$ | B1 | |
| 1(c) | $3p + 6 = 18$ | M1 | Must see an attempt at expansion. Allow arithmetic error but not $3p + 2$<br>or Must see attempt at division by 3 Allow arithmetic errors for $18 \div 3$<br>or flow chart $\times 3 + 6$ gets M1<br>but $+2 \times 3$ must see an attempt at inverse flow chart |
| | $3p = 12$ | A1 | $p + 2 = 6$. |
| | 4 | A1 ft | ft on one sign, arithmetic or rearrangement error<br>SC1 For $p = \frac{16}{3}$ from $3p + 2$ oe<br>Allow embedded answer if clear |
| 2 | Sum (need not be evaluated) of any two primes between 11 and 59 inclusive, eg 17 + 19 | M1 | List of at least 5 primes, which must include at least 2 correct 2-digit primes, with at most 1 error for every 5 primes<br>eg 1, 2, 3, 5, 7, 9, 11, 13 is B0<br>2, 3, 5, 7, 9, 11, 13 is B1 |
| | Finds a mid-point for chosen pair of primes<br>eg, adds and divides by 2 or draws a number line, or similar and attempts to find mid-point | M1 Dep | |
| | Any of (11, 23), (11, 47), (17, 29), (17, 41), (19, 43), (23, 59), (29, 53), (31, 43), (41, 53), (47, 59) | A1 | SC1 Correct prime answer for any two-digit prime up to 60 and any odd two-digit non-prime up to 60<br>SC2 Correct prime answer for any single digit prime and any two-digit prime up to 60 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| ***3(a)** | 68 | B1 | |
| | Alternate | Q1 | Strand (i)<br>Q0 for Z angle but ignore if alternate also stated<br>Accept 'alternative' or 'alternating' but not 'alternative segment'<br>If other explanations involving angles on a straight line, interior, opposite, corresponding angles etc must be complete and use correct terminology |
| **3(b)** | $360 \div 5$<br>**NB** It must be clear that they are calculating the exterior angle<br>This may be informed by the diagram. | M1 | $540 \div 5$ oe eg $3 \times 180 \div 5$<br>**NB** It must be clear that they are calculating the interior angle.<br>This may be informed by the diagram |
| | 72 | A1 | 108 |
| | Their 72 + 90 (their 72 must be $<$ 90) | M1 | 360 – (their 108 + 90) (their 108 must be $>$ 90) |
| | 162 | A1 ft | ft with 90 from square or 'exterior' of square only |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **4(a)** | Sight of 10 | M1 | Alt $30 \times 30 \div 9$ |
| | 100 | A1 | |
| ***4(b)** | $450 \div 30$ (= 15) or $300 \div 30$ (= 10)<br>Allow mix of units | M1 | oe Area patio ÷ area larger square<br>Allow mix of units |
| | $450 \div 30$ (= 15) **and** $300 \div 30$ (= 10)<br>$4.50 \div 0.3$ (= 15) **and** $3 \div 0.3$ (= 10) | M1 Dep | $450 \times 300 \div 900$ or $4.5 \times 3 \div 0.09$ |
| | 150 square | A1 | |
| | Attempts to find total number of large squares in the patio by dividing both sides by 30 or 0.3 and multiplying values, giving this as the number of small squares and multiplying by 4 to get number of rectangles<br>150 and 600 is 4 marks with working, 3 marks if no working | Q1 | Strand (iii)<br>Attempts to divide area of patio by area of larger square giving this as the number of small squares and multiplying by 4 to get number of rectangles<br>150 and 600 is 4 marks with working. 3 marks if no working<br>SC1 Rectangular = 4 × squares if no other marks awarded |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(a)** | (76 – 68)   (= 8) | M1 | |
| | 60 + 4 × 8  or  68 + 3 × 8<br>or 76 + 2 × 8 | M1 | 60, 68, 76, 84, 92, (100, ….) |
| | 92 | A1 | SC2  100 |
| **5(b)** | 8$n$   8 × $n$   $n$(8) | B1 | Do not accept $n$8 but any other algebra is OK, eg $n$ × 8 |
| | 8$n$ + 52 or equivalent<br>eg 60 + 8 × ($n$ – 1) | B1 Dep | Do accept $n$8 + 52 for B0, B1<br>8$n$ + 60 or equivalent after 100 in (a) is 2 marks |
| **6(a)** | 60 × 20 × 25 (= 30 000) | M1 | oe |
| | 630 000 ÷ their 30 000 | M1 Dep | |
| | 21 | A1 | |
| **6(b)** | 27 ÷ 3 × 25 | M1 | oe  25, 50, 75, 100, 125, 150, …. or correct attempt to build up the heights as far as 150 but if it goes beyond 225 then M0 |
| | 225 | A1 | SC1 675 |
| | 2.25 | B1ft | Their height if a value stated (in cm) and converted to m<br>**NB** If initial calculation uses 0.25 this is B1.<br>SC2  6.75 from 27 × 25 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **7(a)** |  | B2 | B1 For translation of $\begin{pmatrix}5\\a\end{pmatrix}$<br>or translation $\begin{pmatrix}b\\-4\end{pmatrix}$ |
| **7(b)** | $\begin{pmatrix}-1\\-6\end{pmatrix}$ | B2 | B1 For –1 in first line<br>B1 For –6 in second line<br>B1 For $\begin{pmatrix}1\\6\end{pmatrix}$<br>B1 For $\begin{pmatrix}-6\\-1\end{pmatrix}$<br>B1 For (–1, –6) seen if no vector filled in |
| **8** | 36420 – 32518 (= 3902) | M1 | |
| | Their 3902 ÷ 32 518 (× 100) | M1 Dep | |
| | 12% from 11.99 … | A1 | 11.9 … is 2/3 |
| **8 Alt 1** | 36 420 ÷ 32 518 (×100) | M1 | |
| | 1.119 … or 111.9 … | A1 | 112 |
| | 12% | A1 | |
| **8 Alt 2** | 10% + 1% (+ 1%) = 3251.8 + 325.18 (+ 325.18) | M1 | M1 For attempt to find a whole number percentage greater than 10% with at least 10% correct<br>32518 + 3251.8 + 325.18 + (325.18) |
| | 3576.98, 3902.16 | M1 Dep | 36094.98, 36420.16 |
| | 12% | A1 | |
| **9** | $3(x + 1) + 2(x + 4)$ | M1 | |
| | $5x + 11$ | A1 | |
| | Their $5x + 11 = 12$ | M1 | $3(x + 1) + 2(x + 4) = 12$ is M2 |
| | 0.2 | A1 ft | oe ft on one error but both Ms awarded |

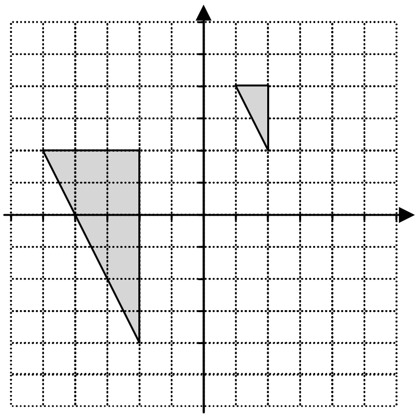
| Q | Answer | Mark | Comments |
|---|---|---|---|
| 10(a) | $32^2$ (1024) and $26^2$ (676) | M1 | $x^2 + 26^2 = 32^2$ or 1024 – 676 |
| | $\sqrt{32^2 - 26^2}$ | M1 Dep | Square root must be seen or implied |
| | [18.6, 19] $2\sqrt{87}$ | A1 | Accept 19 with working |
| Alt 10(a) | $\cos^{-1}(26 \div 32) = 35.65\ldots$<br>**and** either $x = 26\tan(35.65)$<br>or $x = 32\sin(35.65)$ | M2 | Must be a complete alternative method for M2 |
| | [18.6, 19] $2\sqrt{87}$ | A1 | Accept 19 with working |
| 10(b) | Sight of cos | M1 | |
| | $\cos y = 11 \div 17$ | M1 Dep | |
| | [49.5, 50] | A1 | Accept 50 with working |
| Alt 10(b) | $\sqrt{(17^2 - 11^2)} = 12.96$ **and**<br>either $\sin^{-1}(12.96 \div 17)$<br>or $\tan^{-1}(12.96 \div 11)$ | M2 | Must be a complete alternative method for M2 |
| | [49.5, 50] | A1 | Accept 50 with working |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **11** | Sight of 0.6 | B1 | |
| | 2 (00) $\times$ $0.6^9$ | M1 | |
| | [2, 2.02] | A1 | 2.0155392<br>SC2 [3.35, 3.36]<br>SC2 [1.2, 1.21]<br>2 must be supported by working. |
| **Alt 11** | (This is for the build up method)<br>200, 120, 72, 43.2 seen | M1 | or same digits |
| | All values up to 8 bounces within the range of the table below | A1 | |
| | [2, 2.1] | A1 ft | SC2 [3.3, 3.4]<br>SC2 [1.2, 1.26]<br>ft on one error |

| **Time** | **Minimum value** | **Maximum value** |
|---|---|---|
| 0 | 200 | 200 |
| 1 | 120 | 120 |
| 2 | 72 | 72 |
| 3 | 43 | 43.2 |
| 4 | 25 | 26 |
| 5 | 15 | 15.6 |
| 6 | 9 | 9.4 |
| 7 | 5 | 5.7 |
| 8 | 3 | 3.5 |
| 9 | 2 | 2.1 |
| 10 | 1.2 | 1.26 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **12** | $(x \pm a)(x \pm b)$ | M1 | $ab = \pm 10$ |
| | $(x - 5)(x - 2)$ | A1 | |
| | $(x = )\ 5, 2$ | A1 ft | ft Their brackets if M1 awarded |
| **12 Alt 1** | $(x - 3\frac{1}{2})^2 - (3\frac{1}{2})^2 + 10$ | M1 | |
| | $x - 3\frac{1}{2} = \pm 1\frac{1}{2}$ | A1 | ± must be seen |
| | $(x = )\ 5, 2$ | A1 | |
| **12 Alt 2** | $\dfrac{7 \pm \sqrt{(-7)^2 - 4 \times 1 \times 10}}{2}$ | M1 | Accept $-7^2$ in square root |
| | $\dfrac{7 \pm \sqrt{9}}{2}$ | A1 | ± must be seen |
| | $(x = )\ 5, 2$ | A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **13** | 3:15<br>or chooses a multiple of 18 greater than 18 and divides into ratio 1 : 5 or 7:11 | M1 | eg 36 ⇒ 6 : 30 or 14 : 22<br>**NB** Look on diagram for values |
| | Difference of their first or second values | M1 | eg 7 – 3, 15 – 11, 14 – 6 or 30 – 22 |
| | 3 : 4 : 11 | A1 | oe 6 : 8 : 22<br>**NB** 3 : 7 : 11 implies M1<br>3 : 4 : any value or any value : 4: 11 implies M2 (or equivalents including decimals).<br>Check if any 'pair of ratios' is correct.<br>If so then award M1 |
| **Alt 13** | $\frac{1}{6}, \frac{5}{6}$ and $\frac{7}{18}, \frac{11}{18}$ | M1 | oe |
| | $\frac{7}{18} - \frac{1}{6} \left(= \frac{4}{18}\right)$ | M1 | oe |
| | 3 : 4 : 11 | A1 | oe 6 : 8 : 22 $\frac{1}{6} : \frac{2}{9} : \frac{11}{18}$ |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **14** | $8^2 + 9^2 - 2 \times 8 \times 9 \times \cos 54$ | M1 | |
| | 60.358 … | A1 | |
| | [7.769 …, 8] | A1 | 8 with working |
| **15(a)** | Correct transformation  | B2 | B1 Any enlargement sf $\frac{1}{3}$<br>B1 For any 2 vertices in correct position<br>B1 For at least 2 rays drawn from (4, 5) to *P*, *Q*, or *R* |
| **15(b)** | (22, ….) | B1 | |
| | (…., 14) | B1 | |
| **16** | 32 – 15 (= 17) | M1 | Check diagram |
| | *y* coordinate = 19 | A1 | |
| | 36 – 17 – 10 (= 9) | M1 | oe eg 26 – 17 |
| | *x* coordinate = 23 | A1 | (19, 23) is A1 max |
| **Alt 16** | Graph drawn with *A* at (15, 10) and *B* at (32, 36) | M1 | |
| | Any rectangles drawn from A and B matching the diagram. | M1 | |
| | *x* coordinate = 23 | A1 | |
| | *y* coordinate = 19 | A1 | |
| **17** | $2 \times PF = 24$ | M1 | oe |
| | $x = 7$ | A1 | |
| | $6 \times y = (\text{their } x + 2) \times 5$ | M1 Dep | |
| | $y = 7.5$ | A1 ft | ft Their *x*<br>SC1 No valid working but $8 \times 3$ or 24 seen |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **18** | $(x + 2)$ | M1 | |
| | $(x + 2)^2 - 4\ (-8)$ | A1 | $(x + 2)^2 - 12$ or $(x + 2)^2 = 12$ |
| | $(x + 2) = \pm\sqrt{12}$ | M1 | Allow M1 for moving their constant term over equal sign and square rooting, but must have ± |
| | $(x =) -2 \pm \sqrt{12}$ **and** $\sqrt{12} = \sqrt{(4 \times 3)}$ or state $\sqrt{12} = 2\sqrt{3}$ | A1 | Must show that $\sqrt{12} = 2\sqrt{3}$ for A1 |
| **18 Alt 1** | $(-2 + 2\sqrt{3})^2 + 4(-2 + 2\sqrt{3}) - 8$ | M1 | |
| | $4 + -8\sqrt{3} + 12 - 8 + 8\sqrt{3} - 8 = 0$ | A1 | All terms must be correctly evaluated to at least those shown and some indication that they cancel<br>Stating = 0 is not enough |
| | $(-2 - 2\sqrt{3})^2 + 4(-2 - 2\sqrt{3}) - 8$ | M1 | |
| | $4 + 8\sqrt{3} + 12 - 8 - 8\sqrt{3} - 8 = 0$ | A1 | All terms must be correctly evaluated to at least those shown and some indication that they cancel<br>Stating = 0 is not enough |
| **18 Alt 2** | $\dfrac{-4 \pm \sqrt{(4)^2 - 4 \times 1 \times (-8)}}{2 \times 1}$ | M1 | If quadratic formula used, maximum 3 marks |
| | $\dfrac{-4 \pm \sqrt{48}}{2}$ | A1 | Must have ± |
| | $-2 \pm \dfrac{\sqrt{16 \times 3}}{2}$ | A1 | Must show the division of both terms and that $\sqrt{48} = 4\sqrt{3}$ |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| ***19** | (vol cyl = ) $\pi \times r^2 \times 6r$ | M1 | (vol cyl = ) $18.849\ldots\ r^3$ |
| | (vol spheres = ) $3 \times \frac{4}{3} \times \pi r^3$ | M1 | (vol spheres = ) $3 \times 4.188\ldots \times r^3$ |
| | $6\pi r^3$ and $4\pi r^3$ | A1 | $18.849\ldots\ r^3$ **and** $12.566\ldots\ r^3$ |
| | Both volumes correctly worked and $4 = \frac{2}{3} \times 6$ or equivalent seen | Q1 | Strand (ii) - Numerical values must be stated to 1 dp accuracy at least and score Q0 even if shown to be in ratio 0.6666 … |