Mark Scheme (Results)

November 2012

GCSE Mathematics (2MB01) Higher
5MB3H (Calculator) Paper 01

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NOTES ON MARKING PRINCIPLES

1   All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.

2   Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.

3   All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.

4   Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.

5   Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

6   Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

i) *ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear*
    Comprehension and meaning is clear by using correct notation and labeling conventions.

ii*) select and use a form and style of writing appropriate to purpose and to complex subject matter*
    Reasoning, explanation or argument is correct and appropriately structured to convey mathematical reasoning.

iii) *organise information clearly and coherently, using specialist vocabulary when appropriate*.
    The mathematical methods and processes used are coherently and clearly organised and the appropriate mathematical vocabulary used.

7 With working

If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.

If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.

If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks. Send the response to review, and discuss each of these situations with your Team Leader.

If there is no answer on the answer line then check the working for an obvious answer.

Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks. Discuss each of these situations with your Team Leader.

If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.

8 Follow through marks

Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.

Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

9 Ignoring subsequent work

It is appropriate to ignore subsequent work when the additional work does not change the answer in a way that is inappropriate for the question: e.g. incorrect canceling of a fraction that would otherwise be correct

It is not appropriate to ignore subsequent work when the additional work essentially makes the answer incorrect e.g. algebra.

Transcription errors occur when candidates present a correct answer in working, and write it incorrectly on the answer line; mark the correct answer.

10   Probability
Probability answers must be given a fractions, percentages or decimals. If a candidate gives a decimal equivalent to a probability, this should be written to at least 2 decimal places (unless tenths).
Incorrect notation should lose the accuracy marks, but be awarded any implied method marks.
If a probability answer is given on the answer line using both incorrect and correct notation, award the marks.
If a probability fraction is given then cancelled incorrectly, ignore the incorrectly cancelled answer.

11   Linear equations
Full marks can be gained if the solution alone is given on the answer line, or otherwise unambiguously indicated in working (without contradiction elsewhere). Where the correct solution only is shown substituted, but not identified as the solution, the accuracy mark is lost but any method marks can be awarded.

12   Parts of questions
Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

13 **Range of answers**

Unless otherwise stated, when an answer is given as a range (e.g 3.5 – 4.2) then this is inclusive of the end points (e.g 3.5, 4.2) and includes all numbers within the range (e.g 4, 4.1)

Guidance on the use of codes within this mark scheme
M1 – method mark A1 – accuracy mark B1 – Working mark C1 – communication mark QWC – quality of written communication oe – or equivalent cao – correct answer only ft – follow through sc – special case dep – dependent (on a previous mark or conclusion) indep – independent isw – ignore subsequent working

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Question	Working	Answer	Mark	Notes
1	$3x > 11$ $x > \dfrac{11}{3}$ or 3.66.. OR $(16 - 5) \div 3$ $\dfrac{11}{3}$ or 3.66..	4	3	M1 $3x > 11$ or $3x > 16 - 5$ or $3x + 5 - 5 > 16 - 5$ A1 $\dfrac{11}{3}$ or 3.6(66..) or 3.7 (Accept = or $\geq$ in place of >) B1 ft OR M1 $(16 - 5) \div 3$ A1 $\dfrac{11}{3}$ or 3.6(66..) or 3.7 B1 ft
2	$x + x + 4 + x - 2 = 26$ $3x + 2 = 26$ $3x = 24$ $x = 8$ OR $26 - 4 = 22$ $22 + 2 = 24$ $24 \div 3$	8	4	M1 $x + x + 4$ or $x + x - 2$ or $x + 4 + x - 2$ or "expression in x" $+ x + 4 = 26$ or "expression in x" $+ x - 2 = 26$ M1(dep) "3"x + "2" = 26 M1 "3"x = 26 - "2" A1 cao OR M1 $26 - 4$ or $26 + 2$ M1 "22" + 2 or "28" - 4 M1 "24" ÷ 3 A1 cao OR M3 6 + 8 + 12 seen (M2 three ages that meet the criteria $x, x + 4$ and $x - 2$) (M1 two trials of three ages added or a set of three ages that would add to 26) A1 cao

Question	Working	Answer	Mark	Notes
3	$\pi \times 20$	62.8 cm	3	M1 $\pi \times 20$ or $\pi \times 19.5$ or $\pi \times 19.95$ A1 62.8 – 63 B1(indep) for units consistent with answer
4*	$1.22 + 0.96 + 2.42 = 4.60$ $1.15 + 0.86 + 2.28 = 4.29$ $4.60 \times 0.95 = 4.37$ $4.37 > 4.29$ OR $1.22 \times 0.95 = 1.159$ $0.96 \times 0.95 = 0.912$ $2.42 \times 0.95 = 229.9$ $1.159 + 0.912 + 2.299 = 4.37$ OR $1.22 \times 0.95 = 1.159$ $0.96 \times 0.95 = 0.912$ $2.42 \times 0.95 = 229.9$ $1.159 > 1.15$ and $0.912 > 0.86$ and $2.229 > 2.28$	no 5% reduction will not be enough	3	M1 $1.22 + 0.96 + 2.42$ or 4.60 or $1.15 + 0.86 + 2.28$ or 4.29 A1 4.37 and 4.29 C1 (dep on M1) ft clear statement of comparison based on their answers OR M1 1.22×0.95 oe or 0.96×0.95 oe or 2.42×0.95 oe A1 4.37 and 4.29 C1 (dep on M1) ft clear statement of comparison based on their answers OR M1 1.22×0.95 oe or 0.96×0.95 oe or 2.42×0.95 oe A1 115.9 or 116 or 115 **and** 91.2 or 91 or 92 **and** 229.9 or 229 or 230 C1(dep on M1) ft clear statement of comparison based on their answers NB Allow working throughout in pence or pounds

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Question		Working	Answer	Mark	Notes
5		$64 \div 10 = 6.4$ arc of radius 6.4cm drawn with cross at 70° OR $64 \div 10 = 6.4$ line drawn at 70° with cross at 6.4cm	Town B marked	2	B2 town B marked in correct place (B1 bearing 070° $\pm$ 2° or 6.4 $\pm$ 0.2cm)
6	(a)	$6p - 15 = 21$ $6p = 36$ OR $2p - 5 = 7$ $2p = 12$	6	3	M1 $3 \times 2p - 3 \times 5$ or $6p - 15$ M1 "6"p - "15" + "15" = 21 + "15" A1 cao OR M1 $2p - 5 = 21 \div 3$ M1 $2p - 5 + 5 = 5 + "7"$ A1 cao
	(b)	$9x - 11 = 5x + 7$ $9x - 5x = 7 + 11$ $4x = 18$	4.5	3	M1 correct method to isolate either the term in x or the numerical term e.g $9x - 5x - 11 = 5x - 5x + 7$ or $9x = 5x + 18$ A1 $4x = 18$ or $-18 = -4x$ A1 4.5 oe
7		$9^2 + 14^2 = 81 + 196 = 277$ $AB = \sqrt{277}$	16.6	3	M1 $9^2 + 14^2$ or $81 + 196$ or 277 M1 $\sqrt{277}$ or $\sqrt{81 + 196}$ or A1 16.6 -16.644

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Question		**Working**	**Answer**	**Mark**	**Notes**
8*		Paint for You $7.5 \div 2.5 = 3$ tins $3 \times 8.35 = £25.05$ $25.05 \times 1.20 = £30.06$ Paul's paints $7.5 \div 0.75 = 10$ tins $10 \times 3.15 = £31.50$ OR Paint for You $8.35 \times 1.20 = £10.02$ $10.02 \div 2.5 = £4.008$ per litre Paul's Paints $3.15 \div 0.75 = £4.20$ per litre There is no wastage	Paint for You (2.5 litre tins)	4	M1 $7.5 \div 2.5$ or 3 seen or $7.5 \div 0.75$ or 10 seen M1 $8.35 \times 1.2(0)$ oe or 10.02 or "25.05" $\times 1.2(0)$oe M1 "3" $\times 8.35$ or "3" $\times$ "10.02" **and** "10" $\times 3.15$ C1 for both 30.06 and 31.5(0) and correct conclusion OR M1 $7.5 \div 2.5$ or 3 seen or $7.5 \div 0.75$ or 10 seen M1 $8.35 \times 1.2(0)$ oe or 10.02 or $8.35 \div 2.5 \times 1.2(0)$oe or $3.34 \times 1.2(0)$ oe M1 "10.02" $\div 2.5$ or 4.008 or 4.01 **and** $3.15 \div 0.75$ or 4.20 C1 for both 4.008 (or 4.01) and 4.2(0) and correct conclusion OR M1 $7.5 \div 2.5$ or 3 seen or $7.5 \div 0.75$ or 10 seen M1 $8.35 \times 1.2(0)$ oe or 10.02 M1 $2.5 \div 0.75$ **and** "10.02" $\div 3.15$ C1 for both 3.3(3.. and 3.1(8...) and correct conclusion OR any equivalent process using correct methods which leads to two values that can be compared

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Question	**Working**	**Answer**	**Mark**	**Notes**
9	$9 \times 7 - 4 \times 5 = 43$ 43×8 OR $9 \times 7 \times 8 = 504$ $5 \times 4 \times 8 = 160$ $504 - 160$ OR $9 \times 2 + 5 \times 5$ 43×8 OR $9 \times 2 \times 8 = 144$ $5 \times 5 \times 8 = 200$ $144 + 200$ OR $7 \times 5 \times 8 = 280$ $2 \times 4 \times 8 = 64$ $280 + 64$	344	3	M1 $9 \times 7 - 4 \times 5$ or 43 M1 "43" $\times 8$ A1 cao OR M1 $9 \times 7 \times 8$ or 504 or $5 \times 4 \times 8$ or 160 M1 $9 \times 7 \times 8$ or 504 - $5 \times 4 \times 8$ or 160 A1 cao OR M1 $9 \times 2 + 5 \times 5$ or 43 M1 "43" $\times 8$ A1 cao OR M1 $9 \times 2 \times 8$ or 144 or $5 \times 5 \times 8$ or 200 M1 $9 \times 2 \times 8$ or 144 + $5 \times 5 \times 8$ or 200 A1 cao OR M1 $7 \times 5 \times 8$ or 280 or $2 \times 4 \times 8$ or 64 M1 $7 \times 5 \times 8$ or 280 + $2 \times 4 \times 8$ or 64 A1 cao

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Question		**Working**		**Answer**	**Mark**	**Notes**
10	(a)			reflected shape	2	B2 correct triangle drawn with vertices (4,4), (5,4) and (5,6) (B1 for a correct reflection in $x = a$)
	(b)			rotation centre (0,1) 90° anti-clockwise or 270° clockwise	3	B1 rotation B1 about the centre (0,1) B1 90° anticlockwise or 270° clockwise **NB** If more than one transformation seen then B0
11		x $\quad$ $x^3 - x$ 3.1 $\quad$ 26.(691) 3.2 $\quad$ 29.(568) 3.3 $\quad$ 32.(637) 3.4 $\quad$ 35.(904) 3.5 $\quad$ 39.(375) 3.6 $\quad$ 43.(056) 3.7 $\quad$ 46.(953) 3.8 $\quad$ 51.(072) 3.9 $\quad$ 55.(419) 3.25 $\quad$ 31.(078) 3.26 $\quad$ 31.3(85) 3.27 $\quad$ 31.6(95) 3.28 $\quad$ 32.0(07) 3.29 $\quad$ 32.3(21)		3.3	4	B2 for trial $3.2 \le x \le 3.3$ (B1 for trial $3 < x < 4$) B1 for different trial $3.25 \le x < 3.3$ B1 cao (dep on at least one previous B1) Accept trials correct to the nearest whole number (rounded or truncated) if the value of x is to 1dp but correct to 1dp (rounded or truncated) if the value of x is to 2dp

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Question		**Working**	**Answer**	**Mark**	**Notes**
12		½litre = 500ml $500 = \pi \times 4^2 \times h$ $h = 500 \div (\pi \times 4^2)$	9.95	5	B1 ½litre = 500ml or 500 seen M1 $\pi \times 4^2 \times h$ (= 50.2.×.h)or $\pi \times 4^2$ (= 50.2..) M1 "500" = $\pi \times 4^2 \times h$ oe M1 (h =) "500" ÷ ($\pi \times 4^2$) oe A1 9.9 – 10.0
13		168000 = 112% (of original price) 168000 ÷ 112 × 100	150000	3	M1 168000 = 112% or 112 or 100 + 12 or 1.12 or 1 + 0.12 with an intention to divide M1 168000 ÷ 1.12 or 16800 ÷ 112 × 100 A1 cao

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Question	**Working**	**Answer**	**Mark**	**Notes**
14	$AB = 5$ $\sin 36 = \dfrac{5}{AD}$ $AD = \dfrac{5}{\sin 36}$ Or $\sin 36 = \dfrac{5}{BC}$ $BC = \dfrac{5}{\sin 36}$ $AD = BC$ OR $\cos 54 = \dfrac{5}{BC}$ $BC = \dfrac{5}{\cos 54}$	8.51	4	B1 $AB = 5$ M1 $\sin 36 = \dfrac{5}{AD}$ or $\dfrac{\sin 36}{5} = \dfrac{\sin 90}{AD}$ M1 $AD = \dfrac{5}{\sin 36}$ or $AD = \dfrac{5\sin 90}{\sin 36}$ A1 $8.5 - 8.51$ OR M1 $\sin 36 = \dfrac{5}{BC}$ or $\dfrac{\sin 36}{5} = \dfrac{\sin 90}{BC}$ M1 $BC = \dfrac{5}{\sin 36}$ or $BC = \dfrac{5\sin 90}{\sin 36}$ B1 $AD = {'BC'}$ A1 $8.5 - 8.51$ OR B1 angle $DCB = 54$ or angle $DBC = 36$ M1 $\cos 54 = \dfrac{5}{BC}$ M1 $BC = \dfrac{5}{\cos 54}$ A1 $8.5 - 8.51$ NB Other methods such as tan + Pythagoras must be complete methods and will earn M2

Question		Working	Answer	Mark	Notes
15		$m^2 = \dfrac{k}{6}$	$m = \sqrt{\dfrac{k}{6}}$	2	M1 $m^2 = \dfrac{k}{6}$ or $\dfrac{6m^2}{6} = \dfrac{k}{6}$ or $\sqrt{6m^2} = \sqrt{k}$ or $\sqrt{6}\, m = \sqrt{k}$ A1 $m = \sqrt{\dfrac{k}{6}}$ or $m = \pm\sqrt{\dfrac{k}{6}}$ or $m = -\sqrt{\dfrac{k}{6}}$
16	(a)		2.5	1	B1 cao
	(b)	$500 \times (1.025)^{12}$	672.44	2	M1 ft $500 \times (\text{“}1.025\text{”})^{12}$ or 1.34… seen A1 672 or 672.44
17	(a)		5.5×10^4	1	B1 cao
	(b)		1 800 000	2	M1 1.8×10^n or $18(0.....\,)$ or 18×10^n or $3600000000 \times 0.00005$ A1 cao
18	(a)	$\begin{pmatrix} 4 \\ 8 \end{pmatrix} - \begin{pmatrix} 2 \\ 4 \end{pmatrix}$	$\begin{pmatrix} 2 \\ 4 \end{pmatrix}$	2	M1 $\overrightarrow{OQ} - \overrightarrow{OP}$ in co-ordinates or vectors or $\begin{pmatrix} 2 \\ y \end{pmatrix}$ or $\begin{pmatrix} x \\ 4 \end{pmatrix}$ A1 cao [SC If no marks then B1 $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ or $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$

Question		Working	Answer	Mark	Notes
18	(b)	$M = (3, 6)$ $N = (4, 8) + ½ (6, –4) = (7, 6)$ $\overrightarrow{MN} = \begin{pmatrix} 7 \\ 6 \end{pmatrix} - \begin{pmatrix} 3 \\ 6 \end{pmatrix}$ OR $\overrightarrow{MN} = ½\overrightarrow{PR}$ $\overrightarrow{PR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix} + \begin{pmatrix} 2 \\ 4 \end{pmatrix} = \begin{pmatrix} 8 \\ 0 \end{pmatrix}$ OR $\overrightarrow{MN} = ½\overrightarrow{PQ} + ½\overrightarrow{QR}$ $\overrightarrow{MN} = ½ \begin{pmatrix} 2 \\ 4 \end{pmatrix} + ½ \begin{pmatrix} 6 \\ -4 \end{pmatrix}$	$\begin{pmatrix} 4 \\ 0 \end{pmatrix}$	3	B1 $M = (3, 6)$ M1 $N = (4, 8) + ½ (6, –4)$ or $(7, 6)$ or $\overrightarrow{MN} = \begin{pmatrix} 7 \\ 6 \end{pmatrix} - \begin{pmatrix} 3 \\ 6 \end{pmatrix}$ A1 cao OR B1 $\overrightarrow{MN} = ½\overrightarrow{PR}$ M1 ft $\overrightarrow{PR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix} + \begin{pmatrix} '2' \\ '4' \end{pmatrix}$ or $\begin{pmatrix} 8 \\ 0 \end{pmatrix}$ A1 cao OR B1 $\overrightarrow{MN} = ½\overrightarrow{PQ} + ½\overrightarrow{QR}$ M1 ft $\overrightarrow{MN} = ½ \begin{pmatrix} '2' \\ '4' \end{pmatrix} + ½ \begin{pmatrix} 6 \\ -4 \end{pmatrix}$ A1 cao
19	(a)	$½ \times 9.2 \times 14.6 \times \sin 64$	60.4	2	M1 $½ \times 9.2 \times 14.6 \times \sin 64$ A1 60.3 – 60.4
	(b)	$AB^2 = 9.2^2 + 14.6^2 – 2 \times 9.2 \times 14.6 \times \cos 64$ $AB^2 = 297.8 – 268.64 \cos 64° = 297.8 - 268.64 \times 0.43837..$ $AB^2 = 297.8 – 117.76..$ $AB^2 = 180.03$ $AB = \sqrt{180.03}$	13.4	3	M1 $9.2^2 + 14.6^2 – 2 \times 9.2 \times 14.6 \times \cos 64°$ M1 (dep) for correct order of evaluation e.g. 297.(8) – 117.(7..) A1 13.4 – 13.42

Question	Working	Answer	Mark	Notes
20	$SF = (x^2 - 1) \div 2\,(x - 1)$ $= (x - 1) \times (x + 1) \div 2\,(x - 1)$ $= \frac{1}{2}\,(x + 1)$ Area $DEF = 4 \times$ $\left[\dfrac{1}{2}(x+1)\right]^2$ $= (x + 1)^2$ $= x^2 + 2x + 1$		4	M1 $(x^2 - 1) \div 2\,(x - 1)$ or $SF \times 2\,(x - 1) = (x^2 - 1)$ M1 $\frac{1}{2}\,(x + 1)$ or $(x - 1) \times (x + 1) \div 2\,(x - 1)$ M1 $4 \times \left(\dfrac{x+1}{2}\right)^2$ or $4 \times \left(\dfrac{x^2 - 1}{2(x-1)}\right)^2$ C1 fully correct convincing process OR M1 $(x^2 + 2x + 1) \div 4$ M1 $\sqrt{\left(x^2 + 2x + 1\right) \div 4}$ or $\sqrt{(x+1)(x+1) \div 4}$ or $(x + 1) \div 2$ M1 $2\,(x - 1) \times (x + 1) \div 2$ C1 fully correct convincing process
21	$x^2 + (2x + 5)^2 = 25$ $x^2 + 4x^2 + 20x + 25 = 25$ $5x^2 + 20x = 0$ $5x\,(x + 4) = 0$ $x = 0,\ x = -4$ $y = 2 \times 0 + 5$ $y = 2 \times -4 + 5$	$x = 0,$ $y = 5$ or $x = -4,$ $y = -3$	6	M1 $x^2 + (2x + 5)^2\ (= 25)$ A1 $x^2 + 4x^2 + 10x + 10x + 25\ (= 25)$ M1 Use of factorisation or correct substitution into quadratic formula or completing the square to solve an equation of the form $ax^2 + bx + c = 0,\ a \neq 0$ A1 $x = 0,\ x = -4$ M1 substitution of an x value into an original equation A1 $y = 5,\ y = -3$ correctly matched to x values SC (If M0M0M0 then B1 for one pair (x, y) of correct answers)