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Mark Scheme (Results)

November 2013

Pearson Edexcel GCSE
Linked Pair Pilot in Mathematics
Methods in Mathematics (2MM01)
Higher Paper 1H

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If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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

PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
1	(i)		3179000	1	B1 cao
	(ii)		317.9(0)	1	B1
	(iii)		37400	1	B1 cao
2	(a)		$\frac{3}{7}$	1	B1 for $\frac{3}{7}$ oe
	(b)	$\frac{3}{9}+\frac{2}{9}$	$\frac{5}{9}$	1	B1 for $\frac{5}{9}$ oe
3			78	4	M1 for a correct method to find the area of a relevant rectangle. M1 for a correct method to find the area of a relevant triangle M1 for a complete and correct method to find the total area A1 cao Or M2 for splitting the shape into two trapeziums and using a correct method to find the area of the trapezium M1 for 2 ×'area of trapezium' A1 cao

<table>
<tr><th colspan="4">PAPER: 5MM1H_01</th></tr>
<tr><th colspan="2">Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td>4</td><td></td><td><table><tr><td>−1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td><td>−1</td></tr></table></td><td>correct line drawn</td><td>3</td><td>(Table of values)
M1 for at least 2 correct attempts to find points by substituting values of x.
M1 ft for plotting at least 2 of their points (any points plotted from their table must be correct)
A1 for correct line between -1 and 4

(No table of values)
M2 for at least 2 correct points (and no incorrect points) plotted OR
line segment of $y = 7 - 2x$ drawn (ignore any additional incorrect segments)
(M1 for at least 3 correct points with no more than 2 incorrect points)
A1 for correct line between -1 and 4

(Use of y=mx+c)
M2 line segment of $y = 7 - 2x$ drawn (ignore any additional incorrect segments)
(M1 for line drawn with gradient of −2 OR line drawn with a y intercept of 7 and a negative gradient)
A1 for correct line between -1 and 4</td></tr>
<tr><td>5</td><td></td><td>$\frac{200}{0.5}$</td><td>400</td><td>2</td><td>M1 for rounding to 200 or 0.5
A1 cao</td></tr>
</table>

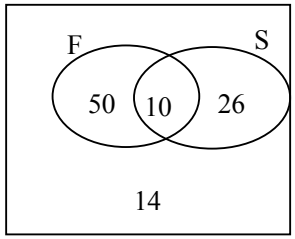
PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
6			$\frac{8}{12}$	2	M1 for $\frac{x}{12}, x \neq 8$, x < 12 or $\frac{8}{x}, x \neq 12$, x > 8 A1 for $\frac{8}{12}$ oe
7	(a)	2)220 2)110 5) 55 11	$2^2 \times 5 \times 11$	2	M1 for a systematic method of at least two correct divisions by a prime number or 2 correct division stages on a factor tree or a full process with one calculation error A1 for $2 \times 2 \times 5 \times 11$ or $2^2 \times 5 \times 11$
	(b)	165, 330, 495, 660 220, 440, 660 $220 = 2^2 \times 5 \times 11$ $165 = 3 \times 5 \times 11$ $2^2 \times 5 \times 11 \times 3$	660	2	M1 for listing multiples, at least 3 of each, condone one addition error 165, 330, 495, 660 220, 440, 660 A1 cao or M1 for $3 \times 5 \times 11$ and $2^2 \times 5 \times 11$ (accept $4 \times 5 \times 11$) Could be seen in part a. A1 cao
8		$7x + 2 = 3x - 12$ $7x - 3x = -12 - 2$ $4x = -14$ $x = \frac{-14}{4}$	$\frac{-7}{2}$	3	M1 for $3 \times x - 3 \times 4$ oe or $\frac{7x+2}{3}$ oe M1(dep) for correct method to isolate terms in x or numbers on one side of the equation A1 for $\frac{-7}{2}$ oe

<table>
<tr><th colspan="6">PAPER: 5MM1H_01</th></tr>
<tr><th colspan="2">Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td>9</td><td>(a)</td><td></td><td>reflection in $x = 5$</td><td>2</td><td>B1 for reflection
B1 for $x = 5$</td></tr>
<tr><td></td><td>(b)</td><td></td><td>rectangle with vertices
(1, 3),(1, 6), (7, 6), (7, 3)</td><td>2</td><td>M1 for enlargement sf 3
A1 for fully correct answer</td></tr>
<tr><td></td><td>(c)</td><td></td><td>90° clockwise, centre (0, 0)</td><td>3</td><td>B2 90˚ clockwise or 270˚ anticlockwise
(B1 90˚ or 270˚ stated without direction or with incorrect direction or correct translation of S shown)
B1 centre (0,0)</td></tr>
<tr><td>10</td><td>(i)</td><td>$(\frac{1}{3}\times\frac{1}{3})+(\frac{1}{3}\times\frac{1}{3})$</td><td>$\frac{2}{9}$</td><td>5</td><td>M1 for identifying there are 9 possible outcomes or $(\frac{1}{3}\times\frac{1}{3})$
M1 for clearly identifying the two outcomes (1, 6) and (3, 2)
or $(\frac{1}{3}\times\frac{1}{3})+(\frac{1}{3}\times\frac{1}{3})$
A1 for $\frac{2}{9}$ oe</td></tr>
<tr><td></td><td>(ii)</td><td><table><tr><td>×</td><td>1</td><td>3</td><td>5</td></tr><tr><td>2</td><td>2</td><td>6</td><td>10</td></tr><tr><td>4</td><td>4</td><td>12</td><td>20</td></tr><tr><td>6</td><td>6</td><td>18</td><td>30</td></tr></table></td><td>$\frac{5}{9}$</td><td></td><td>M1 for identifying the 5 correct outcomes or at least 4 correct with no more than one incorrect
A1 for $\frac{5}{9}$ oe</td></tr>
</table>

PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
11		$\frac{0+5}{2}, \frac{3+0}{2}, \frac{2+2}{2}$	(2.5, 1.5, 2)	3	B1 2.5 B1 1.5 B1 2 (SCB1 if no previous mark awarded, for A (0,3,2) or B (5,0,2))
12	(a)		a^3	1	B1 cao
	(b)		b^4	1	B1 cao
	(c)		c^{12}	1	B1 cao
	(d)		$11x^2 + 18$	2	M1 for correct expansion of one bracket $5x^2 + 10$ or $6x^2 + 8$ A1 cao
	(e)	$x^2 - 6x + x - 6$	$x^2 - 5x - 6$	2	M1 for 4 terms correct with or without signs or 3 out of exactly 4 fully correct terms (the terms may be in an expression or table) A1 cao

PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
13	(a)	$\frac{8}{20} + \frac{5}{20}$ |	2	5 | | 1		5 | | 4	8	20 |	$\frac{13}{20}$	2	M1 for both fractions expressed with a suitable common denominator (multiple of 20) and at least one of the two fractions correct A1 for $\frac{13}{20}$ oe or M1 for 0.4 + 0.25 A1 for 0.65 or M1 for table structure, all cells correct A1 for $\frac{13}{20}$ oe
	(b)	$\frac{25}{8} \times \frac{12}{5}$	$\frac{15}{2}$	3	M1 for a correct method to convert to improper fractions eg $\frac{3\times8+1}{8}$ or $\frac{2\times5+2}{5}$ M1 (dep) for $\frac{'25'\times'12'}{8\times5}$ A1 for $\frac{15}{2}$ or $7\frac{1}{2}$ (SCB2 for 7.5)

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
14	(a)	$4^2 + 3 \times 4 - 2$	26	2	M1 for substituting 4 into the expression eg $4^2 + 3 \times 4 - 2$ A1 cao
	(b)	1 7 17 31 49 6 10 14 18 4 4 4 $2n^2 + c$	$2n^2 - 1$	3	M1 for correct method to find second differences M1(dep) for $2n^2 + bn + c$ A1 for $2n^2 - 1$ or M1 for identifying general expression, nth term$=an^2 + bn + c$ M1 for 3 equations in a, b, c, $a \times 1^2 + b \times 1 + c = 1$ $a \times 2^2 + b \times 2 + c = 7$ $a \times 3^2 + b \times 3 + c = 17$ A1 for $2n^2 - 1$ Or M1 for listing the first 5 square numbers M1 for doubling the first five square numbers A1 for $2n^2 - 1$
15	(a)		740000	1	B1 cao
	(b)		3.5×10^{-7}	1	B1 cao
	(c)	$\frac{4}{8} \times 10^{-6-5}$ 0.5×10^{-11}	5×10^{-12}	2	M1 for $\frac{4}{8} \times 10^{-6-5}$ or $a \times 10^{-11}$ or 5×10^{b}, $b \neq -12$ or 0.000000000005 A1 cao

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
16	(a)		$5x(2x + 1)$	2	B2 $5x(2x + 1)$ (B1 for $x(10x + 5)$ or $5(2x^2 + x)$ or $(5x + 0)(2x + 1)$)
	(b)		$(x - 3)(x - 4)$	2	M1 for $(x \pm 3)(x \pm 4)$ A1 for $(x - 3)(x - 4)$
17	(a)	$100 - 14 = 86$ $60 + 36 - 86 = 10$ $60 - 10 = 50$ $36 - 10 = 26$		4	M1 for two overlapping labelled circles B1 for 14 shown outside the circles M1 for 60-'10' or 36-'10' ('10'≠0) A1 for a fully correct and labelled Venn diagram (condone omission of surrounding rectangle)
	(b)	$\frac{100-14}{100}$	$\frac{86}{100}$	2	M1 for '50' + '10' + '26' or 100 − '14' A1 ft $\frac{'86'}{100}$

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
18		90 − 32	58° with reasons	4	M1 for angle *CDA* = 90 − 32 or 180 - 90 - 32 A1 for *ABD* is 58 C2 for complete reasons ('the tangent to a circle is perpendicular (90^o) to the radius (diameter)' and 'Alternate segment theorem') and degrees sign (C1 for one reason) or M1 for angle *AOD* = 180 − 2 × 32 A1 for *ABD* is 58 C2 for complete reasons (angles in an isosceles triangle are equal, angles in a triangle add up to 180^o' and Angle at centre is twice angle at circumference) and degrees sign (C1 for Angle at centre is twice angle at circumference)
19	(a)		$\frac{5}{8}$, $\frac{5}{7}$ and $\frac{4}{7}$	2	B2 for $\frac{5}{8}$, $\frac{5}{7}$ and $\frac{4}{7}$ in correct positions (B1 for 1 or 2 in correct positions)
	(b)	$\frac{3}{8} \times \frac{2}{7}$	$\frac{6}{56}$	2	M1 for $\frac{3}{8} \times \frac{2}{7}$ A1 for $\frac{6}{56}$ oe

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
20	(a)	$\frac{1}{2} = 2^{-1}$ $\frac{1}{\sqrt{2}} = 2^{-0.5}$ $\sqrt{2} = 2^{0.5}$	2^{-2}, $\frac{1}{2}$, $\frac{1}{\sqrt{2}}$, 2^{0}, $\sqrt{2}$	2	M1 for changing to powers of 2, eg sight of $2^{0.5}$ or 2^{-1} or $2^{-0.5}$ A1 for correct order (accept alternative equivalent forms eg all powers of 2) (SCB1 if M0 scored, for all in correct reverse order)
	(b)	$\frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{2}} = \frac{8}{2\sqrt{2}}$ $\frac{8}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ $\frac{8\sqrt{2}}{4}$	$2\sqrt{2}$	3	M1 for cubing eg $\frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{2}} = \left(= \frac{8}{2\sqrt{2}}\right)$ M1 for a correct method to rationalise eg $\frac{8}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ or $\frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ A1 for $2\sqrt{2}$ (accept a=2) or M1 for $\frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ (= $\sqrt{2}$) oe M1 for $(\sqrt{2})^3$ A1 for $2\sqrt{2}$ (accept a=2)

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
*21		*ABE* = angle *CBD* (vertically opposite angles) angle *EAB* = angle *CDB* (alternate angles) angle *AEB* = angle *BCD* (alternate angles) Or angle *EAB* = angle *CDB* (alternate angles) angle *AEB* = angle *BCD* (alternate angles) *ABE* = angle *CBD* (angles in a triangle sum to 180°)	proof	4	M1 for any 2 pairs of angles correctly matched A1 for all 3 pairs correctly matched C2 (dep on M1)for full reasons and concluding statement (C1(dep on M1) for at least one reason)
22	(a)	$1 - \frac{1}{4}$	$\frac{3}{4}$	1	B1 for $\frac{3}{4}$ oe
	(b)	$\frac{3}{5} \times \frac{3}{4}$	$\frac{9}{20}$	2	M1 for $\frac{3}{5} \times$ ‘$\frac{3}{4}$’ A1 for $\frac{9}{20}$ oe or ft from (a)

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
*23		$\left[\frac{2n+2n+2}{2}\right]^2$ $= (2n+1)^2 = 4n^2 + 4n + 1$ $\frac{(2n)^2 + (2n+2)^2}{2}$ $= \frac{8n^2 + 8n + 4}{2}$ $= 4n^2 + 4n + 2$ $\frac{a^2 + b^2}{2} - \frac{a^2 + 2ab + b^2}{4}$ $\frac{a^2 - 2ab + b^2}{4}$ $\left[\frac{b-a}{2}\right]^2$	Proof	5	M1 for expressions for 2 consecutive even numbers, eg $2n$, $2n + 2$ M1 for $\left[\frac{'2n'+'2n+2'}{2}\right]^2$ M1 for $\frac{('2n')^2 + ('2n+2')^2}{2}$ A1 for $4n^2+4n+1$ or for $4n^2+4n+2$ oe C1 for $4n^2+4n+1$oe and $4n^2+4n+2$ oe and correct conclusion from correct working or M1 for realisation that $b - a = 2$ (or $a - b = -2$) M1 for correct method to expand $\left[\frac{a+b}{2}\right]^2$ (= $\frac{a^2 + 2ab + b^2}{4}$) M1 for $\frac{a^2 + b^2}{2} - $ ‘$\frac{a^2 + 2ab + b^2}{4}$’, A1 for $\frac{a^2 - 2ab + b^2}{4}$ C1 for $\left[\frac{b-a}{2}\right]^2$ oe and correct conclusion from correct working

Paper 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
24	(a)(i)	$\vec{BP} = \frac{1}{2}\vec{BC}$	$\frac{1}{2}\underset{\sim}{b}$	2	B1 for $\frac{1}{2}\underset{\sim}{b}$ oe
	(ii)	$\vec{BD} = \underset{\sim}{b} - \underset{\sim}{a}$	$\underset{\sim}{b} - \underset{\sim}{a}$		B1 for $\underset{\sim}{b} - \underset{\sim}{a}$ oe
	(b)(i)	$\vec{AB} + \vec{BP}$	$\underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b}$	3	B1 for $\underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b}$ oe
	(ii)	$\vec{AB} + \vec{BQ}$ $\underset{\sim}{a} + \frac{1}{3}(\underset{\sim}{b} - \underset{\sim}{a})$	$\underset{\sim}{a} + \frac{1}{3}(\underset{\sim}{b} - \underset{\sim}{a})$		M1 for $\vec{AB} + \vec{BQ}$ or $\vec{AB} + \frac{1}{3}\vec{BD}$ A1 for $\underset{\sim}{a} + \frac{1}{3}(\underset{\sim}{b} - \underset{\sim}{a})$ $(= \frac{2}{3}\underset{\sim}{a} + \frac{1}{3}\underset{\sim}{b})$ oe
	(c)	$AQ = \frac{2}{3}\underset{\sim}{a} + \frac{1}{3}\underset{\sim}{b}$	Q is on AP $AQ:QP = 2:1$	1	B1 for Q lies on the line AP or for $AQ = \frac{2}{3}AP$ oe

Modifications to the mark scheme for Modified Large Print (MLP) papers.

Only mark scheme amendments are shown where the enlargement or modification of the paper requires a change in the mark scheme.

The following tolerances should be accepted on marking MLP papers, unless otherwise stated below:
Angles: ±5º
Measurements of length: ±5 mm

PAPER: 5MM1H_01			
Question		**Modification**	**Notes**
Q4		2cm grid.	Standard mark scheme
Q6		1, 5, 7, 11 moved above P and Q.	Standard mark scheme
Q8		*x* changed to *y*.	Standard mark scheme
Q9	(a)	2cm grid. .	Standard mark scheme
	(b)	2cm grid. Rectangle R changed to rectangle E. Enlargement drawn on graph and labelled rectangle F coordinates (1, 3) (1, 6) (7, 3) (7, 6). Wording changed to "Describe fully the single transformation that maps rectangle E onto rectangle F."	B1 Enlargement by a scale factor of 3 B1 Centre (4,0)
	(c)	1½cm grid. *y* axis -1 to -8 labels put on right side of *y* axis	Standard mark scheme
Q11		Model given as well as diagram. AB joined.	Standard mark scheme

PAPER: 5MM1H_01			
Question		**Modification**	**Notes**
Q12		(a) *a* changed to *e*. (b) *b* changed to *e*. (d) *x* changed to *y*. (e) *x* changed to *y*.	Standard mark scheme
Q16		(a) and (b) *x* changed to *y*.	Standard mark scheme
Q19		Tree diagram size enlarged and solid answer lines.	Standard mark scheme
Q20		(b) *a* changed to *x*.	M1 for cubing eg $\frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \left(= \frac{8}{2\sqrt{2}} \right)$ M1 for a correct method to rationalise eg $\frac{8}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ or $\frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ A1 for $2\sqrt{2}$ (accept x=2) or M1 for $\frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ $(= \sqrt{2})$ oe M1 for $(\sqrt{2})^3$ A1 for $2\sqrt{2}$ (accept x = 2)

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