Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCSE
Linked Pair Pilot in Mathematics
Methods in Mathematics (2MM01)
Higher: (Non-Calculator) Unit 1

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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 labelling 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If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.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 cancelling 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)		$\frac{9}{20}$ or 0.45 or 45%	4	M1 for 20 – (6 + 5) or 9 seen or for $\frac{n}{20}$, where $n < 10$ A1 for $\frac{9}{20}$, oe (eg. 45%, 0.45)
	(ii)		$\frac{15}{20}$ or 0.75 or 75%		M1 for $\frac{20-5}{20}$ or $1-\frac{5}{20}$ or $\frac{6+"9"}{20}$ A1 for $\frac{15}{20}$ oe [SC: B1 for 15 to 20 or 15:20 or 15 out of 20 oe if M0 scored]
2	(a)		Triangle at (2,2),(2,6) and (10,2)	2	B2 fully correct answer (B1 correct enlargement incorrect centre)
	(b)		90^o anticlockwise or 270^o clockwise about (0, 0)	3	B2 for 90^o anticlockwise or 270^o clockwise (B1 for 90^o or 270^o stated without direction or with incorrect direction or correct translation of S shown) B1 for centre (0, 0)

PAPER: 5MM1H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
3		88 cm^2	5	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 method to find the total area A1 cao B1 for cm^2 OR M2 for splitting the shape into two trapeziums and using a correct method to find the area of a trapezium M1(dep) for 2 × 'area of trapezium' A1 cao B1 for cm^2

PAPER: 5MM1H_01

Question	Working	Answer	Mark	Notes
4 (a)	<table><tr><td>×</td><td>2</td><td>3</td><td>4</td></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>2</td><td>4</td><td>6</td><td>8</td></tr><tr><td>3</td><td>6</td><td>9</td><td>12</td></tr></table>	$\frac{2}{9}$	5	M1 for identifying there are 9 possible outcomes or $\frac{1}{3}\times\frac{1}{3}$ M1 for clearly identifying the two required outcomes, (1, 4) and (2, 2) or $\frac{1}{3}\times\frac{1}{3}+\frac{1}{3}\times\frac{1}{3}$ A1 for $\frac{2}{9}$ oe
(b)		$\frac{3}{9}$		M1 for identifying the 3 correct outcomes (or at least 2 with no more than one incorrect) A1 for $\frac{3}{9}$ oe

PAPER: 5MM1H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
5		Angle *APQ* = 61°	5	M1 for 180 – 90 – 32 (= 58) M1 (180 – 58) ÷ 2 (= 61) A1 for angle *APQ* = 61(°) C2 (dep on M2) for "sum of the angles in a triangle is 180°" oe and "base angles of an isosceles triangle are equal" oe (C1 (dep on M1) for one correct reason in the correct context) **OR** M1 for 360 – 32 – 90 (= 238) M1 for (360 – "238") ÷ 2 (=61) A1 for angle *APQ* = 61(°) C2 (dep on M2) for "sum of the angles in an quadrilateral is 360°" and "base angles of an isosceles triangle are equal" and "sum of the angles on a straight line is 180°" oe (C1 (dep on M1) for one correct reason in the correct context)
6 (a)		252 960	1	B1 cao
(b)		2.5296	1	B1 cao
(c)		7.44	2	M1 for 68 ÷ 34 (=2) or 252.96 ÷ 68 or 3.72 or 25296 ÷ 68 × 2 or 372 × 2 or digits 744 A1 cao

PAPER: 5MM1H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
7	$2 \times (3x - 1 + 2x + 3) = 39$ $2 \times (5x + 2) = 39$ $5x + 2 = 19.5$ $5x = 17.5$ $x = 3.5$ $3 \times 3.5 - 1 = 9.5$ $2 \times 3.5 + 3 = 10$ 9.5×10	95	5	M1 for $2 \times (3x - 1 + 2x + 3)$ oe **or** $3x - 1 + 2x + 3$ oe M1 for $2 \times (3x - 1 + 2x + 3) = 39$ oe **or** $3x - 1 + 2x + 3 = 19.5$ oe M1 (dep on M2) for correct processes to isolate terms in x or (x =) 3.5 oe M1 (dep on M1) for substituting '3.5' into $3x - 1$ **or** $2x + 3$ **or** 9.5 seen as length **or** 10 seen as width A1 cao
8 (i)		$\frac{2}{15}$	5	B1 for $\frac{2}{15}$ oe
(ii)		$\frac{10}{15}$		M1 for indicating elements of A ∪ B (could be by listing) or $\frac{10}{n}$ in where n is integer and $n > 10$ A1 for $\frac{10}{15}$ oe
(iii)		$\frac{9}{15}$		M1 for indicating elements of B' (could be by listing) or $\frac{9}{n}$ in where n is integer and $n > 9$ A1 for $\frac{9}{15}$ oe
9		$\frac{5}{6}$	3	M1 for $\frac{35}{8}$ or $\frac{21}{4}$ M1 for $\frac{35}{8} \times \frac{4}{21}$ oe or $\frac{140}{168}$ oe A1 for $\frac{5}{6}$

PAPER: 5MM1H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
10	<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>y</td><td>-4</td><td>-1</td><td>2</td><td>5</td><td>8</td></tr></table>	$y = 3x + 2$ drawn	4	**(Table of values)** C1 for axes scaled and labelled (condone zero omitted at origin) 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 plotted correctly) A1 for correct line **(No table of values)** C1 for axes scaled and labelled (condone zero omitted at origin) M2 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = 3x + 2$ drawn (ignore any additional incorrect segments) (M1 for at least 3 correct points with no more than 2 incorrect points) A1 for correct line **(Use of y=mx+c)** C1 for axes scaled and labelled (condone zero omitted at origin) M2 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = 3x + 2$ drawn (ignore any additional incorrect segments) (M1 for line drawn with gradient of 3 OR line drawn with a y intercept of 2 and a positive gradient) A1 for correct line

PAPER: 5MM1H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
11 (a)	2)140 2) 70 5) 35 7 $140 = 2^2 \times 5 \times 7$ 140 / \\ 2 70 / \\ 2 35 / \\ 5 7	$2^2 \times 5 \times 7$	2	M1 for a systematic method of at least 2 correct divisions by a prime number or 2 correct division stages on a factor tree or a full process with one calculation error A1 $2 \times 2 \times 5 \times 7$ or $2^2 \times 5 \times 7$
(b)	2×5	10	2	M1 for listing factors of 140 and 110 (at least 3 correct for each) or correct prime factorisation of 110 or identification of one common factor (2 or 5) or 2x5 A1 cao
(c)	$140 = 2^2 \times 5 \times 7$ $110 = 2 \times 5 \times 11$ $2 \times 5 \times 2 \times 7 \times 11$	1540	2	M1 for listing multiples, at least 3 of each, condone one addition error 140, 280, 420, ... 110, 220, 330, ... A1 for 1540 cao Alternative: M1 for $2 \times 5 \times 2 \times 7 \times 11$ A1 for 1540

PAPER: 5MM1H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
12 (a)		2	2	M1 for substituting 3 into the expression e.g. $3^2 - 4 \times 3 + 5$ A1 cao
(b)	5 11 21 35 53 6 10 14 18 4 4 4	$2n^2 + 3$	3	M1 for correct method to find second differences M1 (dep) for $2n^2 + c$, $c \neq 3$ A1 for $2n^2 + 3$ OR M1 for identifying general expression , nth term = $an^2 + bn + c$ M1 for 3 equations in a, b and c $a \times 1^2 + b \times 1 + c = 5$ $a \times 2^2 + b \times 2 + c = 11$ $a \times 3^2 + b \times 3 + c = 21$ A1 for $2n^2 + 3$ OR M1 for listing the first 5 square numbers M1 for doubling the first five square numbers A1 for $2n^2 + 3$

PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
13	(a)		2.8×10^7	1	B1
	(b)		0.000832	1	B1
	(c)		1.45×10^4	2	M1 for 12000 + 2500 or 14500 or digits 145 seen A1 cao OR M1 for $1.2 \times 10^4 + 0.25 \times 10^4$ or $12 \times 10^3 + 2.5 \times 10^3$ A1 cao
14	(a)		18	2	M1 for a correct method to calculate a scale factor or multiplier eg 7.5÷2.5(=3) or 2.5÷7.5 (= 0.33...) or 6 × 7.5 ÷ 2.5 oe A1 cao
	(b)		14	2	M1 for a fully correct method to use a scale factor or multiplier to find *AC* or *AE* eg 10.5÷3 (=3.5) or 10.5×0.33...or $10.5\times\frac{1}{3}$ (=3.5) or 10.5÷7.5×2.5 or 10.5×1.33...

PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
15	(a)	$12 = 5x - 10$	4.25 or $4\frac{1}{4}$ or $\frac{17}{4}$	3	M1 one correct manipulation either $4c - 8$ or $\frac{9}{4}$ M1 for isolating term in c and number terms, eg. $4c = 9 + 8$ A1 for 4.25 or $4\frac{1}{4}$ or $\frac{17}{4}$
	(b)		4, –3	3	M2 for $(x - 4)(x + 3)$ (M1 for $(x \pm 4)(x \pm 3)$) A1 cao 4 and –3 OR M1 for substitution into formula (condone incorrect signs) M1 $\frac{1 \pm \sqrt{49}}{2}$ A1 cao 4 and –3
16	(a)		±6	1	B1 for ±6 allow 6 or –6
	(b)		$\frac{1}{16}$	1	B1 cao
	(c)		1	1	B1 cao

PAPER: 5MM1H_01					
Question		**Working**	**Answer**	**Mark**	**Notes**
17	(a)		$(3p - 1)(3p + 1)$	1	B1 for $(3p - 1)(3p + 1)$
	(b)		$2(x + y)(2x + 2y - 1)$	2	M1 for $2(x + y)[2(x + y) - 1]$ or any correct factorisation , eg. $(x + y)(4x + 4y - 2)$ or $2[(x + y)^2 - (x + y)]$ A1 cao
	(c)		$6a^2 - ab - 15b^2$	2	M1 for any 3 of $6a^2$, $-10ab$, $9ab$, $-15b^2$ or $6a^2$ and $10ab$ and $9ab$ and $15b^2$, ignoring signs A1 for $6a^2 - ab - 15b^2$
	(d)		$\frac{1}{w - 4}$	2	B1 for $(2w - 1)(w - 4)$ B1 cao

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Question	**Working**	**Answer**	**Mark**	**Notes**
*18		42°	4	M1 for angle *CDA* = 90 – 48 or 180 – 90 – 48 A1 for angle *ABD* = 42(°) C2 for complete reasons: "tangent to a circle is perpendicular (90°) to the radius (diameter)" and "Alternate segment theorem") and degrees sign (C1 for one relevant reason related to circle theory) OR M1 for angle *AOD* = 180 – 2 × 48 A1 for angle *ABD* = 42(°) C2 for complete reasons: "base angles of an Isosceles triangle are equal", "the angles in a triangle add up to 180°" and "the angle at the centre is twice the angle at the circumference" and degrees sign (C1 for one relevant reason related to circle theory)

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Question	**Working**	**Answer**	**Mark**	**Notes**
19		Proof	5	M1 for expressions for 2 consecutive even numbers, eg. $2n$, $2n + 2$ M1 for $\left[\frac{"2n"+"2n+2"}{2}\right]^2$ or $\frac{("2n")^2+("2n+2")^2}{2}$ M1 for a correct expansion of either numerator A1 for $4n^2 + 4n + 1$ oe or $4n^2 + 4n + 2$ 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 $p - r = 2$ (or $r - p = -2$) M1 for correct method to expand $\left[\frac{p+r}{2}\right]^2$ $(=\frac{p^2+2pr+r}{4})$ M1 for $\frac{p^2+r^2}{2} - '(\frac{p^2+2pr+r^2}{4})'$ A1 for $\frac{p^2-2pr+r^2}{4}$ C1 for $\left[\frac{p-r}{2}\right]^2$ oe and correct conclusion from correct working

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Question	**Working**	**Answer**	**Mark**	**Notes**
20	P(R, not R) + P(not R, R) + P(RR) OR 1 – P(not R) × P(not)	$\frac{68}{110}$	4	B1 for $\frac{3}{10}$ or $\frac{7}{10}$ or $\frac{4}{10}$ (could be seen in working or on a tree diagram) M1 for $\frac{4}{11}\times\frac{7}{10}$ or $\frac{7}{11}\times\frac{4}{10}$ or $\frac{4}{11}\times\frac{3}{10}$ or $\frac{4}{11}\times\frac{5}{10}$ or $\frac{5}{11}\times\frac{4}{10}$ or $\frac{2}{11}\times\frac{4}{10}$ or $\frac{4}{11}\times\frac{2}{10}$ M1 for $\frac{4}{11}\times\frac{7}{10}+\frac{7}{11}\times\frac{4}{10}+\frac{4}{11}\times\frac{3}{10}$ oe or $\frac{4}{11}\times\frac{5}{10}+\frac{5}{11}\times\frac{4}{10}+\frac{2}{11}\times\frac{4}{10}+\frac{4}{11}\times\frac{2}{10}+\frac{4}{11}\times\frac{3}{10}$ A1 for $\frac{68}{110}$ oe OR B1 for $\frac{6}{10}$ M1 for $\frac{7}{11}\times\frac{6}{10}$ oe M1 for $1-\frac{7}{11}\times\frac{6}{10}$ oe A1 for $\frac{68}{110}$ oe **SC** B2 for $\frac{72}{121}$
21		$\frac{3x-1}{(1-x)(1+x)}$	3	M1 for common denominator of $(1-x)(1+x)$ oe M1 for $\frac{(1+x)-2(1-x)}{(1-x)(1+x)}$ oe (may be as two separate fractions) A1 for $\frac{3x-1}{(1-x)(1+x)}$ **or** $\frac{3x-1}{1-x^2}$ **or** $\frac{1-3x}{x^2-1}$

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Question	**Working**	**Answer**	**Mark**	**Notes**
22 (a)		Show using vector algebra	1	C1 for $-(4\mathbf{a}+\mathbf{b})+(3\mathbf{a}+2\mathbf{b})=\mathbf{b}-\mathbf{a}$ oe OR $4\mathbf{a}+\mathbf{b}+\mathbf{b}-\mathbf{a}=3\mathbf{a}+2\mathbf{b}$
(b)		3 : 1	3	M1 for $\overrightarrow{RS}=-(7\mathbf{a}-2\mathbf{b})+(4\mathbf{a}+\mathbf{b})$ oe or $\overrightarrow{SR}=7\mathbf{a}-2\mathbf{b}-(4\mathbf{a}+\mathbf{b})$ oe A1 for $-3\mathbf{a}+3\mathbf{b}$ $(=3\mathbf{b}-3\mathbf{a})$ A1 for 3 : 1 OR M1 for $\overrightarrow{RP}=-(7\mathbf{a}-2\mathbf{b})+(3\mathbf{a}+2\mathbf{b})$ oe A1 for $4\mathbf{b}-4\mathbf{a}$ oe A1 for 3 : 1

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