

Mark Scheme (Results)

November 2012

GCSE Mathematics Linked Pair Pilot
Methods in Mathematics (2MM01)
Higher (Calculator) Paper 2H

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the world's leading learning company. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk for our BTEC qualifications.

Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

If you have any subject specific questions about this specification that require the help of a subject specialist, you can speak directly to the subject team at Pearson. Their contact details can be found on this link: www.edexcel.com/teachingservices.

You can also use our online Ask the Expert service at www.edexcel.com/ask. You will need an Edexcel username and password to access this service.

Pearson: helping people progress, everywhere

Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

November 2012

Publications Code UG033884

All the material in this publication is copyright

© Pearson Education Ltd 2012

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

5MM2H/01				
Question	Working	Answer	Mark	Notes
1	$1.85 \div 5 \times 9 =$	3.33	2	M1 for $1.85 \div 5$ or 1.85×9 or 0.37 seen or 16.65 seen or 333 seen A1 cao NB: Working can be in £ or pence
2	$= \frac{13.226}{4.613}$ $= 2.867114676\dots$	2.86711	2	B2 for 2.86711(...) (B1 for 13.226 or 4.613 seen or 2.87 or 2.867 or 2.8671)
3	(a) $30 - 12 = 18$ $12 : 18 = 2 : 3$	2 : 3	2	M1 for $12 : "30 - 12"$ oe eg $12 : 18$ eg $6 : 9$ eg $4 : 6$ or $3 : 2$ A1 cao
	(b) $18 \div 2 = 9$ $12 - 9 = 3$	3	3	M1 for $"(30 - 12)" \div 2$ or 9 seen M1(dep) for $12 - "9"$ A1 cao

5MM2H/01				
Question	Working	Answer	Mark	Notes
4*		110 with reasons	4	<p>M1 for $180 - 90 - 20$ or an angle correctly identified as 70 (could be on the diagram)</p> <p>M1 for an angle correctly identified as $180 - 70$ or (could be on the diagram)</p> <p>C2 for 110 and all reasons clearly given eg</p> <p>$ABG = 90$ <u>corresponding angles are equal</u> $AGB = 180 - 90 - 20 = 70$ <u>angles in a triangle add to 180</u> $BGD = 180 - 70 = 110$ <u>angles on a straight line add to 180</u> $x = BGD = 110$ <u>corresponding angles are equal</u></p> <p>OR</p> <p>$ABG = 90$ <u>corresponding angles are equal</u> $AGB = 180 - 90 - 20 = 70$ <u>angles in a triangle add to 180</u> $FGD = 70$ <u>vertically opposite angles equal</u> $x = 180 - 70$ <u>co-interior (or allied) angles add up to 180</u></p> <p>OR</p> <p>$ADC = 180 - 90 - 20 = 70$ <u>angles in a triangle add to 180</u> $FGD = 70$ <u>alternate angles equal</u> $x = 180 - 70$ <u>co-interior (or allied) angles add up to 180</u></p> <p>(C1 for one appropriate reason for candidate's working)</p> <p>QWC: Reasons written out clearly with correct geometrical language used</p>

5MM2H/01				
Question	Working	Answer	Mark	Notes
5	$150 \div 6 = 25$ $\sqrt{25} = 5$ $5 \times 5 \times 5 =$	125	3	M1 for $150 \div 6 (= 25)$ or area of 25 (may be seen on one face of a cube) or side lengths of 5 (may be marked on a diagram) M1 for $\sqrt{25} \times \sqrt{25} \times \sqrt{25}$ A1 cao
6*		108 and explanation	3	M1 for $360 \div 5 (= 72)$ or $3 \times 180 (= 540)$ A1 for 108 C1 for explanation e.g. 108 is not a factor of 360 or diagram drawn with sizes of angles shown and explanation of why they won't fit e.g. $360 \div 108$ is not a whole number S.C. B1 for 3 pentagons drawn at a point with a gap identified QWC: Explanation should be clear with working clearly presented
7	(a) $4 \times 2 \times 2 \times 2 = 32$ (b) $a - b = 5c$ $\frac{a-b}{5} = c$	32 $c = \frac{a-b}{5}$	1 2	B1 cao M1 for an intention to subtract b from both sides as a first step or divide all terms by 5 as a first step A1 for $\frac{a-b}{5}$ oe SC: B1 for $a - b \div 5$

5MM2H/01				
Question	Working	Answer	Mark	Notes
8	(a)	58.4	3	M1 for $\frac{27}{100} \times 80$ oe or 21.6 seen M1(dep) for 80 – “21.6” A1 cao OR M1 for 100 – 27 or 73 seen M1 for $\frac{73}{100} \times 80$ oe A1 cao
	(b)			
9	(a)	157	2	M1 for $\pi \times 10^2 \div 2$ A1 for 157 – 157.1
	(b)	51.4	3	M1 for $2 \times \pi \times 10$ or $\pi \times 20$ or 62.8 – 62.9 seen M1 (dep) for $\pi \times 20 \div 2 + 20$ or $\pi \times 20 \div 2$ or $\pi \times 20 + 20$ or 31.4 – 31.5 seen for arc length A1 for 51.4 – 51.5

5MM2H/01				
Question	Working	Answer	Mark	Notes
12	<p>PERCENTAGES:</p> <p>B: $\frac{3}{5} \times 100 = 60$ G: 25%</p> <p>R: $100 - 25 - 60 = 15$ $12 \div 15 \times 100 = 80$</p> <p>FRACTIONS:</p> <p>G: $25\% = \frac{1}{4}$ B: $\frac{3}{5}$</p> <p>R: $1 - \frac{1}{4} - \frac{3}{5} = \frac{3}{20}$ $12 \div 3 \times 20 = 80$</p> <p>DECIMALS:</p> <p>G: $25\% = 0.25$ and B: $\frac{3}{5} = 0.6$</p> <p>R: $1 - 0.25 - 0.6 = 0.15$ $12 \div 0.15 = 80$</p>	80	4	<p>PERCENTAGES:</p> <p>M1 for $\frac{3}{5} \times 100$ oe or 60(%) seen</p> <p>M1 for recognising that 12 represents $(100 - 25 - \text{“60”})\%$</p> <p>M1 for $12 \div \text{“15”} \times 100$</p> <p>A1 cao</p> <p>FRACTIONS:</p> <p>M1 for $25\% = \frac{1}{4}$ and used with $\frac{3}{5}$</p> <p>M1 for recognising that 12 represents $1 - \frac{1}{4} - \frac{3}{5}$ oe</p> <p>M1 for $12 \div \text{“3”} \times \text{“20”}$</p> <p>A1 cao</p> <p>DECIMALS:</p> <p>M1 for $25\% = 0.25$ and $\frac{3}{5} = 0.6$</p> <p>M1 for recognising that 12 represents $1 - 0.25 - 0.6$</p> <p>M1 for $12 \div \text{“0.15”}$</p> <p>A1 cao</p>

5MM2H/01				
Question	Working	Answer	Mark	Notes
13	$10^2 - 8^2 = 36$ $\sqrt{36} = 6$ $4^2 + 6^2 = 52$ $\sqrt{52} =$	7.21	4	M1 for $10^2 - 8^2$ or $8^2 + x^2 = 10^2$ M1 for $\sqrt{100 - 64}$ or $\sqrt{36}$ M1 for $4^2 + "6"{}^2$ A1 for 7.21(11025)
14		2.5×10^6	2	M1 for 2 500 000 oe eg 25×10^5 eg 0.25×10^7 or 2.5×10^n or $A \times 10^6$ where $1 \leq A < 10$ A1 cao
15	(a)	2, -2, -4, 8	2	B2 for all correct (B1 for 2 or 3 correct)
	(b)	Correct graph	2	B2 for fully correct graph OR M1 for 6 or 7 of their points plotted correctly A1 for correct curve
	(c)	3.6, -0.6	2	B1ft from graph for 3.6 ± 0.2 B1ft from graph for -0.6 ± 0.2 SC: B1ft from graph for (3.6, 0) and (-0.6, 0)

5MM2H/01				
Question	Working	Answer	Mark	Notes
16	$AB = 8.6 \cos 23$ $= 8.6 \times 0.92050\dots$ $= 7.916\dots$	7.92	3	M1 for $\cos 23 = \frac{AB}{8.6}$ or $\sin(90 - 23) = \frac{AB}{8.6}$ oe M1(dep on M1) for $AB = 8.6 \cos 23$ or $AB = 8.6 \sin "67"$ or 7.9 seen A1 for 7.91 – 7.92 SC: Award B2 for an answer of $\pm 4.58 - \pm 4.59$ or 8.04 – 8.05
17	$216 \div 1.35 =$	160	3	M2 for $216 \div 1.35 \times 100$ oe (M1 for sight of 1.35 or 135%) A1 cao
18	$12x + 9y = -21$ $\underline{12x - 16y = 104}$ $25y = -125$ $y = -5$ $4x + 3 \times -5 = -7$ OR $16x + 12y = -28$ $\underline{9x - 12y = 78}$ $25x = 50$ $x = 2$ $4 \times 2 + 3y = -7$	$x = 2$ $y = -5$	4	M1 for correct process to eliminate either x or y (condone one arithmetic error) A1 for either $x = 2$ or $y = -5$ M1 (dep on 1 st M1) for correct substitution of their found value or (indep) for correct process to eliminate the other variable (condone one arithmetic error) A1 cao for both $x = 2$ and $y = -5$ SC: B1 for $x = 2$ or $y = -5$ if M0 scored
19		$y = 3x + 4$	2	B2 for $y = 3x + 4$ (B1 for $y = 3x + k, k \neq 4$ or $y = mx + 4, m \neq 0$ or 3 or for $3x + 4$)

5MM2H/01				
Question	Working	Answer	Mark	Notes
20	$x = \frac{-2 \pm \sqrt{2^2 - 4 \times 3 \times -4}}{2 \times 3}$ $= \frac{-2 \pm \sqrt{4 + 48}}{6}$ $= \frac{-2 \pm \sqrt{52}}{6}$ $= 0.868517\dots, \quad -1.535183\dots$	0.869, -1.54	3	<p>M1 for correct substitution into formula of 3, 2 and -4 (condone sign errors)</p> <p>M1 for reduction to $\frac{-2 \pm \sqrt{52}}{6}$</p> <p>A1 for 0.86 to 0.87 and -1.53 to -1.54</p>
21	$\cos A = \frac{8.3^2 + 10.4^2 - 5.6^2}{2 \times 8.3 \times 10.4}$ $= \frac{145.69}{172.64} = 0.84389\dots$ $A = 32.446\dots$ $\frac{1}{2} \times 10.4 \times 8.3 \times \sin 32.446\dots$ <p>OR</p> $\cos B = \frac{5.6^2 + 10.4^2 - 8.3^2}{2 \times 5.6 \times 10.4}$ $= \frac{70.63}{116.48} = 0.60637\dots$ $B = 52.672\dots$ $\frac{1}{2} \times 5.6 \times 10.4 \times \sin 56.672\dots$ <p>OR</p> $\cos C = \frac{8.3^2 + 5.6^2 - 10.4^2}{2 \times 8.3 \times 5.6}$ $= \frac{-7.91}{92.96} = -0.08509\dots$ $C = 94.881\dots$ $\frac{1}{2} \times 8.3 \times 5.6 \times \sin 94.881\dots$	23.2	5	<p>M1 for correct substitution into cosine rule to find any angle</p> <p>M1 (dep) for correct order of evaluation to get to $\cos A = \frac{x}{y}$ where x and y are numbers</p> <p>A1 for 32.4 – 32.5 or 52.6 – 52.7 or 94.8 – 94.9</p> <p>M1 (indep) for substitution of two sides and their included angle into $\frac{1}{2} ab \sin C$</p> <p>A1 for 23.1 – 23.2</p>

5MM2H/01				
Question	Working	Answer	Mark	Notes
22		3.6, -1.6 -1.6, 3.6	3	M1 for drawing $x + y = 2$ or any line with gradient -1 or any straight line passing through $(0, 2)$ A2 for 2 correct solutions ± 0.2 (A1 for 1 correct solution ± 0.2 .)
23	(a) $\sqrt{\frac{936}{104}} = 3$ $5 \times 3 = 15$	15	3	M1 for $936 \div 104$ or 9 or $104 \div 936$ M1 for $\sqrt{\frac{936}{104}}$ or $\sqrt{9}$ or 3 or $\sqrt{\frac{104}{936}}$ or $\sqrt{\frac{1}{9}}$ or $\frac{1}{3}$ A1 cao
	(b) $1620 \div 3^3 = 60$	60	2	M1 for $(“3”)^3$ or 27 or $(“\frac{1}{3}”)^3$ or $\frac{1}{27}$ A1 cao
24	(a)	(4, 8)	1	B1 cao
	(b)	(4, 6)	1	B1 cao
	(c)	(1, 3)	1	B1 cao

5MM2H/01				
Question	Working	Answer	Mark	Notes
25	$\sqrt{10^2 - 5^2} = 8.660254\dots$ $\tan 22 = \frac{DC}{10}$ $DC = 10 \tan 22^\circ = 4.040262\dots$ $\tan DEC = \frac{4.04}{8.66}$ <p>OR</p> $\sqrt{10^2 - 5^2} = 8.660254\dots$ $\cos 22 = \frac{10}{BD}$ $BD = \frac{10}{\cos 22} = 10.785\dots$ $ED = \sqrt{10.785^2 - 5^2}$ $= 9.556$ $\cos DEC = \frac{8.66}{9.556}$	25	5	<p>M1 for complete method to find CE, eg $\sqrt{10^2 - 5^2}$ (= 8.660254...)</p> <p>M1 for $\tan 22 = \frac{DC}{10}$</p> <p>M1 for $(DC =) 10 \tan 22^\circ$ (= 4.04...)</p> <p>M1 for $\tan DEC = \frac{"4.04"}{"8.66"}$</p> <p>A1 for 25 – 25.02</p> <p>OR</p> <p>M1 for complete method to find CE, eg $\sqrt{10^2 - 5^2}$ (= 8.660254...)</p> <p>M1 for $(BD \text{ or } AD =) \frac{4.04}{\cos 22}$ (= 10.785...)</p> <p>M1 for $(ED =) \sqrt{10.785^2 - 5^2} = 9.556$</p> <p>M1 for $\cos DEC = \frac{"8.66"}{"9.556"}$</p> <p>A1 for 25 – 25.02</p>

5MM2H/01				
Question	Working	Answer	Mark	Notes
26	$p(r-3) = 2r+5$ $pr - 3p = 2r+5$ $pr - 2r = 3p+5$ $r(p-2) = 3p+5$	$\frac{3p+5}{p-2}$	4	<p>M1 for multiplying both sides by $r-3$ eg $p(r-3)$ or $pr-3p$ or $pr-3$ or $p \times r-3$</p> <p>M1 for isolating their two terms in r on one side of an equation to get $pr-2r$ or $2r-pr$</p> <p>M1 (dep on M1) for correctly factorising r from '$pr-2r$'</p> <p>A1 for $\frac{3p+5}{p-2}$ or $\frac{-3p-5}{2-p}$ oe</p>
27	$\frac{2}{3}\pi r^3 = 400$ $r^3 = \frac{600}{\pi} = 190.9859\dots$ $r = \sqrt[3]{\frac{600}{\pi}} = 5.7588238\dots$ $\text{Vol} = \frac{1}{3} \times \pi \times 5.7588^2 \times 10$	347	4	<p>M1 for $\frac{2}{3}\pi r^3 = 400$ oe</p> <p>M1 for $r^3 = \frac{600}{\pi}$ oe or $r = 5.7(\dots)$</p> <p>M1 for $\frac{1}{3} \times \pi \times ("5.7\dots")^2 \times 10$</p> <p>A1 for 347 – 347.4</p> <p>SC: B2 for an answer of 218 – 219 (B1 for $r^3 = \frac{300}{\pi}$ (= 95.49...))</p>

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467

Fax 01623 450481

Email publication.orders@edexcel.com

Order Code UG033884 November 2012

For more information on Edexcel qualifications, please visit our website
www.edexcel.com

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE

Ofqual



Llywodraeth Cynulliad Cymru
Welsh Assembly Government

