OCR
Oxford Cambridge and RSA

GCSE

Methods in Mathematics (Pilot)

Unit **B392/02:** Higher Tier

General Certificate of Secondary Education

Mark Scheme for June 2015

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations used in the detailed Mark Scheme.

Annotation	Meaning
✓	Correct
✗	Incorrect
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working (after correct answer obtained), provided method has been completed
M0	Method mark awarded 0
M1	Method mark awarded 1
M2	Method mark awarded 2
A1	Accuracy mark awarded 1
B1	Independent mark awarded 1
B2	Independent mark awarded 2
MR	Misread
SC	Special case
^	Omission sign

These should be used whenever appropriate during your marking.

The **M**, **A, B**, etc annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks.
It is vital that you annotate these scripts to show how the marks have been awarded.
It is not mandatory to use annotations for any other marking, though you may wish to use them in some circumstances.

Subject-Specific Marking Instructions

M marks are for <u>using a correct method</u> and are not lost for purely numerical errors.
A marks are for an <u>accurate</u> answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
B marks are <u>independent</u> of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
SC marks are for <u>special cases</u> that are worthy of some credit.

Unless the answer and marks columns of the mark scheme specify **M** and **A** marks etc, or the mark scheme is 'banded', then if the correct answer is clearly given and is <u>not from wrong working</u> **full marks** should be awarded.

Do <u>not</u> award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen <u>and</u> the correct answer clearly follows from it.

Where follow through (**FT**) is indicated in the mark scheme, marks can be awarded where the candidate's work follows correctly from a previous answer whether or not it was correct.

Figures or expressions that are being followed through are sometimes encompassed by single quotation marks after the word *their* for clarity, eg FT 180 × (*their* '37' + 16), or FT 300 – $\sqrt{}$(*their* '$5^2 + 7^2$'). Answers to part questions which are being followed through are indicated by eg FT 3 × *their* (a).

For questions with FT available you must ensure that you refer back to the relevant previous answer. You may find it easier to mark these questions candidate by candidate rather than question by question.

Where dependent (**dep**) marks are indicated in the mark scheme, you must check that the candidate has met all the criteria specified for the mark to be awarded.

The following abbreviations are commonly found in GCSE Mathematics mark schemes.

- **figs 237**, for example, means any answer with only these digits. You should ignore leading or trailing zeros and any decimal point eg 237000, 2.37, 2.370, 0.00237 would be acceptable but 23070 or 2374 would not.
- **isw** means **ignore subsequent working** after correct answer obtained and applies as a default.
- **nfww** means **not from wrong working**.
- **oe** means **or equivalent**.
- **rot** means **rounded or truncated**.
- **seen** means that you should award the mark if that number/expression is seen anywhere in the answer space, including the answer line, even if it is not in the method leading to the final answer.
- **soi** means **seen or implied**.

In questions with no final answer line, make no deductions for wrong work after an acceptable answer (ie **isw**) unless the mark scheme says otherwise, indicated by the instruction 'mark final answer'.

In questions with a final answer line following working space,

(i) if the correct answer is seen in the body of working and the answer given on the answer line is a clear transcription error allow full marks unless the mark scheme says 'mark final answer'. Place the annotation ✓ next to the correct answer.

(ii) if the correct answer is seen in the body of working but the answer line is blank, allow full marks. Place the annotation ✓ next to the correct answer.

(iii) if the correct answer is seen in the body of working but a completely different answer is seen on the answer line, then accuracy marks for the answer are lost. Method marks could still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation × next to the wrong answer.

In questions with a final answer line:

(i) If one answer is provided on the answer line, mark the method that leads to that answer.

(ii) If more than one answer is provided on the answer line and there is a single method provided, award method marks only.

(iii) If more than one answer is provided on the answer line and there is more than one method provided, award zero marks for the question unless the candidate has clearly indicated which method is to be marked.

In questions with no final answer line:

(i) If a single response is provided, mark as usual.

(ii) If more than one response is provided, award zero marks for the question unless the candidate has clearly indicated which response is to be marked.

When the data of a question is consistently misread in such a way as not to alter the nature or difficulty of the question, please follow the candidate's work and allow follow through for **A** and **B** marks. Deduct 1 mark from any **A** or **B** marks earned and record this by using the MR annotation. **M** marks are not deducted for misreads.

Unless the question asks for an answer to a specific degree of accuracy, always mark at the greatest number of significant figures even if this is rounded or truncated on the answer line. For example, an answer in the mark scheme is 15.75, which is seen in the working. The candidate then rounds or truncates this to 15.8, 15 or 16 on the answer line. Allow full marks for the 15.75.

Ranges of answers given in the mark scheme are always inclusive.

For methods not provided for in the mark scheme give as far as possible equivalent marks for equivalent work. If in doubt, consult your Team Leader.

Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

Question			Answer	Marks	Part Marks and Guidance	
1	**(a)**	**(i)**	92.77[2...] or 92.8	**2**	**M1** for 22.627... or for answer between 92.66 and 92.79	
		(ii)	1.2416×10^{11} oe	**2**	**M1** for 1.552×10^{11} oe or 1.2416^{11}	Allow rounding to 3 or 4 sf
	(b)		Clear explanation of correct checking procedure	**1**		Possibilities include estimation eg 1200 ÷ 6 [=200] or working backwards eg 6 x 22.5 or eg a complete, correct non-calculator method for 1215 ÷ 6 leading to 202[.5]
	(c)		$1\frac{1}{3}$ **or** $\frac{4}{3}$ or equivalent fraction	**2**	**M1** for $\frac{1}{3}$ or 9x = 12 **OR** **SC1** for $1\frac{3}{10}$ or $\frac{13}{10}$	
2	**(a)**		Indicates the second line	**1**		

Question			Answer	Marks	Part Marks and Guidance
2	**(b)***		Both angles correct with reasons for all angles calculated, associated with appropriate angles, (including intermediate angles) and all working clear. *eg* p = 36º (alternate angles) Angle KLM= 79º (ext angle of triangle) q = 101º (angles on st line)	**4**	Condone one missing intermediate reason **3** for both angles correct with at least one correct reason associated with an appropriate angle **2** for angle p correct with correct reason[s] **or** angle q correct **or** correct FT from *their* 36 to q **1** for angle p correct (with incorrect or no reason) or correct FT from *their* q to p Angles may be on diagram.

3	**(a)**		12, 42 in either order	**3**	**B2** for one correct **OR** **M2** for [54 -] 54÷9 x 2 and [54 -] 54÷9 x 7 **OR** **M1** for 54÷9	
	(b)	**(i)**	$5\frac{1}{4}$	**2**	**M1** for $\frac{21}{4}$ or 5.25	
		(ii)	$\frac{1}{7}$ or 7^{-1} cao	**1**		Condone $0.\dot{1}4285\dot{7}$
	(c)		11:10	**2**	**M1** for 110 or 1.1 seen	For M1 condone transposed values or missing colon
4	**(a)**		$2n+1$ **oe**	**2**	**M1** for 2n + a **oe**	Condone a = 0 and use of n2

4	**(b)***		Clear and correct demonstration	**2**	Terms in the sequence are odd numbers. When any two terms are multiplied, the result is an odd number so it must be in the sequence. eg terms are odd **and** odd x odd = odd **OR** Algebraic (a ≠ b) eg (2a + 1)(2b + 1) leading to 2(2ab + a + b) + 1 **1** for one correct statement or two correct examples of multiplying two terms with result (not 3 x 7 = 21) or one correct example justifying that the result is also in the sequence **OR** Algebraic eg (2a + 1)(2a + 1) leading to $2(2a^2 + 2a) + 1$ or eg (2a + 1)(2a + 3) leading to $2(2a^2 + 4a + 1) + 1$

5	(a)		$x + y = 8$ **oe**	1		
	(b)		Correct straight line drawn	2	**M1** for at least two correct points	Straight line by eye from (1, 7) to (7, 1) or longer
	(c)		Graph of $y = 3x$	1		For 1 mark y = 3x must traverse one large square and reach *their* x + y = 8
			x = 2 and y = 6	3	**B1** for one correct value **OR** **SC2** for values transposed or FT x and y values that sum to 8 (from their intersection) **OR** **SC1** for two values from *their* y = 3x (± 0.1)	

6			160	**4**	<u>Method 1</u> **M1** for 6 x 6 x 6 **M1** for [3 or 2 x] 6 x 2 x 2 **M1** for [2 x] 2 x 2 x 2 <u>Method 2</u> **M1** for 6 x 6 x 6 **M1** for 6 x 2 x 2 **M1** for [4 x] 2 x 2 x 2 <u>Method 3</u> **M1** for 6 x 6 x 6 **AND** **M2** for 6 or 7 x 2 x 2 x 2 **OR** **M1** for [n x] 2 x 2 x 2 <u>Method 4</u> Top/bottom layer **M1** for 6 x 6 x 2 **M1** for 2 x 2 x 2 Middle layer **M1** for 4 x 2 x 2 x 2 <u>Method 5</u> **M3** for 20 x 2 x 2 x 2	**Whole cube - 3 cuboids + 2 small cubes** Implied by 216 Implied by 72 or 48 or 24 Implied by 16 or 8 **Whole cube - cuboid - 4 small cubes** Implied by 216 Implied by 24 Implied by 32 or 8 **Whole cube - 7 small cubes** Implied by 216 Implied by 48 or 56 Implied by n x 8 **Working in layers** Implied by 72 (144 for 2 layers) Implied by 8 (16 for 2 layers) Implied by 32 Mark method that leads to answer. If not clear then mark to candidate's best advantage but do not mix methods.

7	**(a)**		[x=] 8	**3**	**M2** for complete, correct method with one error **OR** **M1** for $4x - 24$ or x – 6 = x/4 **OR** **M1** for subtracting x from each side (using their ax ± b = x) **OR** **M1** for correct FT from kx = n After 0 scored **SC1** for 8 correctly embedded as their final response	Removing brackets Correctly re-arranging to get x on one side
	(b)	**(i)**	2.25 or $2\frac{1}{4}$ or $\frac{9}{4}$	**2**	**M1** for $\frac{36}{4^2}$ oe	
		(ii)	$[A =]\sqrt{\frac{P}{R}}$	**2**	**M1** for $A^2R = P$ or $A^2 = \frac{P}{R}$	
		(iii)	P and A with $\frac{P}{A^2} = 3.4 \times 10^8$	**2**	**M1** for $\frac{P}{A^2} = 3.4 \times 10^8$ or P = 3.4 x 10^8 x A^2 or $A^2 = \frac{P}{3.4 \times 10^8}$	eg 1.36 x 10^9 and 2 3.4 x 10^{10} and 10 1.36 x 10^{11} and 20 3.4 x 10^{12} and 100 6.8 x 10^{12} and $\sqrt{(2x10^4)}$ 3.4 x 10^8 and 1 Need not be in standard form

8			4.2[4.....]	4	**B1** for (side of square) 6 **AND** **M2** for diagonal = 8.48… or $\sqrt{their\,72}$ oe **OR** **M1** for 2 *their* AB^2 **oe**	Allow $3\sqrt{2}$ or 4.25 from 8.5 Not if clearly given as eg radius. Can be implied by half square length = 3 Alternatives **M2** for radius = $\sqrt{18}$ **OR** **M1** for $2r^2 = 6^2$ **oe** or for trigonometry **M2** for $\frac{6}{\sin 45}$ or $\frac{6}{\cos 45}$ **OR** **M1** for $\sin 45 = \frac{6}{diameter}$ or $\cos 45 = \frac{6}{diameter}$
9	(a)		65.3 **OR** 65.25...	3	**M2** for $\cos^{-1}\left(\frac{3.6}{8.6}\right)$ oe **OR** **M1** for $\cos[P] = \frac{3.6}{8.6}$ oe **OR** **SC2** for 24.7465…rot to 1dp or better as final answer	eg $\sin^{-1}\left(\frac{7.81...}{8.6}\right)$ eg $\sin[P] = \frac{7.81...}{8.6}$ Could use Pythag. and cos. rule
	(b)		14.05 to 14.07 or 14.1	2	**M1** for $\frac{1}{2} \times 3.6 \times 8.6 \times \sin their\ P$ or for QR = $\sqrt{61}$ or for ½ x 3.6 x *their* QR	 Implied by 7.8[1…..] QR obtained from correct Pythag

10	**(a)**		0.5, -3 isw	**4**	**M2** for correct factors $(2x-1)(x+3)$ **OR** **M1** for factors which multiply to give two correct terms in $2x^2+5x-3$ **B1** for one correct answer	Can be solved by use of formula or completing square **M2** for $\frac{-5\pm\sqrt{49}}{2\times 2}$ **OR** **M1** for $\frac{-5\pm\sqrt{5^2-4\times 2\times(-3)}}{2\times 2}$ condone 1 error in substitution **OR** **M2** for $\left(x+\frac{5}{4}\right)^2-\frac{49}{16}=0$ oe **OR** **M1** for $\left(x+\frac{5}{4}\right)^2$
	(b)		$\frac{4}{(x-2)(x+2)}$ or $\frac{4}{x^2-4}$	**2**	**B1** for correct common denominator used	Denominator can be factors or multiplied out
	(c)	**(i)**	u = 2 and v = 4	**3**	**M2** for $(x+2)^2+4$ or $2^2+v=8$ **OR** **M1** for $(x+2)^2$ or $x^2+ux+ux+u^2$ oe **OR** **B1** for u=2 or v = 4	T&I will score 3 marks if both correct otherwise B1 only if one correct
		(ii)	A suitable value of x where $-4 < x < 0$	**1**		

11			Use of Pythagoras to show $x^2 - 6x + 9 = x^2 + 1$ $1\frac{1}{3}$ oe or 1.33[333....]	**3** **3**	**M1** for $QS^2 = 5^2 - 3^2$ or ST = 3 - x **M1** for $(3 - x)^2 = 9 - 6x + x^2$ **M1** for $(3-x)^2 = x^2 + 1^2$ **AND** **M1** for -6x + 9 = 1 **M1** for 6x = 8 **oe**	Implied by QS = 4 If elements of the proof are shown as part of the solution mark at any stage. eg $5^2 - 3^2 = 16$ $\sqrt{16} = 4$ QS = 4 and SR = 1 then solves May use trigonometry
12	**(a)**		3.2 oe	**3**	**M2** for $y = \frac{16}{\sqrt{x}}$ OR $\frac{16}{\sqrt{25}}$ or **M1** for $k = 16$ or for $y = \frac{k}{\sqrt{x}}$ After M0 **SC1** for $y = 4\sqrt{x}$ **AND** **SC1** FT to 20 from $y = 4\sqrt{x}$	
	(b)		64	**2**	**M1** for $2 = \frac{16}{\sqrt{x}}$ or 64 in working **OR** **SC1** for 0.25 from 20 in (a)	FT from *their k* for **M1**
13	**(a)**		Graph of $y = 3\cos x$	**3**	**M1** crosses *x*-axis at 90 and 270 **M1** Max of 3 at *x* = 0 and min of -3 at *x* = 180 by eye **A1** correct smooth curve	May cross at other pts. on x axis Dep. On M2
	(b)		Graph translated 1 unit up	**2**	**M1** for vertical translation ≠ 1 **or** for a curve through 3 correct points **SC1** for horizontal translation of ±1	For 2 marks do not allow any intersection of graphs but condone parallel lines

14	**(a)**		90º in both triangles [given] ∠JMN = ∠PKL (alt angles) JM = KL (opp sides of parallelogram) Triangles congruent AAS	**3**	**M2** for all three statements with at least 1 correct reason **OR** **M1** for all three statements with no reason **or** for 2 statements with a correct reason **A1** for AAS	Accept correct alternative methods Accept Z angles Dep on at least M1
	(b)		6.9[418...]	**3**	**M2** for 48.189 **OR** **M1** for $8.4^2+3.9^2–2x8.4x3.9cos55$ or for correct use of cos55 =	
15			13.73 to 13.7432….	**5**	**M1** for $\frac{50}{360} \times 2 \times \pi \times 8$ oe **A1** for 6.98..… or $20\pi/9$ **AND** **M1** for 8^2+8^2 - 2x8x8xcos50 oe **A1** for 6.76… or √45.7..…	Accept correct alternative methods to find [½]AB

APPENDIX 1

Exemplar responses for question 4b

Response	Mark awarded
If you multiply any of the two numbers in this sequence, they will equal an odd number, as all the numbers are odd. All numbers in this sequence are odd, so any next to each other multiplied have to be odd, for example 13x5=195, and 195 will be in the sequence because it is an odd number.	2
The product can have any two terms in the sequence because they are odd numbers and if you times two together they make an odd number and that is how you can tell because all of the numbers in this sequence is odd.	2
7x9=63 63 is an odd number and all of the odd numbers are in the sequence.	1
The product of any two terms in this sequence will also be in the sequence because this is a sequence of odd numbers so for example 5x7 will be in the sequence later on.	1
5x7=35 the nth term 2n+1 makes 35 the 17^{th} term and 35 comes up in the sequence	1
Both numbers are odd then they will multiply to a number in the sequence	1 BOD

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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