GCSE

Methods in Mathematics (Pilot)

General Certificate of Secondary Education

Unit **B392/02:** Higher Tier

Mark Scheme for June 2012

Annotations

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

1.   **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.

2.   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.

3.   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 − √(*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.

4.   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.

5.   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).
-    **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**.

6.   Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise, indicated for example by the instruction 'mark final answer'.

7.   As a general principle, if two or more methods are offered, mark only the method that leads to the answer on the answer line. If two (or more) answers are offered, mark the poorer (poorest).

8.   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.

9.   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.

10.   If the correct answer is seen in the body and the answer given in the answer space is a clear transcription error allow full marks unless the mark scheme says 'mark final answer' or 'cao'. Place the annotation ✓ next to the correct answer.

        If the answer space is blank but the correct answer is seen in the body allow full marks. Place the annotation ✓ next to the correct answer.

        If the correct answer is seen in the working but a completely different answer is seen in the answer space, then accuracy marks for the answer are lost. Method marks would still be awarded. Use the M0, M1, M2 annotations as appropriate and place the annotation ✘ next to the wrong answer.

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

12.   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.

13.   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)		25.09[9....]	1	Allow 25.1[0]	
	(b)		$6 \times 5 + \sqrt{42}$ or $5 \times 6 + \sqrt{42}$	2	**M1** for 6, 5, 4 and 2 entered in boxes in a way that gives an answer larger than *their* **(a)** or **SC1** for 36.48...	Figures used more than once scores **M0**
2	(a)	(i)	-0.5 **oe**	2	**M1** for $\dfrac{3 + {}^-4}{2}$ **seen**	
		(ii)	$a = yc - b$ **oe**	2	**M1** for $yc = a + b$ **seen** or **SC1** for $yc - b$ **oe** *(a = missing)*	first <u>relevant</u> step
	(b)		$2b^3$ **oe**	2	**M1** for b^2 or $2b$ **seen**	Condone incomplete processing

Question			Answer	Marks	Part Marks and Guidance	
3	(a)		264 or 260	4	**M2** for $\sqrt{540^2 + 390^2}$ **soi** by 666.[...] **OR** **M1** for $540^2 + 390^2$ or incorrect use of Pythagoras eg $\sqrt{540^2 - 390^2}$ **and** **M1** for (390 + 540) – *their* 666 from Pythagoras Allow **B3** for 263.9 or 263.8919...	<u>Alternative</u>: **M2** for $\tan^{-1}$ (390/540) or $\tan^{-1}$ (540/390) followed by use of sin or cos to find AB **OR** **M1** for use of either $\tan^{-1}$ and sin or $\tan^{-1}$ and cos. **and** **M1** for (390 + 540) – *their* 666 from trig For scale drawing allow full marks for final answer of 264 or 260 or **M1** for acceptable scale drawing **and** **M1** for (390 + 540) – *their* 666 from scale drawing
	(b)		345 to 346	2	**M1** for $\pi \times 55 \times 2$ or for **figs** 345 **or** **B1** for 341	

Question	Answer	Marks	Part Marks and Guidance
4	[£] 9.3[0] and 35[%]	6	**B3** for £9.30
			OR
			M1 for 0.225 × 12 or 2.7[0] or eg percentages totalling 22½% with at least one correctly evaluated **and** **M1** for 12 − *their* 0.225 × 12
			OR **M1** for 1 − 0.225 or 0.775 **and** **M1** for (*their* 1 − 0.225) × 12
			OR **M2** for 0.775 × 12
			AND **B3** for 35%
			or **B2** for 65%
			or **M2** for 1 − 5.72/8.80 or (8.80 − 5.72)/8.80
			or **M1** for 5.72/8.80 or 3.08 or 308

eg 20% 2% ½%

First **M1** may be implied by second **M1**

Allow eg (880 − 572)/8.80

Question			Answer	Marks	Part Marks and Guidance	
5	(a)		2 : 3	2	**M1** for ratio equivalent to 36 : 54 but simpler or 1 : 3/2 or 2/3 : 1 **or** **SC1** for answers transposed	eg 18 : 27, 6 : 9, etc.
	(b)		£15, £30	2	**M1** for 45 ÷ 3 **or** **SC1** for one correct value in any position	
6			36 47	1 1	**SC1** for answers correct on diagram and then transposed in answer	Answers may be taken from diagram if answer space is empty.
7	(a)		-2.5 **oe**	2	**M1** for $x + 3 = 0.5$ or $4x + 12 = 2$	Accept $x + 3 = 2/4$ Allow embedded in answer if not contradicted
	(b)		$x < 5$	2	**M1** for $3x < 15$ or $[x =]\ 5$ or $x \leq 5$ or $x < 7/3$ **oe**	Condone x $\leq$ 4.99999999… for **M1**
8	(a)		125	1		
	(b)		3	2	**M1** for $\dfrac{1}{3}$ seen or answer of 3/1	
9	(a)		(1,0)	1, 1	**SC1** for transposed co-ordinates	
	(b)	(i)	Ruled, perpendicular bisector of AB that touches or crosses AB	2	**M1** for correct freehand line or correct intersecting arcs on each side of AB or 3 or more points plotted on the perp. bisector or correct line that does not reach AB	

Question			Answer	Marks	Part Marks and Guidance	
		(ii)	$y = x - 1$ **oe**	FT2	**M1** for gradient = 1 implied by eg $x - 1$	
10	(a)		$-6, 0, -0.375, 6$	2	**B2** all values correct **or** **B1** 2 values correct	
	(b)			2	**B1** for all points from *their* table correctly plotted **AND** **B1** for smooth curve through *their* points	within ½ small square (condone one error) but, for points that are not on an intersection, we expect to see it between the correct horizontal lines by eye within ½ small square. Must have turning points in both 2nd and 4th quadrants. **B0** for multiple/"hairy" curves
	(c)		Sketch – correct curved lines one of which passes through (1, 0) that translate downwards and do not intersect with the original curves	2	**B1** for vertical translation of both curves in the same direction or "correct" line in only one quadrant	Do not penalise inaccurate drawing as long as the intention is clear. Condone curves that touch at the asymptotes but not those that cross

Question			Answer	Marks	Guidance	
11	(a)*		All four angles, calculated correctly with reasons eg 45 from 90/2 (**or** from ½ square corner) **and then** 135 from co-interior angles in a trapezium or angles in a trapezium/quadrilateral add to 360 or (360 – 90)/2 **OR** 135 from (360 – 90)/2 (or 270/2) **and then** 45 from co-interior angles in a trapezium or angles in a trapezium/quadrilateral add to 360 or 90/2 unless contradicted.	3 - 2	For lower mark – both angles correctly calculated (45º and 135º)	
			One angle correct (with or without reasons or working) **or** angles *a, a*, 180 – *a*, 180 – *a* with explanation including symmetry and angles of trapezium 360.	1		

Question			Answer	Marks	Part Marks and Guidance	
	(b)		1.8 cm	2	**M1** for length s.f. = 3 or ⅓ seen or area of internal square calculated (3.24)	Condone missing units
			2.5 to 2.55 cm	3	**M2** for √(1.8² + 1.8²) with *their* 1.8 or √(5.4² + 5.4²) ÷ 3 **or** **M1** for (1.8² + 1.8²) with *their* 1.8 **soi** by 6.48 or √(5.4² + 5.4²) **soi** by 7.6	Alternative (for 2.5...): **M2** for (*their* 1.8)/sin45 or (*their* 1.8)/cos45 **oe** **or** **M1** for sin45 = (*their* 1.8)/"hyp" or cos45 = (*their* 1.8)/"hyp" **oe** (*Their* 1.8 must come from *their* short side of trapezium)

Question			Answer	Marks	Guidance
12	(a)		$(x-y)(x+y)$	1	Condone missing final bracket
	(b)*		Finding both ways ($8^2 - 7^2$ and $4^2 - 1^2$), expressed clearly and <u>showing that there are no other ways</u> eg considers all pairs of factors of 15 or shows that differences of square numbers over 8^2 are not relevant as differences between adjacent squares become too great. Accept at least 4 trials, one going beyond $8^2 - 7^2$ with ascending results and appropriate comment.	4-3	For lower mark - both ways found and some attempt to show there are no other ways (e.g. trials beyond $8^2 - 7^2$) but not completely watertight.
			Finding both ways ($8^2 - 7^2$ **and** $4^2 - 1^2$)	2-1	For lower mark – finding one way ($8^2 - 7^2$ **or** $4^2 - 1^2$)
			Not finding a way to write 15 as a difference of two squares	0	

Question			Answer	Marks	Part Marks and Guidance	
13	(a)		Correct complete working that starts with diagrams or sequence and concludes with $2n^2 - 2n + 1$	3	**M2** for splitting shapes into two squares or rectangles and finding a correct expression for the sum of the parts or sequence of sum of squares or showing that second difference = 4 and finding coefficient of n^2 **or** **M1** for splitting shapes into two squares or rectangles and finding a correct expression for the area of one part or substitutes $n = 1$ to 4 in the formula to obtain 1, 5, 13, 25 or showing that second difference = 4	eg $(n - 1)^2 + n^2$ Not simply by counting squares
	(b)		Correct proof there is no pattern – complete correct working with justification	3	**M2** for $2n^2 - 2n$ is even **and** $2n^2 - 2n +1$ is odd **or** **M1** for $2n^2 - 2n + 1 = 500$ **A1** for conclusion that includes 500 is even (dep. on **M2** scored) **OR** **M2** for substitutes correctly into the formula using $2n^2 - 2n - 499 = 0$ **or** **M1** for $2n^2 - 2n + 1 = 500$ **A1** for $n = 16.3$ .. or $b^2 - 4ac = 3996$ **soi** and comment that n is not whole number or that 3996 is not a perfect square **OR** **M2** for both $n = 16$ (481) **and** $n = 17$ (545) evaluated correctly	 For **M1** allow T&I if answer between 16 and 17 is obtained 63.21... implies 3996

Question			Answer	Marks	Part Marks and Guidance	
					or **M1** for either $n = 16$ (481) **or** $n = 17$ (545) evaluated correctly or 479 **and** 543 seen **A1** for correct justification that 500 is not part of pattern (dep. on two of the above values calculated) **OR** **M2** for statement that n^2 and $(n-1)^2$ are consecutive squares so their sum must be odd **or** **M1** Statement that n^2 and $(n-1)^2$ are consecutive squares **A1** Conclusion that includes 500 is even (dep on **M2** scored)	Condone reference relating to last digit is odd following at least 5 trials eg Therefore 500 doesn't work
14	(a)		47 or 47.4 to 47.43	3	**M2** for $\sin A = \dfrac{8\sin 67}{10}$ $[= 0.7364....]$ **or** **M1** for $\dfrac{\sin A}{8} = \dfrac{\sin 67}{10}$ **oe**	Answer using rads = -0.753802377 Answer using grads = 48.91073809 Use of Pythagoras scores 0
	(b)		Correct explanation	1	eg Angle A is opposite a shorter side than angle B so it must be smaller or If angle A was obtuse, it would be (*their*) 132.6º and the angles of the triangle would add up to over 180º	**NOT** (examples) ... • because there is an interior and exterior angle • simply that triangle adds to 180 • angle A is less than 90

Question			Answer	Marks	Part Marks and Guidance	
	(c)		36.4 to 36.43	3	**M2** for $0.5 \times 8 \times 10 \times \sin(\textit{their } C)$ **or** **M1** for angle $C = 180 - (67 + \textit{their } A)$	
15	(a)		$21x^2 - x - 2$ or $21x^2 - 7x + 6x - 2$ as final answer	3	**M2** for three of the following terms seen: $21x^2 - 7x + 6x - 2$ **or** **M1** for two terms	-x can imply two terms
	(b)	(i)	$(2x - 3)(x + 1)$	2	**M1** for $(2x + 1)(x - 3)$ or $(2x + 3)(x - 1)$ or $(2x - 1)(x + 3)$	Condone final bracket missing
		(ii)	$\dfrac{x + 1}{x - 2}$	3	**M2** for correct factorisation of denominator **and** use of *their* **(b(i))** in numerator **or** **M1** for $(2x - 2)(x - 3)$ or $2(x - 1)(x - 3)$ or $(2x + 2)(x + 3)$ or $2(x + 1)(x + 3)$ or $(2x + 3)(x + 2)$ or use of *their* **(b)(i)** in numerator	Cancelling $2x^2$ scores **0**

Question	Answer	Marks	Part Marks and Guidance	
16	117 or 116.85 to 116.9	5	**M1** for $\frac{4}{3}\pi \times 3.2^3$ (137.258..) or $\frac{2}{3}\pi \times 3.2^3$ **A1** for 68.6[29..] **M1** for $\frac{1}{3}\pi \times 3.2^2 \times$ *their h* **A1** for 48.25[4..]	**NOT** $h \geq 7.7$ or 3.2
	cm^3	B1		
17	19.47 to 19.5	4	**M1** for $8^2 + 8^2$ **soi** by 128 **A1** for DB = 11.3…. or $8\sqrt{2}$ or $\sqrt{128}$ **AND** **M1** for tan B = 4/(*their* DB) or sin B = 4/(*their* BM) or cos B = $\sqrt{128}$/(*their* BM) If 0 scored, allow: **SC1** for answer of 26.5[65...] or 26.6	Use of DB = 8 scores **M0**

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