GCSE

Methods in Mathematics (Pilot)

General Certificate of Secondary Education

Unit **B392/02:** Higher Tier

Mark Scheme for January 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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

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	Workless mark awarded 1
B2	Workless 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 using a correct method and are not lost for purely numerical errors.
   A marks are for an accurate answer and depend on preceding **M** (method) marks. Therefore **M0 A1** cannot be awarded.
   B marks are independent of **M** (method) marks and are for a correct final answer, a partially correct answer, or a correct intermediate stage.
   SC marks are for special cases 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 not from wrong working **full marks** should be awarded.

   Do not award the marks if the answer was obtained from an incorrect method, ie incorrect working is seen and 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 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**.

6. 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 for example by the instruction ‘mark final answer’.

7. 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.

8. 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).

9. 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.

10. 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.

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)		0.18, $\frac{9}{50}$ 33[⅓], $\frac{1}{3}$ 31.25, 0.3125	4	**B3** for 4 or 5 correct **or** **B2** for 3 correct **or** **B1** for 1 or 2 correct	Condone missing % sign in percentage column Allow 33[.333...%] Condone 31% or 31.3% instead of 31.25% but 0.3125 is **cao**
	(b)		$\frac{2}{5}$ **oe**	1	Fraction only	
2			36	3	**M2** for 120 ÷ 200/60 or 120 × 60/200 or 20 cal in 6 mins **oe seen** then 6 × 6 **or** **M1** for 200/60 or 60/200 or 120/200 or 20 cal in 6 mins **oe seen**	Allow 120 ÷ 3.3….. **soi** for **M2** 200/60 may be implied by 3.3…. Number of calories given must be a factor of 120
3	(a)		$\frac{1}{4}$ **oe**	1		
	(b)		1	1		Do not allow $\frac{8}{8}$
4	(a)		(x =)16	3	**M1** for correct numbers on one side eg 11 + 21 or –21 – 11 (**figs** 32) **and** **M1** for correct x on other side eg $4x - 2x$ or $2x - 4x$ ($\pm 2x$)	Method marks can be earned in either order. Expressions need not be simplified.

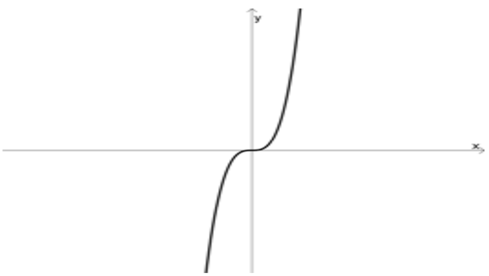
Question			Answer	Marks	Part marks and Guidance	
	(b)		$x \le 8$ final answer	**3**	**B2** for $x = 8$ or $x < 8$ **or** **B1** for $x \ge 8$ or $x > 8$ or $x \le {}^{-}8$ or answer 8 **or** **M1** for $3x$ and 19 + 5 **oe seen**	
5			66	**3**	**M2** for 22 × 3 or 3 × 3 × 5 + 3 × 1 × 4 + 3 × 3 × 1 or 120 – 54 or complete, correct method with one error **or** **M1** for finding area of cross-section (condone one error) or *their* area of cross section × 3 or splitting shape into cuboids or 120 – *their* volume	Methods: 3 × (15 + 4 + 3) 3 × (8 + 12 + 2) 45 + 12 + 9 24 + 36 + 6 120 – (24 + 30) 120 – (48 +6)
6	**(a)**		$\sqrt{10^2 - 9^2}$ 4.358[898…] **seen** or 4.36 from √19	**M2** **A1**	Allow √19 **nfww** **M1** for a Pythagoras statement **soi** or alternative method **M2** for $\sqrt{4.36^2 + 9^2}$ = 10 or better **or** **M1** for $4.36^2 + 9^2$	$\sqrt{(10^2 + 9^2)}$ or $10^2 - 9^2$ Condone unrounded final answer
	(b)		Correct pair of sides with evidence that the product is greater than 9 × 4.36 = 39.24	**4**	**M1** for use of Pythagoras to find another pair of sides (<10) with diagonal 10 **soi** **A1** for 99 < sum of squares < 101 **M1** for 9 × *their* 4.36 **soi** (by 39.23 to 39.24) **A1** for *their* evaluated area compared to *their* 39.24	Correct pair of sides is implied by 99 < sum of squares < 101 eg 6 and 8 **www** implies **M1 A1** **M1** may be seen in part **(a)** Two areas seen can be taken as evidence of comparison.

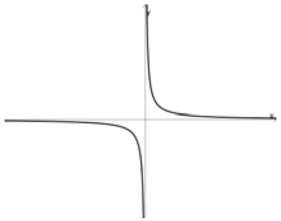
Question			Answer	Marks	Part marks and Guidance	
7	(a)		(C =) 50 + 20n **oe**	2	**B1** for equation of line with gradient 20 or y-intercept 50	20n ± a or bn ± 50 (Condone a or b = 0 or eg n20) NOT 50n + 20n
	(b)		Correct, straight line drawn, through origin and to at least x = 3	2	**B1** for correct shorter line or at least two correct points plotted but not joined or for coordinates of two correct points seen (possibly in table) or for straight line through origin with positive gradient.	
	(c)	(i)	(5, 150)	1	**FT** co-ordinates of *their* intersection	± 1 small square horizontally and vertically
		(ii)	[For five hours] they charge the same amount **oe**	1	**FT** *their* **(i)** for time	Allow eg solution of C = 30n and C = 50 + 20n
8	(a)		$\frac{1}{9}$	2	**M1** for equivalent fraction	
	(b)		Two fractions, each less than one, which multiply to give $\frac{4}{11}$	2	**M1** for evidence of multiplying two fractions, each <1, not those in **(a)** **SC1** Two fractions which multiply to give $\frac{4}{11}$ but where one is ≥1	 **NOT** $\frac{4}{11}\times 1$ or $\frac{4}{1}\times\frac{1}{11}$

Question			Answer	Marks	Answer
9	(a)*		A correct, complete and clear proof that the angle sum of any pentagon is 540° Accept diagram showing pentagon split into three triangles with angles of triangles in vertices of pentagon. Statement that the sum of the angles in a pentagon is equal to the sum of the angles in three triangles and calculation of 3 × 180 or diagram showing pentagon split into five triangles meeting at a common point inside the pentagon. Statement that the sum of the angles of the pentagon is equal to the sum of the angles of the triangles – the sum of the angles around the point and calculation of 5 × 180 – 360	**3 – 2**	For lower mark explanation incomplete (two of three points covered) eg diagram of pentagon split into three (or five) triangles plus correct calculation or full explanation from diagram split into a triangle and quadrilateral
				1	Only one aspect considered. eg **diagram** showing pentagon split into three (or five) triangles or triangle plus quadrilateral or sum of angles in three triangles = sum of angles in pentagon or 3 × 180

Question			Answer	Marks	Part marks and Guidance	
	(b)		132, 98	**3**	**M1** for 180 – 48 [= 132] or 360 – 228 **and** **M1** for 540 **–** (sum of *their* other four angles) seen or clear attempt at sum of 180 – 137 and 180 – 125 **OR** **SC2** for correct answers reversed If **M0** scored, allow **SC1** for two answers that sum to 230 or one correct angle seen	Alternative method for 98 is to draw parallel through vertex D and use angles in parallel lines.
10	**(a)**		$x^2 + 2x - 15$	**3**	**M2** for three of x^2, $-3x$, [+]$5x$, $^-15$ **soi** **or** **M1** for two correct terms	$+2x$ could be two terms for **M2** or **M1**
	(b)	**(i)**	7, 29, 61	**3**	**B1** for each correct in ascending order **SC2** for reverse order **or** **SC1** for any correct substitution of 1, 2 or 3 in formula	

Question			Answer	Marks	Answer
		(ii)*	Finding a correct counter example, evaluated correctly and demonstrating why the term is not prime or complete, correct algebraic proof eg when n = 5 the result is 155 which is a multiple of 5 (or has more than two factors) [therefore not prime] Counter example may be implied by substitution eg $5 \times 5^2 + 7 \times 5 - 5 = 155$ for both t_n and evaluation of t_n	3 – 2 1	For lower mark, correct counter example seen, and correctly evaluated, but demonstration incorrect/incomplete or incomplete algebraic proof eg when n = 5 the result is 155 therefore not prime At least one term correctly evaluated beyond those given in **(b)(i)**

Question			Answer	Marks	Part marks and Guidance	
11			1.69×10^{120}	**2**	**B1** for either 1.69 or 10^{120} in answer or correct answer not in SF	
12	**(a)**			**2**	**B1** for any other cubic curve	

Question			Answer	Marks	Part marks and Guidance	
	(b)		Correct curves in 1st and 3rd quadrants. 	2	**B1** for one correct branch in correct quadrant or correct branches in 2nd and 4th quadrants	Mark intention but do not condone curves that cross at the asymptotes Ignore curves in other quadrants
13			0.121 – 0.123 or 0.12	5	**M1** for $\frac{40}{360} \times \pi \times 2.1^2$ **M1** for $0.5 \times 2.1^2 \times \sin 40$ **oe** **A1** for either triangle or sector correctly evaluated **M1** for *their* sector – *their* triangle	Area of sector = 1.53938… Area of triangle = 1.417346….. Must be areas
14			312	3	**M2** for 1.16^3 seen or 269.12 or 269 or 312.17 to 312.2 **or** **M1** for 1.16 seen or 232 **SC2** for answer of 313 or 362 **or** **SC1** for 200 × 1.48 [=296]	

Question			Answer	Marks	Part marks and Guidance	
15			$M = \frac{200}{d^2}$ **oe**	3	**M1** for $M = \frac{k}{d^2}$ **and** **M1** for $50 = \frac{k}{2^2}$ **oe** **or** **SC1** for $M = \frac{50}{4}d^2$ or $M = \frac{100}{d}$ **oe**	
16	**(a)**		3.41, 0.59	4	<u>Formula</u> **M2** for $\frac{4 \pm \sqrt{8}}{2}$ **or** **M1** for correct substitution into quadratic formula (condone one error) **B1** for both unrounded answers or one correct answer rounded	<u>Completing the square</u> **M2** for $(x - 2) = \pm\sqrt{2}$ **or** **M1** for $(x - 2)^2$ seen
	(b)	**(i)**	$(x+1)(3x-2)$	2	**M1** for $(3x + 2)(x – 1)$ or $(3x + 1)(x – 2)$ or $(3x – 1)(x + 2)$	Condone use of $1x$ for x
		(ii)	$\frac{3x-2}{x-1}$	3	**M2** for $(x – 1)(x + 1)$ seen as denominator and use of *their* numerator from part **(b)(i)** **or** **M1** for attempt to factorise denominator or use of *their* numerator from part **(b)(i)**	Two brackets seen with correct x terms and correct numbers Ignore signs eg $(x–1)(x–1)$

Question			Answer	Marks	Part marks and Guidance	
17		(ii)	45 **cao** **nfww**	5	**M1** for correct Pythagoras statement **A1** for [AC =] √200 or [AO =] √50 **AND** **M2** for [A =] $\cos^{-1}$ 0.707...**oe** **or** **M1** for $\cos A = \frac{\textit{their}\ \text{AO}}{10}$ **SC1** for 45 with no working	14.14....(or 7.07..) implies **M1 A1** **soi** by 45, 45.008[...] or 45.57[...]
18	(a)		Tick in first box only	1		
	(b)		75	3	Method 1 **M2** for 25% **soi** or ¾ **or** **M1** for area sf = 4 or 1/4 **soi**	Method 2 **M2** for 27π **soi** or 25% **or** **M1** for one of areas 36π (113.1 or better) or 9π (28.3 or better)
	(c)		0.6	4	Method 1 **M1** for [inner circle =] 1% **soi** **M1** for area sf = 100 **soi** **M1** for length sf=10	Method 2 **M1** for [inner circle =] 1% **soi** **M1** for area 0.36π (1.13[.....]) **M1** for $r^2 = 0.36$ **soi** Ignore any units (allow 6 mm)

APPENDIX 1

Exemplar responses for **Q7(c)(ii)**

Response	**Mark**
The amount charged for the same time is the same	**1**
The point where Mr F and HD rates are the same	**0**
The point where Mr F and HD prices are the same	**1**
The point where Mr F and HD rates/costs are the same	**1 bod**
It represents how long it takes for costs to be equal	**1 bod**
The difference in cost	**0**
The point where Mr F equals HDs price	**1**
The point where Mr F becomes more expensive than HD	**1 bod**
The cost is equal minimum allowed	**1**
The point at which both prices are equal	**1**
The point where Mr F price and hour and HD meet	**0**
The point at which "hiring" either Mr F or HD would be the same	**1**
When the two repair men cost the same	**1**
The point where Mr F starts to become more expensive than HD	**1**
How much they both cost for 5 hours	**1**
Where the pay and hours are the same	**0**

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