ADDITIONAL MATHEMATICS **4037/02, 0606/02**

Paper 2 **October/November 2009**

MARK SCHEME

Maximum Mark : 80

IMPORTANT NOTICE

Mark Schemes have been issued on the basis of **one** copy per Assistant examiner and **two** copies per Team Leader.

[Turn over

General Instructions for Examiners

Before the Coordination meeting

- Examine the Mark Scheme and familiarise yourself with the questions.
- Team Leaders will attempt to contact new examiners.
- Mark a few scripts in pencil using the scheme provided.
- Check that scripts and Mark Sheets received correspond to your apportionment.

The Coordination meeting.

- Try and make contact with your team leader.
- Make notes of any changes or amendments decided at the meeting.
- Try and be clear in your own mind of what is required for each mark, but particularly for M marks.
- Photostats should be available at the meeting and these will be marked during the course of the day.

Marking

- Please use red ink or red ball-point.
- Errors in the scheme must be underlined or ringed and omissions indicated so that the reason for a loss of mark is clear to anyone revising the script.
- Every page containing work should have some mark on it to indicate that it has been seen.
- If work is deleted and replaced, please mark the replacement only. If work is deleted without replacement, please mark the deleted work. If two solutions are offered, please allow marks for the better solution.
- Please show marks in the **outer margins :- RH for odd pages, LH for even pages.**
- For a partially correct part of a question, please exhibit the detailed marks in the margin, eg M1 A0, level with the appropriate work. For a completely correct part, only the total mark for that part need be given; please show this mark in the margin. The question total should also be shown in the margin, ringed, at the end of the question. This total must equal the sum of the un-ringed marks for the question and should be entered on the front page of the script (in the grid if available).
- **The total mark for the script must be obtained by two independent methods and checked for agreement. Firstly, add all the un-ringed marks for the script and enter the total on the top RH corner of the front page. Secondly, add the question totals in the grid at the front of the answer book.**
- Although the scheme will allow for the majority of likely methods, full marks are to be given for a correct result from any correct method, with equivalent sub-marks for equivalent stages. (This does not however apply if candidates have been directed to answer a question by a particular method).
- Very occasionally solutions are offered for which the scheme, strictly applied, would be unduly harsh. The examiner should award what he regards as a fair mark and initial to indicate a departure from the scheme.

Mark Scheme Notes

- Marks are of the following three types.

  M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

  A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

  B Accuracy mark for a correct result or statement independent of method marks.

- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

- The symbol √ implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.

- Note. B2 or A2 means that the candidate can earn 2 or 0.
  B2,1,0 means that the candidate can earn anything from 0 to 2.

- The following abbreviations may be used in a mark scheme or used on the scripts.

  AG   Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid).
  BOD Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear).
  CAO Correct Answer Only (emphasising that no "follow through" from a previous error is allowed).
  ISW Ignore Subsequent Working.
  MR   Misread.
  PA   Premature Approximation (resulting in basically correct work that is insufficiently accurate).
  SOS See Other Solution (the candidate makes a better attempt at the same question).

Penalties.

- **MR –1** A penalty of MR –1 is deducted from A or B marks when the data of a question are misread. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy.
- **OW-1,2** This is deducted from A or B marks when essential working is omitted.
- **PA–1** This is deducted from A or B marks in the case of premature approximation. The PA–1 penalty is usually discussed at the meeting.
- **S–1** Occasionally used for persistent slackness – usually discussed at the meeting.
- **EX–1** Applied to A or B marks when extra solutions are offered to a particular equation. Again this is usually discussed at the meeting.

After the Meeting

- 10 marked scripts, preferably in the range 25-55 should be sent to the team leader as soon as possible. No bulk batches of scripts or mark sheets may be posted until these sample scripts have been returned and scripts already marked revised as necessary.
- Enclose with each batch of sample scripts:
  a. the completed form for sample scripts.
  b a stamped addressed envelope for the return of the scripts
  c a list of specific problems not previously discussed over the telephone
- Your team leader will discuss particular problems arising in the coordination scripts over the telephone and will ask for specified centres from Batch 1 (and from the final batch) to be forwarded by first class post. You should not return any scripts from each of these batches to Cambridge until after this request has been made. You will not receive these scripts back from your Team Leader, so you must complete and return your mark sheets to Cambridge by the stated Batch 1 (and final Batch) return date along with the rest of your Batch 1 (and final Batch) mark sheets. Further checking by Team Leaders and senior examiners of Examiners' marking takes place at the Grade Review stage.
- When all scripts have been marked, brief notes on the candidate's work should be sent to the principal Examiner. The particular questions on which to comment will be allocated at the Coordination meeting.

0606/2
<u>**4037/2 Revised Mark Scheme November 2009**</u>

1	(i)	$> e^{-1}$	B1
	(ii)	Uses ln function	M1
		$1 + \ln x$	A1
	(iii)	$> e^{-1}$	B1√

4

2	(i)	$64 - 96x + 60x^2 - 20x^3$	B1+B1+B1+B1
	(ii)	Multiply by $1 + 2x + x^2$	M1
		$-20 + 120 - 96 = 4$	A1

6

3 (i)   Plots $x^2 y$ against x with linear scale.   M1

x	2	4	6	8	10
$x^2 y$	24.96	45.12	64.44	85.12	105

		A2,1,0
(ii)	Calculates gradient	M1
	$a = 10 \pm 0.2$	A1
	Equates intercept to b	M1
	$b = 5 \pm 0.5$	A1

7

4	$\left(\dfrac{dy}{dx} =\right) 3x^2 + 6x - 45$	B2, 1, 0
	Equate to 0 and solve	M1
	$x = 3$ and $x = -5$	A1
	$(3, -21)$ and $(-5, 235)$	A1
	Complete method for max/min	M1
	minimum when $x = 3$ and maximum when $x = -5$	A1

7

5	**(i)**	$\sqrt{7^2+24^2}$	M1
		$|OA|=25$	A1
	(ii)	$\overrightarrow{AB}=\begin{pmatrix}3\\-4\end{pmatrix}$	B1
		$|AB|=5$	B1
	(iii)	$\overrightarrow{AC}=5\overrightarrow{AB}=\begin{pmatrix}15\\-20\end{pmatrix}$	M1
		$\overrightarrow{OC}=\overrightarrow{OA}+\overrightarrow{AC}$	M1
		$\begin{pmatrix}22\\4\end{pmatrix}$	A1
			7

6	**(i)**	Uses product rule	M1
		$\sqrt{4x+12}+\dfrac{1}{2}\times 4x(4x+12)^{-\frac{1}{2}}$	A1
		Expresses with common denominator	M1
		$k=6$	A1
	(ii)	$\dfrac{3}{k}x\sqrt{4x+12}$	M1
		Uses limits	M1
		20	A1
			7

7	**(i)**	Sine curve	M1
		Correct position at multiples of $45°$	A2, 1,0
	(ii)	$2\cos x-1$	B1
		Cosine curve	M1
		Starts $(0,1)$, ends $(360,1)$, minimum $(180,-3)$	A1
		2	A1√
			7

8	**(i)**	Matrix multiplication	M1
		$\begin{pmatrix} 0 & -6 \\ 10 & -12 \end{pmatrix}$	A1
	(ii)	Matrix multiplication	M1
		$\begin{pmatrix} 11 \\ 10 \end{pmatrix}$	A1
	(iii)	$A^{-1} = \dfrac{1}{10}\begin{pmatrix} 3 & 1 \\ -4 & 2 \end{pmatrix}$	B2, 1, 0
		$X = A^{-1}B$	M1
		$\dfrac{1}{10}\begin{pmatrix} 5 & -9 \\ 0 & 12 \end{pmatrix}$	A1

8

9	**(i)**	1.25	B1
	(ii)	$a = \dfrac{dv}{dt} = \dfrac{-80}{(2t+4)^3}$	M1
		Substitute 3 into $\dfrac{dv}{dt}$	DM1
		-0.08	A1
	(iii)	$s = \int v\,dt$	M1
		$\dfrac{-10}{2t+4}$	A1
		Uses limits	M1
		2	A1

8

10	**(a)**	$2 \lg 5 = \lg 25$	B1
		$2 = \lg 100$	B1
		$\lg(175x - 75) = \lg(100x + 300)$	M1
		5	A1
	(b)	Substitute and express as equation in u	M1
		$3u^2 - 28u + 9 = 0$	A1
		Solve 3 term quadratic	M1
		$u = \dfrac{1}{3}$ and 9	A1
		$x = -1$ and 2	A1

9

11   **EITHER**

(i)   AB = 3   B1

        Correct use of trigonometry to APB = $\dfrac{2\pi}{3}$ B1

(ii) $s = r\theta$ M1

        3.14 or 3.63 or π or $\dfrac{2\sqrt{3}\pi}{3}$ A1

        6.77   A1

(ii)   uses $\dfrac{1}{2}r^2\theta$ M1

        uses $\dfrac{1}{2}r^2\sin\theta$ M1

        1.84 or 0.815   A1
        Complete plan   M1
        2.65 to 2.66   A1

                                                        10

   OR

(i)   Method for D   M1
        (-4, 9)   A1
(ii)   Method for E   M1
        (-1, 7)   A1
(iii)   Finds area parallelogram (= 80)   M1
        Area trapezium =120   A1
        Height trapezium = 6   B1
        Uses Area = ½ ×6 × (AB +EF)   M1
        EF = 30   A1
        F (29, 7)   A1

                                                        10

(iii)   alternative last 4 marks
        F (k, 7)   B1
        Array method complete   M1
        $3k + 33 = 120$ oe   A1
        F (29, 7)   A1

3.