www.PapaCambridge.com

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS (US) **0459/02**

Paper 2 **For Examination from 2013**

SPECIMEN MARK SCHEME

2 hours

MAXIMUM MARK: 80

This document consists of **9** printed pages and **1** blank page.

© UCLES 2012

www.PapaCambridge.com

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.

- ft 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. –1 each error. A mark is deducted from the total mark available up to the maximum mark available for that question. The minimum mark awarded is zero e.g., if a candidate makes 3 errors in a question worth 2 marks they score zero.

- The following abbreviations may be used in a mark scheme.

  AG 'Answer given' on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid).

  cao 'Correct answer only' (emphasizing that no "follow through" from a previous error is allowed).

  isw 'Ignore subsequent working'.

  oe 'Or equivalent'.

  sc 'Special case'. Awarded for some questions where e.g., the candidate has not used the method specified but a different, correct, method leading to the correct answer.

  soi 'Seen or implied'.

© UCLES 2012

www.PapaCambridge.com

Question	Answer	Marks	Guidance
1	$x^2 - 3 \overline{)x^3 + x^2 + 4x + 6}$ $\quad x + 1$ $x^3 \quad -3x$ $x^2 + 7x + 6$ $x^2 \quad -3$ $7x + 9$	M1	for getting as far as $x^2 + 7x$ or for a reasonable attempt at a valid method
	$a = 1$, $b = 7$, $c = 9$	A2, 1, 0 [3]	–1 each error
2	$\overrightarrow{PQ} = \begin{pmatrix} 9 \\ 20 \end{pmatrix} - \begin{pmatrix} 6 \\ 7 \end{pmatrix}$	M1	
	$\overrightarrow{QR} = \begin{pmatrix} 12 \\ 52 \end{pmatrix}$	A1	
	$\overrightarrow{OR} = \begin{pmatrix} 21 \\ 72 \end{pmatrix}$	B1ft	
	$\left\lvert\overrightarrow{OR}\right\rvert = \sqrt{21^2 + 72^2} = 75$	M1	
	Unit vector $= \frac{1}{75}\begin{pmatrix} 21 \\ 72 \end{pmatrix}$ oe	A1 [5]	$\begin{pmatrix} 21/75 \\ 72/75 \end{pmatrix}$ or $\begin{pmatrix} 7/25 \\ 24/25 \end{pmatrix}$ or $\begin{pmatrix} 0.28 \\ 0.96 \end{pmatrix}$
3	$\dfrac{(3-x)^{\frac{-2}{3}} + (3-x)^{\frac{1}{3}}}{(3-x)^{\frac{1}{3}}}$	B1	soi
	$(3-x)^{-1} + 1$	B1+B1	
	their $(3-x)^{-1} = \frac{2}{3} - 1$ or better	M1	
	6	A1 [5]	

© UCLES 2012

www.PapaCambridge.com

4	$f(3) = \frac{1}{2} f(2) + f(1)$ $28.5 = \frac{1}{2} \times 17 + f(1)$ $b = 20$ $17 = \frac{1}{2} \times$ their $20 + f(0)$ $a = 7$	**B1** **M1** **A1** **M1** **A1** **[5]**	soi
5 (a) (i)	Accuracy of plots	**B2, 1, 0**	–1 each error, allow tolerance ±1 mm
(ii)	$\overline{o} = 26$ $\overline{w} = 55$ Reasonable line of best fit through their (26, 55) Linear equation with reasonable slope	**B1 + B1** **B1 ft** **B1 ft**	
(iii)	Approximately 27	**B1ft** **[7]**	ft their line provided line reasonable
6 (a)	Express as powers of 2 or 4 or 8 Applies rules of indices 7	**M1** **DM1** **A1**	$[2x - (5 - x) = 4x - 3(x - 3)]$
(b)	$\lg(2y + 10) + \lg y = \lg\{y(2y + 10)\}$ or $2 = \lg 100$ $2y^2 + 10y = 100$ oe 5 only	**B1** **B1** **B1** **[6]**	

© UCLES 2012

www.PapaCambridge.com

7	Either (300 240), $\begin{pmatrix}0.6 & 0.3 & 0.1\\0.5 & 0.4 & 0.1\end{pmatrix}$, $\begin{pmatrix}5\\7\\10\end{pmatrix}$		The order of writing down is not important for B2, pro matrices they have written down are conformable if th written in the correct order.
	or (5 7 10), $\begin{pmatrix}0.6 & 0.5\\0.3 & 0.4\\0.1 & 0.1\end{pmatrix}$, $\begin{pmatrix}300\\240\end{pmatrix}$	**B2, 1, 0**	–1 each incorrect matrix.
	First product, either (300 240) $\begin{pmatrix}0.6 & 0.3 & 0.1\\0.5 & 0.4 & 0.1\end{pmatrix}$ or $\begin{pmatrix}0.6 & 0.3 & 0.1\\0.5 & 0.4 & 0.1\end{pmatrix}\begin{pmatrix}5\\7\\10\end{pmatrix}$ or (5 7 10) $\begin{pmatrix}0.6 & 0.5\\0.3 & 0.4\\0.1 & 0.1\end{pmatrix}$ or $\begin{pmatrix}0.6 & 0.5\\0.3 & 0.4\\0.1 & 0.1\end{pmatrix}\begin{pmatrix}300\\240\end{pmatrix}$	**M1**	selection of pair of matrices conformable for multiplication and an attempt to multiply
	(300 186 54) or $\begin{pmatrix}6.1\\6.3\end{pmatrix}$ or (6.1 6.3) or $\begin{pmatrix}300\\186\\54\end{pmatrix}$	**A1**	
	Second product, either (300 186 54) $\begin{pmatrix}5\\7\\10\end{pmatrix}$ or (300 240) $\begin{pmatrix}6.1\\6.3\end{pmatrix}$ or (6.1 6.3) $\begin{pmatrix}300\\240\end{pmatrix}$ or (5 7 10) $\begin{pmatrix}300\\186\\54\end{pmatrix}$	**M1**	selection of their first product and remaining matrix, conformable for multiplication and an attempt to multiply
	3342	**A1** **[6]**	if **M0** then **SC2** for correct arithmetic method leading to 3342

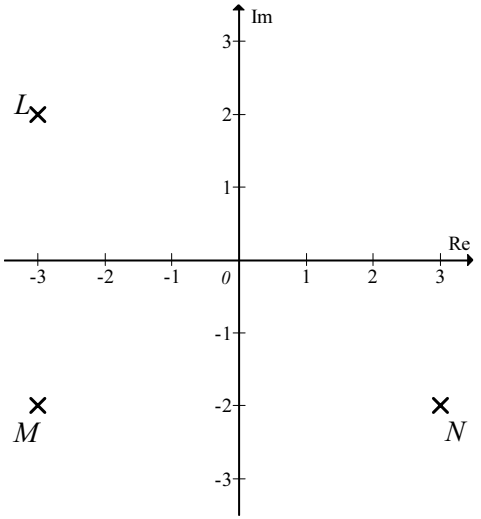
© UCLES 2012

www.PapaCambridge.com

8 **(i)**	$\frac{3}{8}=\frac{5}{8}-\cos A\sin B$	**M1**	
	$\frac{1}{4}$ oe	**A1**	
(ii)	$\frac{5}{8}+\text{their}\frac{1}{4}$	**M1**	
	$\frac{7}{8}$	**A1**	
(iii)	$\frac{\tan A}{\tan B}=\frac{\frac{\sin A}{\cos A}}{\frac{\sin B}{\cos B}}$	**M1**	or $\cos A=\text{their}\frac{1}{4\sin B}$ and $\sin A=\frac{5}{8\cos B}$ and an attempt at $\frac{\sin A}{\cos A}$ oe
	$=\frac{\sin A\cos B}{\cos A\sin B}$	**A1**	or $\tan A=\frac{5}{8\cos B}\times 4\sin B$ oe
	$=\frac{\frac{5}{8}}{\frac{1}{4}}=2.5$	**A1**	or $\tan A=\frac{5}{2}\tan B$ therefore $\frac{\tan A}{\tan B}=\frac{5}{2}$ oe
		[7]	
9 **(i) & (ii)**	For correctly standardizing once in either **(i)** or **(ii)**	**M1**	$z=\frac{27-24}{4}$ or $z=\frac{20-24}{4}$ or $z=\frac{25-24}{4}$
	0.2266	**A1**	
	0.5987	**A1**	
	0.1587	**A1**	
	0.5987 – 0.1587 oe	**M1**	
	0.44	**A1**	
		[6]	

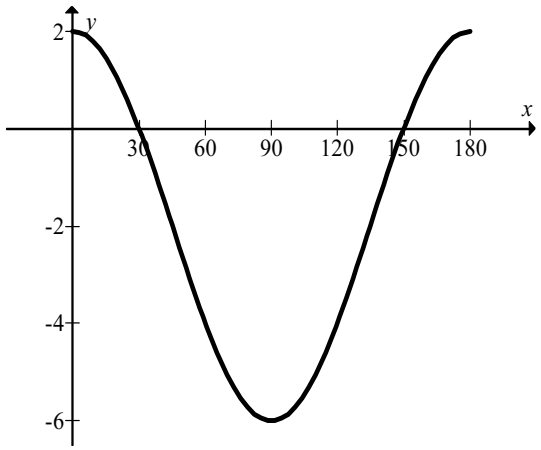
© UCLES 2012

www.PapaCambridge.com

10	**(i)**	$-3 - 2i$	**B1**	
	(ii)		**B2, 1, 0**	ft their **(i)**. –1 for each error or omission.
	(iii)	MN is parallel to the Re axis; LM is parallel to the Im axis, therefore $LM \perp MN$ and LMN is right-angled at M	**B2, 1, 0**	
	(iv)	$-15 + 3i + 10i - 2i^2$ Correct use of $i^2 = -1$ in their expression $-13 + 13i$	**M1** **M1** **A1**	for at least 3 out of 4 correct soi
	(v)	$\left(13\sqrt{2},\ \frac{3}{4}\pi\right)$ oe	**B1ft + B1ft** **[10]**	ft their **(iv)**

© UCLES 2012

www.PapaCambridge.com

11	**(i)**	Amplitude 4, Period 180	**B1 + B1**	
	(ii)	$x = 90,\ y = -6$ oe	**B1 + B1**	
	(iii)	$2x = \cos^{-1}\left(\frac{2}{4}\right)$ or better	**M1**	
		$x = 30$	**A1**	
		$x = 150$	**A1**	
	(iv)		**B2, 1, 0**	2 and –6 marked on the *y*-axis 30 and 150 marked on the *x*-axis correct shape between 0 and 180 ignore any extra sections outside 0 to 180.
	(v)	Section between (x =) 30 and 150 reflected in *x*-axis oe	**B1**	any portion of the graph below the *x*- axis will be reflected above.
			[10]	

© UCLES 2012

www.PapaCambridge.com

12 (a)	$x = -1$ or 7 or $-\frac{1}{2}$ seen	**M1**	for attempt to find a root
	Either $(x + 1)(2x^2 - 13x - 7)$ or $(x - 7)(2x^2 + 3x + 1)$ or $(2x + 1)(x^2 - 6x - 7)$	**M1** **A1** **M1**	for attempt to find quadratic factor for correct quadratic factor for attempt to factorize their quadratic factor
	leading to $(x + 1)(x - 7)(2x + 1)$	**A1**	for correct factorization Must be 3 term
(b)	Find f(2) or f(−3)	**M1**	or long division as far as remainder
	$8 + 4a - 30 + b = 0$ or $4a + b = 22$	**A1**	
	$-27 + 9a + 45 + b = 75$ or $9a + b = 57$	**A1**	
	Solve simultaneous equations	**M1**	
	$a = 7$, $b = -6$	**A1** **[10]**	
		[80]	

© UCLES 2012

BLANK PAGE

www.PapaCambridge.com

© UCLES 2012