MARK SCHEME for the October/November 2011 question paper

for the guidance of teachers

9709 MATHEMATICS

9709/21

Paper 2, maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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

• Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



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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 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 (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) 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 marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

- Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.
- For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking *g* equal to 9.8 or 9.81 instead of 10.

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

- AEF Any Equivalent Form (of answer is equally acceptable)
- 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)
- CWO Correct Working Only often written by a 'fortuitous' answer
- 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)
- SR Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

Penalties

- MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. 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. An MR–2 penalty may be applied in particular cases if agreed at the coordination meeting.
- 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.

GCE AS/A 1 EITHER State or imply r or pair of linear Obtain critical v State correct and OR State one critical v	values $\frac{1}{5}$ and $\frac{7}{5}$ swer $\frac{1}{5} < x < \frac{7}{5}$ al value, e.g. $x = \frac{1}{5}$, by solving a linear equivalent of by inspection writical value correctly		M1 A1 A1	
or pair of linear Obtain critical v State correct and OR State one critica	equations ralues $\frac{1}{5}$ and $\frac{7}{5}$ swer $\frac{1}{5} < x < \frac{7}{5}$ al value, e.g. $x = \frac{1}{5}$, by solving a linear equivalent of by inspection writical value correctly		M1 A1 A1 y)	
OR State one critica	swer $\frac{1}{5} < x < \frac{7}{5}$ al value, e.g. $x = \frac{1}{5}$, by solving a linear equical method or by inspection writical value correctly	uation (or inequalit	A1 y)	
OR State one critica	In value, e.g. $x = \frac{1}{5}$, by solving a linear equical method or by inspection invitical value correctly	uation (or inequalit	y)	
	ical method or by inspection ritical value correctly	uation (or inequalit		
or from a graph	ritical value correctly		B1	
State the other of	1 7		B1	
State correct and	swer $- < x < -5$		B1	[3]
2 Integrate and obtain term of th			M1	
State correct term $\frac{1}{2}\ln(4x+1)$			A1	
Substitute limits correctly			M1	
Use law for the logarithm of a Obtain given answer correctly	quotient or a power		M1 A1	[5]
Obtain given answer concerny			AI	[5]
3 Obtain derivative of the form	$k \sec^2 2x$, where $k = 1$ or $k = \frac{1}{2}$		M1	
Obtain correct derivative sec ² Use correct method for solving	$g \sec^2 2x = 4$		A1 M1	
Obtain answer $x = \frac{1}{6}\pi$ (or 0.52)	24 radians)		A1	
Obtain answer $x = \frac{1}{3}\pi$ (or 1.0)	5 radians) and no others in range		A1	[5]
4 Carry out recognizable solutio	n method for quadratic in 3^x		M1	
Obtain $3^x = 5$ and $3^x = 2$ Use logarithmic method to sol	ve an equation of the form $3^x = k$, where $k > 1$	> 0	A1 M1	
State answer 1.46	•		A1	r <i>e</i> 1
State answer 0.631			A1	[5]
5 (i) Substitute $x = \frac{1}{2}$ and equ	ate to 10		M1	
Obtain answer $a = -16$ Either show that $f(3) = 0$	or divide by $(x - 3)$ obtaining a remainder	of zero	A1 B1	[3]
(ii) At any stage state that $x =$ Attempt division by $(x - 3)$ Obtain quadratic factor 43	B) reaching a partial quotient of $4x^2 + kx$		B1 M1 A1	
Obtain solutions $x = \frac{3}{2}$ and $x = \frac{3}{2}$			A1	.
S.C. M1A1 $$ if value of '	a' incorrect			[4]

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6	(i)		sign of $x^3 - 2x^2 + 5x - 3$ at $x = 0.7$ and $x = 0.8$ the argument correctly with appropriate calculations		M1 A1	[2]
	(ii)		e equation to given equation or <i>vice versa</i> 2 and $b = 5$		B1 B1	[2]
	(iii)	Obtain fir	erative formula correctly at least once nal answer 0.74	u is a sign shance	M1 A1	
			ficient iterations to justify its accuracy to 2 d.p. or show the al (0.735, 0.745)	e is a sign change	B1	[3]
7	(i)	Obtain co	The to differentiate y rect derivative in any form in t for y		M1 A1	
		Use $\frac{\mathrm{d}y}{\mathrm{d}x} =$	$\frac{dy}{dt} \div \frac{dx}{dt}$		M1	
			dr dr ven answer correctly		A1	[4]
	(ii)	State $t = 0$)		M1	
		State that	$\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ and make correct conclusion		A1	[2]
	(iii)		t = -2 into equation for x or y $e^{-6}, 4e^{-2} + 3$		M1 A1	[2]
		ootuni (e			711	[~]
8	(i)		evant use of the $cos(A + B)$ formula evant use of the cos 2A and sin 2A formulae		M1* M1*	
			correct expression in terms of $\cos x$ and $\sin x$		A1	
		Use $\sin^2 x$	$x = 1 - \cos^2 x$ to obtain an expression in terms of $\cos x$	Ν	/1(dep*)	
		Obtain gi	ven answer correctly		A1	[5]
	(ii)	Replace in	ntegrand by $\frac{1}{2}\cos 3x + \frac{1}{2}\cos x$, or equivalent		B1	
		Integrate,	obtaining $\frac{1}{6}\sin 3x + \frac{1}{2}\sin x$, or equivalent	E	B1 + B1	
			s correctly ven answer		M1 A1	[5]