CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary Level

MARK SCHEME for the October/November 2014 series

9709 MATHEMATICS

9709/22 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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2014 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

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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 $\sqrt{}$ 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.

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.

1	Either	Square both sides obtaining 3 terms on each side	M1	
		Solve 3-term quadratic equation	M1	
		Obtain $-\frac{4}{5}$ and 6	A1	[3]
	Or	Obtain value 6 from graphical method, inspection, linear equation, …	B1	
		Obtain value $-\frac{4}{5}$ similarly	B2	[3]

2	**(i)**	Integrate to obtain form $pe^{-x} + qe^{-3x}$ where $p \neq 1, q \neq 6$	M1	
		Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified)	A1	
		Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)	M1	
		Obtain $3 - e^{-a} - 2e^{-3a}$	A1	[4]
	(ii)	State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$	B1√	[1]

3	Obtain $6y + 6x\frac{dy}{dx}$ as derivative of $6xy$	B1	
	Obtain $2y\frac{dy}{dx}$ as derivative of y^2	B1	
	Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$	B1	
	Substitute 1 and 2 to find value of $\frac{dy}{dx}$	M1	
	Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$	A1√	
	Form equation of **normal** through (1, 2) with numerical gradient	M1	
	Obtain $2x - 3y + 4 = 0$	A1	[7]

4	**(a)**	Use power law to produce $\ln(x-4)^2$	B1	
		Apply logarithm laws to produce equation without logarithms	M1	
		Obtain $(x-4)^2 = 2x$ or equivalent	A1	
		Solve 3-term quadratic equation	DM1	
		Obtain (finally) $x = 8$ only	A1	[5]
	(b)	Apply logarithms and use power law (once)	M1	
		Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equation	A1	
		Conclude with single integer 69	A1	[3]

5	**(i)**	Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalent	B1	
		Use $\sin 2x = 2\sin x \cos x$ or equivalent	B1	
		Equate first derivative to zero and solve for x	M1	
		Obtain $\frac{1}{3}\pi$	A1	[4]

	(ii)	Integrate to obtain form $k_1 \sin x + k_2 \sin 2x$	M1	
		Obtain correct $2\sin x - \frac{1}{2}\sin 2x$	A1	
		Apply limits 0 and their answer from part **(i)**	M1	
		Obtain $\frac{3}{4}\sqrt{3}$ or exact equivalent	A1	[4]
6	**(i)**	Identify $x-3$ as divisor	B1	
		Divide by linear expression at least as far as x term	M1	
		Obtain quotient $x^3+3x-16$	A1	
		Obtain zero remainder with no errors in the division	A1	
		Equate quotient to zero and confirm $x=\sqrt[3]{16-3x}$ (AG)	A1	[5]
	(ii)	Use iteration process correctly at least once	M1	
		Obtain final answer 2.13	A1	
		Show sufficient iterations to 4 decimal places or show a sign change in the interval (2.125, 2.135)	A1	[3]
7	**(i)**	State or imply $R=13$	B1	
		Use appropriate formula to find α	M1	
		Obtain 67.38°	A1	[3]
	(ii)	Attempt to find at least one value of $\cos^{-1}\frac{8}{13}$ or $\cos^{-1}\frac{8}{R}$	M1	
		Obtain one correct value of θ (240.6 or 344.6)	A1	
		Carry out correct method to find second value of θ within the range	DM1	
		Obtain second correct value (344.6 or 240.6)	A1	[4]
	(iii)	State or imply $7+13\cos\left(\frac{1}{2}\phi+67.38\right)$ following their answers from part **(i)**	B1√	
		State 20	B1	
		Attempt to find ϕ for which $\cos\left(\frac{1}{2}\phi+67.38\right)=1$	M1	
		Obtain 585.2	A1	[4]