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.

® IGCSE is the registered trademark of Cambridge International Examinations.



Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS Level – October/November 2014	9709	22

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.

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS Level – October/November 2014	9709	22

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.

Cambridge International AS Level - October/November 20149709221EitherSquare both sides obtaining 3 terms on each side Solve 3-term quadratic equation Obtain $-\frac{4}{3}$ and 6A1[3] Ω Obtain off and 6A1[3] Ω Obtain value $-\frac{4}{3}$ similarlyB2[3]2(i)Integrate to obtain form $pe^{-x} + qe^{-3x}$ where $p \neq 1, q \neq 6$ M1Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified) Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)M1Obtain $3 - e^{-x} - 2e^{-3x}$ A1[4](ii)State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B1 $\sqrt[3]{4}$ 3Obtain $6y + 6x \frac{dy}{dx}$ as derivative of fxy Obtain $2y \frac{dy}{dx}$ as derivative of fx?B13Obtain $4(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dy}{dx}$ A1 $\sqrt[3]{7}$ Form equadratic equation for mormal following their value of $\frac{dy}{dx}$ A1 $\sqrt[3]{7}$ 4(a)Use power law to produce $\ln(x-4)^2$ Apply logarithm laws to produce equation without logarithms Obtain $(x - 4)^2 = 2x$ or equivalent Solve 3-term quadratic equation Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equation Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equivalent Solve 3-term quadratic equation Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equivalent Solve 3-term quadratic equationM1Obtain $\frac{10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equivalent Solve 3-term quadratic equationM1Obtain $\frac{10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equivalen	Ρ	age 4	Mark Scheme	Syllabus	Paper	
Solve 3-term quadratic equationM1Obtain $-\frac{4}{3}$ and 6A1QrObtain value 6 from graphical method, inspection, linear equation,B1Obtain value $-\frac{4}{3}$ similarlyB22 (i) Integrate to obtain form $pe^{-x} + qe^{-3x}$ where $p \neq 1, q \neq 6$ M1Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified)A1Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)M1Obtain $3 - e^{-x} - 2e^{-3x}$ A1(ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B13 Obtain $6y + 6x\frac{dy}{4x}$ as derivative of fayB1Obtain $3\frac{1}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitut 1 and 2 to find value of $\frac{dy}{dx}$ A1Obtain $2x - 3y + 4 = 0$ A14 (a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm sand use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 14}$ or equivalent a spart of inequality or equationM1Obtain $\frac{\ln 10^{10}}{\ln 14}$ or equivalent as part of inequality or equationA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 14}$ or equivalent as part of inequality or equationA1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1				9709	22	
OrObtain value 6 from graphical method, inspection, linear equation,B1Obtain value $-\frac{4}{3}$ similarlyB2[3]2(i) Integrate to obtain form $pe^{-x} + qe^{-3x}$ where $p \neq 1, q \neq 6$ M1Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified)A1Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)M1Obtain $3 - e^{-a} - 2e^{-3a}$ A1(ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B13Obtain $6y + 6x \frac{4y}{4x}$ as derivative of $6xy$ B1Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{4y}{4x}$ M1Obtain $2x - \frac{4y}{4x}$ as gradient of normal following their value of $\frac{4y}{4x}$ A16(a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(110)^{10} x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1(j) Differentiate	1	<u>Eith</u>	Solve 3-term quadratic equation		M1	[3]
Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified)A1Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)M1Obtain $3 - e^{-u} - 2e^{-3u}$ A1(ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B13 Obtain $6y + 6x \frac{4s}{4x}$ as derivative of $6xy$ B1Obtain $2y \frac{4s}{4x}$ as derivative of y^2 B1Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{4s}{4x}$ M1Obtain $2x - 3y + 4 = 0$ M14 (a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain (Infinally) $x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1(c) Use sin $2x - 2sin x + 2sin 2x$ or equivalentA1(a) Use power law to produce ln($x - 4$)A1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequivalentB1Use sin $2x = 2sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1		<u>Or</u>	Obtain value 6 from graphical method, inspection, linear equation,			
Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)M1Obtain $3 - e^{-u} - 2e^{-3u}$ A1[4](ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B13 Obtain $6y + 6x \frac{dy}{dx}$ as derivative of $6xy$ B1Obtain $2y \frac{dy}{dx}$ as derivative of y^2 B1Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1Obtain $2x - 3y + 4 = 0$ M14 (a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce $\ln(x - 4)^2$ B1Apply logarithm and use power law (once)M1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(110)^{10}$ or equivalent as part of inequality or equationA1(i) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1(i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use sin $2x = 2\sin x \cos x$ or equivalentB1Use sin $2x = 2\sin x \cos x$ or equivalentB1B1B1B2B35(i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1B3B1B1B4B1B4B1B5(i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1B1B1B1B1B1B2B1B3B1B4B1B5B1B4B1<	2	(i)	Integrate to obtain form $pe^{-x} + qe^{-3x}$ where $p \neq 1, q \neq 6$		M1	
Obtain $3 - e^{-a} - 2e^{-3a}$ A1[4](ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B13 Obtain $6y + 6x \frac{dy}{dx}$ as derivative of $6xy$ B1Obtain $2y \frac{dy}{dx}$ as derivative of y^2 B1Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1Obtain $\frac{3}{x}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1Form equation of normal through $(1, 2)$ with numerical gradientM1Obtain $(x - 3y + 4) = 0$ A14(a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1(i) Differentiate to obtain $-2 \sin x + 2 \sin 2x$ or equivalentB1Use sin $2x = 2 \sin x \cos x$ or equivalentB1Use sin $2x = 2 \sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1			Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified)		A1	
(ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ $B1\sqrt{16}$ 3 Obtain $6y + 6x \frac{dy}{dx}$ as derivative of $6xy$ B1Obtain $2y \frac{dy}{dx}$ as derivative of y^2 B1Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1 $\sqrt{16}$ Form equation of normal through $(1, 2)$ with numerical gradientM1Obtain $2x - 3y + 4 = 0$ A14 (a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(finally) x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1(j) Differentiate to obtain $-2 \sin x + 2 \sin 2x$ or equivalentB1Use $\sin 2x = -2 \sin x \cos x$ or equivalentB1Use $\sin 2x = -2 \sin x \cos x$ or equivalentB1Use $\sin 2x = -2 \sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1			Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$)		M1	
3 Obtain $6y + 6x \frac{dy}{dt}$ as derivative of $6xy$ B1 0 Obtain $2y \frac{dy}{dx}$ as derivative of y^2 B1 0 Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1 Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1 0 Obtain $2y \frac{dy}{dx}$ as gradient of normal following their value of $\frac{dy}{dx}$ M1 0 Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1 $\sqrt[6]$ Form equation of normal through (1, 2) with numerical gradient M1 0 Obtain $2x - 3y + 4 = 0$ B1 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 (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 B1 Use $\sin 2x $			$Obtain \ 3 - e^{-a} - 2e^{-3a}$		A1	[4]
Obtain $2y \frac{dv}{dx}$ as derivative of y^2 B1Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dv}{dx}$ M1Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dv}{dx}$ A1 $\sqrt[4]{}$ Form equation of normal through (1, 2) with numerical gradientM1Obtain $2x - 3y + 4 = 0$ A14(a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(finally) x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Solve are to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use sin $2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1		(ii)	State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$		B1√	[1]
Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1 $\sqrt[4]{}$ Form equation of normal through (1, 2) with numerical gradientM1Obtain $2x - 3y + 4 = 0$ A14(a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(finally) x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Solve 3: term (add with single integer 69A1[3](j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use sin $2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1	3	Obt	ain $6y + 6x \frac{dy}{dx}$ as derivative of $6xy$		B1	
Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1 $\sqrt[4]{}$ Form equation of normal through (1, 2) with numerical gradientM1Obtain $2x - 3y + 4 = 0$ A14(a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain $(finally) x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Solve 3: term (add with single integer 69A1[3](j) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use sin $2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1		Obta	ain $2y \frac{dy}{dx}$ as derivative of y^2		B1	
Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1 $\sqrt{1}$ Form equation of normal through (1, 2) with numerical gradientM1Obtain $2x - 3y + 4 = 0$ A14(a) Use power law to produce $\ln(x-4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x-4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain (finally) $x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Conclude with single integer 69A15(i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use sin $2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1					B1	
ArForm equation of normal through (1, 2) with numerical gradientM1Obtain $2x - 3y + 4 = 0$ A1[7]4(a) Use power law to produce $\ln(x - 4)^2$ B1Apply logarithm laws to produce equation without logarithmsM1Obtain $(x - 4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain (finally) $x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Conclude with single integer 69A15(i) Differentiate to obtain $-2 \sin x + 2 \sin 2x$ or equivalentB1Use $\sin 2x = 2 \sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1		Sub	stitute 1 and 2 to find value of $\frac{dy}{dx}$		M1	
Form equation of normal through $(1, 2)$ with numerical gradientM1 A1Obtain $2x - 3y + 4 = 0$ A14(a) Use power law to produce $\ln(x-4)^2$ B1 Apply logarithm laws to produce equation without logarithmsObtain $(x-4)^2 = 2x$ or equivalentA1 Solve 3-term quadratic equationSolve 3-term quadratic equationDM1 A1Obtain (finally) $x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1 A1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1 A15(i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalent Use $\sin 2x = 2\sin x \cos x$ or equivalent Equate first derivative to zero and solve for xB1 M1		Obta	ain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dy}$		A1√ [^]	
Apply logarithm laws to produce equation without logarithmsM1Obtain $(x-4)^2 = 2x$ or equivalentA1Solve 3-term quadratic equationDM1Obtain (finally) $x = 8$ onlyA1(b) Apply logarithms and use power law (once)M1Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Conclude with single integer 69A15(i) Differentiate to obtain $-2 \sin x + 2 \sin 2x$ or equivalentB1Use $\sin 2x = 2 \sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1						[7]
Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equationA1Conclude with single integer 69A1 [3]5 (i)Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use $\sin 2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1	4	(a)	Apply logarithm laws to produce equation without logarithms Obtain $(x-4)^2 = 2x$ or equivalent Solve 3-term quadratic equation		M1 A1 DM1	[5]
Conclude with single integer 69A1 [3]5 (i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use $\sin 2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1		(b)			M1	
Conclude with single integer 69A1 [3]5 (i) Differentiate to obtain $-2\sin x + 2\sin 2x$ or equivalentB1Use $\sin 2x = 2\sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1			Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equation		A1	
Use $\sin 2x = 2 \sin x \cos x$ or equivalentB1Equate first derivative to zero and solve for xM1					A1	[3]
Equate first derivative to zero and solve for x M1	5	(i)	-			
						[4]

P	Page 5	Mark Scheme	Syllabus	Pap	er
		Cambridge International AS Level – October/November 2014	9709	22	_
	(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 <i>x</i> term		M1	
		Obtain quotient $x^3 + 3x - 16$		A1	
		Obtain zero remainder with no errors in the division $2\sqrt{1-1}$		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		Al	
		Show sufficient iterations to 4 decimal places or show a sign change in the inter(2.125, 2.135)	erval	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 $7+13\cos(\frac{1}{2}\phi+67.38)$ following their answers from part (i)		B1√^	
		State 20		B1	
		Attempt to find ϕ for which $\cos(\frac{1}{2}\phi + 67.38) = 1$		M1	
		Obtain 585.2		A1	[4]
					-