### UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

# MARK SCHEME for the November 2004 question paper

## 9709 MATHEMATICS

9709/02

Paper 2, maximum raw mark 50

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

• CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the November 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.



**Grade thresholds** taken for Syllabus 9709 (Mathematics) in the November 2004 examination.

|             | maximum           | minimum mark required for grade: |    |    |  |
|-------------|-------------------|----------------------------------|----|----|--|
|             | mark<br>available | А                                | В  | E  |  |
| Component 2 | 50                | 33                               | 29 | 15 |  |

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.



### **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.



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.



November 2004

GCE AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/02

MATHEMATICS Paper 2 (Pure Mathematics 2)



|     | Page 1 |       | Mark Scheme                                                                                                              | Syllabus       | Paper     |
|-----|--------|-------|--------------------------------------------------------------------------------------------------------------------------|----------------|-----------|
|     |        |       | AS LEVEL – NOVEMBER 2004                                                                                                 | 9709           | 2         |
|     |        |       |                                                                                                                          |                |           |
|     |        |       | <i>HER:</i> State or imply non-modular inequality $(x + 1)^2 >$<br>Iratic equation or linear equation $x + 1 = -x$       | $x^2$ or corre | esponding |
|     |        |       | Obtain critical value $-\frac{1}{2}$                                                                                     |                |           |
|     |        |       | State answer $x > -\frac{1}{2}$                                                                                          |                |           |
|     | C      | DR:   | Obtain critical value $-\frac{1}{2}$ by solving a linear inec                                                            | luality or b   | у         |
|     |        |       | graphical method or inspection                                                                                           |                |           |
|     |        |       | State answer $x > -\frac{1}{2}$                                                                                          |                |           |
|     | [F     | For   | $2x + 1 > 0, x > + \frac{1}{2}$ , or similar reasonable method]                                                          |                |           |
|     |        |       |                                                                                                                          |                |           |
| 2   |        |       | logarithms to obtain an equation in ln <i>x</i>                                                                          |                |           |
|     | C      | Obta  | $\sin \ln x = \frac{\ln 11}{(3.9 - 3.2)}, \text{ or equivalent}$                                                         |                |           |
|     | C      | Obta  | nin answer x = 31 (accept 30.7, 30.74)                                                                                   |                |           |
| 3   | А      | t ar  | ny stage, state answer $x = 90^{\circ}$ (c.w.o)                                                                          |                |           |
|     | V      | Vrite | e the equation in the form $6\sin x \cos x = \cos x$                                                                     |                |           |
|     |        |       | ove factor of cos x and solve an equation in sin x for x in answer $x = 9.59^{\circ}$ and no others in the range (9.6° O | K·rubric)      |           |
|     |        |       | bre answers outside the given range.)                                                                                    |                |           |
| 4   |        |       | e or obtain 16 – 20 + 2 <i>a</i> + <i>b</i> = 0                                                                          |                |           |
|     |        |       | stitute $x = -1$ and equate to $-6$<br>nin a 3-term equation in any correct form                                         |                |           |
|     |        |       | e a relevant pair of equations, obtaining a or b                                                                         |                |           |
|     |        |       | a = 1  and  b = 2                                                                                                        |                |           |
| 5 ( | i) U   | Jse   | the product rule to obtain the first derivative (must invo                                                               | lve 2 term     | s)        |
|     | C      | Obta  | in derivative 2x lnx + $x^2 \frac{1}{x}$ or equivalent                                                                   |                |           |
|     |        |       | ate derivative to zero and solve for <i>x</i>                                                                            |                |           |
|     |        | -     | an answer $x = e^{-0.5}$ or $\frac{1}{\sqrt{e}}$ or equivalent (e.g. 0.61)                                               |                |           |
|     |        |       | $\sqrt{e}$                                                                                                               |                |           |
| (   | •      |       | rmine nature of stationary point using correct second d                                                                  | erivative      |           |
|     | •      |       | $2\ln x$ ) or correct first derivative or equation of the curve values, central one $y(\exp(-0.5))$                      |                |           |
|     | •      | -     | w point is a minimum completely correctly                                                                                |                |           |
|     |        |       |                                                                                                                          |                |           |
| 6 ( | i) N   | /lake | e recognisable sketch of an appropriate trig curve, e.g.                                                                 | $y = \cot x$ , |           |
|     |        |       | $< \chi < \frac{1}{2}\pi$                                                                                                |                |           |
|     |        |       | 2<br>ch the appropriate second curve e.g. <i>y</i> = <i>x</i> correctly an                                               | d justifv th   | e         |
|     |        |       | n statement                                                                                                              | . j            | -         |
|     |        |       |                                                                                                                          |                |           |

| Complete the argument correctly with appropriate calculations A1<br>Show, using $\cot x = \frac{1}{\tan x}$ , that $\cot x = x$ is equivalent to $x = \arctan\left(\frac{1}{x}\right)$<br>(or vice versa) B1<br>Use the iterative formula correctly at least once M1<br>Obtain final answer 0.86 A1<br>Show sufficient iterations to justify its accuracy to 2 decimal places, or show<br>that there is a sign change in (0.855, 0.865) B1<br>State coordinates (0, 5) B1<br>State coordinates (0, 5) B1<br>State first derivative of the form $k e^x + m e^{-2x}$ , where $km \neq 0$ M1<br>Obtain correct first derivative $2 e^x - 6 e^{-2x}$ A1<br>Substitute $x = 0$ , obtaining gradient of $-4$ A1<br>Form equation of line through A with this gradient (NOT the normal) M1<br>Obtain coordinates (1.25, 0) or equivalent A1<br>Use limits $x = 0$ and $x = 1$ correctly M1<br>Use limits $x = 0$ and $x = 1$ correctly M1<br>Obtain answer 4.7 A1<br>State answer $R = \sqrt{2}$ B1<br>Use trigonometric formulae to find $\alpha$ M1<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\pi/4^c$ somewhere, later) A1<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer B1<br>Obtain the given answer correctly A1<br>Obtain the given answer correctly A1<br>State answer and a and                                                                                                                                                                                                                                                                                                                                                                                     | Page           | e 2   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Syllabus                          | Paper |    |
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| Complete the argument correctly with appropriate calculations A1<br>Show, using $\cot x = \frac{1}{\tan x}$ , that $\cot x = x$ is equivalent to $x = \arctan\left(\frac{1}{x}\right)$<br>(or vice versa) B1<br>Use the iterative formula correctly at least once M1<br>Obtain final answer 0.86 A1<br>Show sufficient iterations to justify its accuracy to 2 decimal places, or show<br>that there is a sign change in (0.855, 0.865) B1<br>State coordinates (0, 5) B1<br>State first derivative of the form $k e^x + m e^{-2x}$ , where $km \neq 0$ M1<br>Obtain correct first derivative $2 e^x - 6 e^{-2x}$ A1<br>Substitute $x = 0$ , obtaining gradient of -4 A1<br>Form equation of line through A with this gradient (NOT the normal)<br>Obtain coordinates (1.25, 0) or equivalent A1<br>Use limits $x = 0$ and $x = 1$ correctly M1<br>Obtain answer $4.7$ B1 + B1<br>Use limits $x = 0$ and $x = 1$ correctly M1<br>Obtain answer $4.7$ A1<br>State answer $R = \sqrt{2}$ B1<br>Use trigonometric formulae to find $\alpha$ M1<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \pi/4^\circ$ somewhere, later) A1<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer B1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Distain the given answer correctly A1<br>Distain derivative in any correct form A1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule A1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule A1<br>Obtain the given answer correctly A1<br>Distain the given answer corectly A1<br>Distain the given answer correctly A1<br>Distain the given a                                                                                                                                                                                                                                                                                                                                                                    |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| 1 Show, using cot $x = \frac{1}{\tan x}$ , that cot $x = x$ is equivalent to $x = \arctan\left(\frac{1}{x}\right)$<br>(or vice versa) B1<br>2 Use the iterative formula correctly at least once M1<br>Obtain final answer 0.86<br>Show sufficient iterations to justify its accuracy to 2 decimal places, or show<br>that there is a sign change in (0.855, 0.865) B1<br>5 State coordinates (0, 5) B1<br>5 State first derivative of the form $k e^x + m e^{-2x}$ , where $km \neq 0$ M1<br>Obtain correct first derivative $2 e^x - 6 e^{-2x}$ A1<br>Substitute $x = 0$ , obtaining gradient of $-4$<br>Form equation of line through A with this gradient (NOT the normal)<br>Obtain coordinates (1.25, 0) or equivalent A1<br>Obtain coordinates (1.25, 0) or equivalent B1 + B1<br>Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer $4.7$ A1<br>State answer $R = \sqrt{2}$ B1<br>Use trigonometric formulae to find $\alpha$ M1<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \pi/4^\circ$ somewhere, later) A1<br>Differentiate using the quotient or product rule<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or product rule M1<br>Obtain the given answer correctly A1<br>Differentiate using the quotient or p                                                                                                                                                                                                                                                                                                                                                                                                                | (ii)           |       | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |       |    |
| (or vice versa) B1<br>(or vice versa) B1<br>(or vice versa) B1<br>(or vice versa) B1<br>(btain final answer 0.86<br>Show sufficient iterations to justify its accuracy to 2 decimal places, or show that there is a sign change in (0.855, 0.865) B1<br>State coordinates (0, 5) B1<br>State coordinates (0, 5) B1<br>(or vice versa) V1<br>(obtain correct first derivative 2 $e^x - 6 e^{-2x}$ , where $km \neq 0$ M1<br>(obtain correct first derivative 2 $e^x - 6 e^{-2x}$ A1<br>Substitute $x = 0$ , obtaining gradient of $-4$ A1<br>Form equation of line through A with this gradient (NOT the normal)<br>(obtain coordinates (1.25, 0) or equivalent A1<br>(obtain coordinates (1.25, 0) or equivalent A1<br>(obtain coordinates (1.25, 0) or equivalent A1<br>(obtain answer 4.7 A1<br>State answer $R = \sqrt{2}$ B1<br>Use trigonometric formulae to find $\alpha$ M1<br>(obtain answer $4.7$ A1<br>(obtain answer $4.7$ A1<br>(obtain answer $4.7$ A1<br>(obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \pi/4^\circ$ somewhere, later) A1<br>(obtain derivative in any correct form $A1$<br>(obtain derivative in any correct form $A1$<br>(obtain derivative in any correct form $A1$<br>(obtain the given answer correctly A1<br>(obtain the given answer correctly A1<br>(othain the given answer corectly A1<br>(othain the gi                                                                                                                                                                                                                                                                                                                                                                                                                           |                | Com   | plete the argument correctly with appropriate calculatio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ns                                |       | A1 |
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| (1) Use the iterative formula correctly at least once<br>(1) Obtain final answer 0.86<br>Show sufficient iterations to justify its accuracy to 2 decimal places, or show<br>that there is a sign change in (0.855, 0.865)<br>(2) State coordinates (0, 5)<br>(3) State first derivative of the form $k e^{x} + m e^{-2x}$ , where $km \neq 0$<br>(3) Obtain correct first derivative $2 e^{x} - 6 e^{2x}$<br>(4) Substitute $x = 0$ , obtaining gradient of $-4$<br>Form equation of line through <i>A</i> with this gradient (NOT the normal)<br>(3) Obtain coordinates (1.25, 0) or equivalent<br>(4) Obtain coordinates (1.25, 0) or equivalent<br>(4) Integrate and obtain $2 e^{x} - \frac{3}{2} e^{-2x}$ , or equivalent<br>(4) Use limits $x = 0$ and $x = 1$ correctly<br>(5) Obtain answer $4.7$<br>(6) State answer $R = \sqrt{2}$<br>(7) Use trigonometric formulae to find $\alpha$<br>(3) Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^{\circ} = \frac{\pi}{4}^{\circ}$ somewhere, later)<br>(4) Use cos $\theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>(5) Differentiate using the quotient or product rule<br>(5) Obtain the given answer correctly<br>(6) Convert integrand to give $\int \frac{1}{2} \sec^{2}(\theta - \frac{\pi}{4})d\theta$<br>(6) Integrate, to obtain function $\frac{1}{2} \tan (\theta - \frac{\pi}{4})$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | (iii)          | Show  | w, using $\cot x \equiv \frac{1}{\tan x}$ , that $\cot x = x$ is equivalent to $x = a$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | $\arctan\left(\frac{-}{x}\right)$ |       |    |
| Obtain final answer 0.86A1Show sufficient iterations to justify its accuracy to 2 decimal places, or show<br>that there is a sign change in (0.855, 0.865)B1State coordinates (0, 5)B1State coordinates (0, 5)B1Obtain correct first derivative of the form $k e^x + m e^{-2x}$ , where $km \neq 0$ M1Obtain correct first derivative $2 e^x - 6 e^{-2x}$ A1Substitute $x = 0$ , obtaining gradient of $-4$ A1Form equation of line through A with this gradient (NOT the normal)M1Obtain coordinates (1.25, 0) or equivalentA1Obtain coordinates (1.25, 0) or equivalentA1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer 4.7M1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \pi/4^\circ$ somewhere, later)A1Use cos $\theta$ + sin $\theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answerB1Differentiate using the quotient or product ruleM1Obtain the given answer correctlyA1Obtain the given answer correctlyA1Obtain the given answer correctlyA1M1Differentiate using the quotient or product ruleM2Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \pi/4)d\theta$ M3Integrate, to obtain function $\frac{1}{2} \tan(\theta - \pi/4)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                | (or v | ice versa)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                   |       | B1 |
| Obtain final answer 0.86A1Show sufficient iterations to justify its accuracy to 2 decimal places, or show<br>that there is a sign change in (0.855, 0.865)B1State coordinates (0, 5)B1State coordinates (0, 5)B1Obtain correct first derivative of the form $k e^x + m e^{-2x}$ , where $km \neq 0$ M1Obtain correct first derivative $2 e^x - 6 e^{-2x}$ A1Substitute $x = 0$ , obtaining gradient of $-4$ A1Form equation of line through A with this gradient (NOT the normal)M1Obtain coordinates (1.25, 0) or equivalentA1Obtain coordinates (1.25, 0) or equivalentA1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer 4.7M1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \frac{\pi}{4}^\circ$ somewhere, later)A1Use cos $\theta$ + sin $\theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answerB1Differentiate using the quotient or product ruleM1Obtain the given answer correctlyA1Obtain the given answer correctlyA1Obtain the given answer correctlyA1M1Differentiate using the quotient or product ruleM2Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4})d\theta$ M3Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | (iv)           | Use   | the iterative formula correctly at least once                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |       | М1 |
| that there is a sign change in (0.855, 0.865)B1State coordinates (0, 5)B1State first derivative of the form $k e^{x} + m e^{-2x}$ , where $km \neq 0$ M1Obtain correct first derivative $2 e^{x} - 6 e^{-2x}$ A1Substitute $x = 0$ , obtaining gradient of $-4$ A1Form equation of line through A with this gradient (NOT the normal)M1Obtain coordinates (1.25, 0) or equivalentA1Use limits $x = 0$ and $x = 1$ correctlyB1 + B1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer $4.7$ B1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^{\circ} = \frac{\pi}{4}^{\circ}$ somewhere, later)A1Differentiate using the quotient or product ruleM1Obtain the given answer correctlyA1Differentiate using the quotient or product ruleM1Obtain the given answer correctlyA1M1Dotain the given answer correctlyA1M2Convert integrand to give $\int \frac{1}{2} \sec^{2}(\theta - \frac{\pi}{4}) d\theta$ B1Integrate, to obtain function $\frac{1}{2} \tan (\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | (1•)           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| State coordinates (0, 5)B11State first derivative of the form $k e^{x} + m e^{-2x}$ , where $km \neq 0$ M11Obtain correct first derivative $2 e^{x} - 6 e^{-2x}$ A12Substitute $x = 0$ , obtaining gradient of $-4$ A1Form equation of line through A with this gradient (NOT the normal)M1Obtain equation in any correct form e.g. $y - 5 = -4x$ A1Obtain coordinates (1.25, 0) or equivalentA1Use limits $x = 0$ and $x = 1$ correctlyB1 + B1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer $4.7$ M1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^{\circ} = \frac{\pi}{4}^{0}$ somewhere, later)A1Integrate using the quotient or product ruleM1Obtain derivative in any correct formA1Obtain derivative in any correct formA1Obtain the given answer correctlyA1M1Obtain derivative in any correct formA1M2Convert integrand to give $\int \frac{1}{2} \sec^{2}(\theta - \frac{\pi}{4}) d\theta$ B1M3Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | places, or                        | show  |    |
| State first derivative of the form $k e^{x} + m e^{-2x}$ , where $km \neq 0$<br>Obtain correct first derivative $2 e^{x} - 6 e^{-2x}$<br>Substitute $x = 0$ , obtaining gradient of $-4$<br>Form equation of line through A with this gradient (NOT the normal)<br>Obtain equation in any correct form e.g. $y - 5 = -4x$<br>Obtain coordinates (1.25, 0) or equivalent<br>Integrate and obtain $2 e^{x} - \frac{3}{2} e^{-2x}$ , or equivalent<br>Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer $4.7$<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^{\circ} = \pi/4^{\circ}$ somewhere, later)<br>Use cos $\theta$ + sin $\theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Obtain the given answer correctly<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^{2}(\theta - \pi/4) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \pi/4)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                | that  | there is a sign change in (0.855, 0.865)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |       | B1 |
| State first derivative of the form $k e^{x} + m e^{-2x}$ , where $km \neq 0$<br>Obtain correct first derivative $2 e^{x} - 6 e^{-2x}$<br>Substitute $x = 0$ , obtaining gradient of $-4$<br>Form equation of line through A with this gradient (NOT the normal)<br>Obtain equation in any correct form e.g. $y - 5 = -4x$<br>Obtain coordinates (1.25, 0) or equivalent<br>Integrate and obtain $2 e^{x} - \frac{3}{2} e^{-2x}$ , or equivalent<br>Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer $4.7$<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^{\circ} = \pi/4^{\circ}$ somewhere, later)<br>Use cos $\theta$ + sin $\theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Obtain the given answer correctly<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^{2}(\theta - \pi/4) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \pi/4)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| Obtain correct first derivative $2 e^x - 6 e^{-2x}$ A1Substitute $x = 0$ , obtaining gradient of $-4$ A1Form equation of line through A with this gradient (NOT the normal)M1Obtain equation in any correct form e.g. $y - 5 = -4x$ A1Obtain coordinates $(1.25, 0)$ or equivalentA1(I)Integrate and obtain $2 e^x - \frac{3}{2} e^{-2x}$ , or equivalentB1 + B1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer $4.7$ M1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \frac{\pi}{4}^\circ$ somewhere, later)A1I)Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answerB1(I)Differentiate using the quotient or product ruleM1(I)Differentiate using the quotient or product ruleM1(I)Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1(I)Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (i)            | State | e coordinates (0, 5)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                   |       | B1 |
| Substitute $x = 0$ , obtaining gradient of $-4$<br>Form equation of line through <i>A</i> with this gradient (NOT the normal)<br>Obtain equation in any correct form e.g. $y - 5 = -4x$<br>Obtain coordinates (1.25, 0) or equivalent<br>1) Integrate and obtain $2 e^x - \frac{3}{2} e^{-2x}$ , or equivalent<br>Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer 4.7<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \frac{\pi}{4}^{c}$ somewhere, later)<br>1) Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Differentiate using the quotient or product rule<br>Obtain the given answer correctly<br>Obtain the given answer correctly<br>(M1)<br>Obtain the given answer correctly<br>(M2)<br>(M3)<br>(M3)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M4)<br>(M | (ii)           | State | e first derivative of the form $k e^{x} + m e^{-2x}$ , where $km \neq 0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |       | M1 |
| Form equation of line through A with this gradient (NOT the normal)<br>Obtain equation in any correct form e.g. $y - 5 = -4x$<br>Obtain coordinates (1.25, 0) or equivalent<br>1) Integrate and obtain $2 e^x - \frac{3}{2}e^{-2x}$ , or equivalent<br>Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer 4.7<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° $= \frac{\pi}{4}^c$ somewhere, later)<br>1) Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>1) Differentiate using the quotient or product rule<br>Obtain the given answer correctly<br>1) Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4})d\theta$<br>Integrate, to obtain function $\frac{1}{2}\tan(\theta - \frac{\pi}{4})$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| Obtain equation in any correct form e.g. $y-5 = -4x$ A1Obtain coordinates (1.25, 0) or equivalentA1Obtain coordinates (1.25, 0) or equivalentA1Integrate and obtain $2e^x - \frac{3}{2}e^{-2x}$ , or equivalentB1 + B1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer 4.7M1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless $45^\circ = \frac{\pi}{4}^\circ$ somewhere, later)A1Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answerB1Obtain derivative in any correct form<br>Obtain the given answer correctlyA1Obtain the given answer correctlyA1M1M1Obtain the given answer correctlyM1M2Convert integrand to give $\int \frac{1}{2}\sec^2(\theta - \frac{\pi}{4})d\theta$ B1Integrate, to obtain function $\frac{1}{2}\tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Ŋ                                 |       |    |
| Obtain coordinates (1.25, 0) or equivalentA1(1)Integrate and obtain $2 e^x - \frac{3}{2} e^{-2x}$ , or equivalentB1 + B1Use limits $x = 0$ and $x = 1$ correctlyM1Obtain answer 4.7M1State answer $R = \sqrt{2}$ B1Use trigonometric formulae to find $\alpha$ M1Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}$ ° somewhere, later)A1Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answerB1Obtain derivative in any correct formM1Obtain the given answer correctlyM1Obtain the given answer correctlyM1Obtain the given answer correctlyM1M1M1M2M1M3M1M4M1M4M4M4M4M5M4M4M4M5M4M4M4M5M4M4M4M5M4M4M4M5M4M4M4M5M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4M6M4<                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | normal)                           |       |    |
| b) Integrate and obtain $2 e^x - \frac{3}{2}e^{-2x}$ , or equivalent<br>Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer 4.7<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}$ ° somewhere, later)<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>B1<br>Differentiate using the quotient or product rule<br>Obtain the given answer correctly<br>Different integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer 4.7<br>State answer $A.7$<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}$ ° somewhere, later)<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                | 0.010 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| Use limits $x = 0$ and $x = 1$ correctly<br>Obtain answer 4.7<br>State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}$ ° somewhere, later)<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$<br>M1<br>M1<br>M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | (iii)          | Integ | rate and obtain 2 $e^x - \frac{3}{2}e^{-2x}$ , or equivalent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   | B1 +  | B1 |
| State answer $R = \sqrt{2}$<br>Use trigonometric formulae to find $\alpha$<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\pi/4^{\circ}$ somewhere, later)<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \pi/4) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \pi/4)$<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |       | E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |       | M1 |
| Use trigonometric formulae to find $\alpha$ M1<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}^{c}$ somewhere, later) A1<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer B1<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly A1<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                | Obta  | in answer 4.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |       | A1 |
| Use trigonometric formulae to find $\alpha$ M1<br>Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}^{c}$ somewhere, later) A1<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer B1<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly A1<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| Obtain answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\frac{\pi}{4}^{c}$ somewhere, later) A1<br>Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer B1<br>Differentiate using the quotient or product rule Obtain derivative in any correct form A1<br>Obtain the given answer correctly A1<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | i)             | State | e answer $R = \sqrt{2}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |       | B1 |
| Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>B1<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                | Use   | trigonometric formulae to find $lpha$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                   |       | M1 |
| Use $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{4}\pi)$ to justify the given answer<br>B1<br>Differentiate using the quotient or product rule<br>Obtain derivative in any correct form<br>Obtain the given answer correctly<br>Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1<br>M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                | Obta  | in answer $\alpha = \frac{1}{4}\pi$ (NOT 45°, unless 45° = $\pi/4^{\circ}$ somewh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | nere, later)                      |       | A1 |
| i) Differentiate using the quotient or product rule M1<br>Obtain derivative in any correct form A1<br>Obtain the given answer correctly A1<br>i) Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |       | 4 74                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                   |       |    |
| i) Differentiate using the quotient or product rule M1<br>Obtain derivative in any correct form A1<br>Obtain the given answer correctly A1<br>i) Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (ii)           | Use   | $\cos \theta + \sin \theta = \sqrt{2} \cos(\theta - \frac{1}{2}\pi)$ to justify the given answ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | /er                               |       | B1 |
| Obtain derivative in any correct form<br>Obtain the given answer correctlyA1<br>A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A1A2A1A1A1A1A1A2A1A1A1A2A1A2A1A3A1A3A1A3A1A3A1A3A1A3A1A3A1A3A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1A4A1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ,              | 000   | 4 "/ to juding the ground and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |       | 2. |
| Obtain derivative in any correct form<br>Obtain the given answer correctlyA1<br>A1A1A1Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | (iii)          | Diffe | rentiate using the quotient or product rule                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                   |       | M1 |
| Convert integrand to give $\int \frac{1}{2} \sec^2(\theta - \frac{\pi}{4}) d\theta$ B1<br>Integrate, to obtain function $\frac{1}{2} \tan(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | . ,            |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |
| Integrate, to obtain function $\frac{1}{2}$ tan $(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                | Obta  | in the given answer correctly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |       | A1 |
| Integrate, to obtain function $\frac{1}{2}$ tan $(\theta - \frac{\pi}{4})$ M1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | (1)            | Con   | (ort integrand to give $\int_{-\infty}^{1} \cos^{2}(0 - \pi/1) d0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |       | D1 |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | (iv)           | Conv  | $J_2^{-1} \sec (\theta - \frac{\pi}{4}) d\theta$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                   |       | DI |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                | Integ | rate, to obtain function $\frac{1}{2}$ tan ( $\theta - \frac{\pi}{4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |       | M1 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |       | E Contraction of the second seco |                                   |       | A1 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                   |       |    |