

CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary and Advanced Level

MARK SCHEME for the June 2005 question paper

9709 MATHEMATICS

9709/01 - Paper 1, maximum raw mark 75

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 June 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Grade thresholds for Syllabus 9709 (Mathematics) in the June 2005 examination.

| | maximum mark available | minimum mark required for grade: | | |
|-------------|------------------------|----------------------------------|----|----|
| | | A | B | E |
| Component 1 | 75 | 60 | 53 | 30 |

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 \surd 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 $\sqrt{}$ " 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.

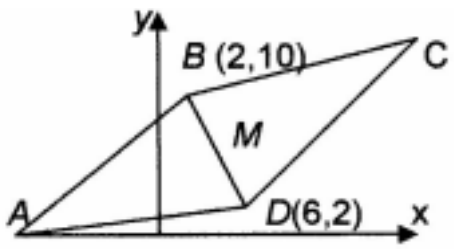


JUNE 2005

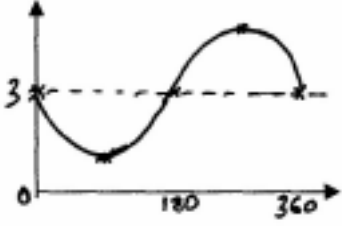
GCE A/AS LEVEL

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| MARK SCHEME |
| MAXIMUM MARK: 75 |
| SYLLABUS/COMPONENT: 9709/01 MATHEMATICS |

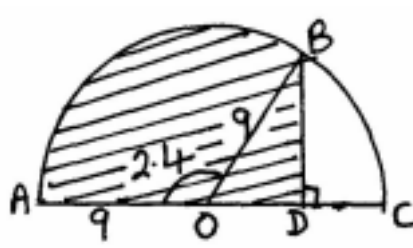
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|--------|----------------------------|----------|-------|
| Page 3 | Mark Scheme | Sy11abus | Paper |
| | GCE AS/A LEVEL – JUNE 2005 | 9709 | 1 |

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| <p>1 $y = \frac{2x^3}{3} - 5x$ (+ c)</p> <p>(3,8) fits $y = \frac{2x^3}{3} - 5x + 5$</p> | <p>M1 A1</p> <p>DM1 A1 [4]</p> | <p>Attempt at integration. CAO</p> <p>Uses (3,8) in an integrated expression. CAO</p> |
| <p>2 $y = \frac{12}{x^2 - 4x}$</p> <p>$\frac{dy}{dx} = -12(x^2 - 4x)^{-2} \times (2x - 4)$</p> <p>If $x = 3$, $\frac{dy}{dx} = -\frac{8}{3}$</p> | <p>B1 M1 A1√</p> <p>A1</p> <p>[4]</p> | <p>$-12(x^2 - 4x)^{-2}$ correct.</p> <p>Use of chain rule. √ for B0 attempts. Quotient or product rule ok (M1A2,1)</p> <p>CAO Uncancelled ok.</p> |
| <p>3 (i) $s + c = 2s - 2c \rightarrow s = 3c$ $\rightarrow \tan \theta = 3$</p> <p>(ii) $\rightarrow \theta = 71.6^\circ$ or 251.6°</p> | <p>M1 A1 [2]</p> <p>B1 B1√[2]</p> | <p>Use of $t = s/c$ + collection $\rightarrow \tan \theta = k$. Algebra needed to reduce to this form.</p> <p>B1√ for $180 + \dots$ as only soln in range.</p> |
| <p>4 (i) $(2 - x)^6 = 64 - 192x + 240x^2$</p> <p>(ii) $(1 + kx)(2 - x)^6$ coeff of $x^2 = 240 - 192k = 0 \rightarrow k = 5/4$ or 1.25</p> | <p>3 x B1 [3]</p> <p>M1 A1√ [2]</p> | <p>One for each term. Allow 2^6.</p> <p>Must be considering sum of 2 terms. ft for his expansion. (allow M1 if looking for coeff of x).</p> |
| <p>5</p>  <p>$M(4, 6)$ m of $BD = -2$ M of $AC = \frac{1}{2}$ Eqn of AC $y - 6 = \frac{1}{2}(x - 4)$</p> <p>$\rightarrow x = -8$ when $y = 0$ $A(-8, 0)$</p> <p>$\rightarrow C = (16, 12)$ by vector move etc.</p> | <p>B1 M1 M1 A1</p> <p>M1 A1</p> <p>[6]</p> | <p>CAO</p> <p>Use of $m_1 m_2 = -1$</p> <p>Correct method leading to A - the equation may not be seen - $y = 0$ may be used with gradient.</p> <p>Any valid method - vectors, midpoint backwards, or solution of 2 sim eqns.</p> |

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|--------|----------------------------|----------|-------|
| Page 3 | Mark Scheme | Sy11abus | Paper |
| | GCE AS/A LEVEL – JUNE 2005 | 9709 | 1 |

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| <p>6 GP $a = 192, r = 1.5, n = 6$ AP $a = a, d = 1.5, n = 21$</p> <p>S_6 for GP = $192(1.5^6 - 1) \div 0.5$ = 3990</p> <p>S_{21} for AP = $\frac{21}{2}(2a + 20 \times 1.5)$</p> <p>Equate and solve $\rightarrow a = 175$</p> <p>21st term in AP = $a + 20d = 205$ (or from $3990 = 21(a + l)/2$)</p> | <p>M1</p> <p>M1 DM1 A1</p> <p>M1 A1</p> <p>[6]</p> | <p>Correct sum formula used.</p> <p>Correct sum formula used. Needs both M's - soln of sim eqns. CAO</p> <p>Correct formula used.</p> |
| <p>7 $f: x \rightarrow 3 - 2\sin x$ for $0^\circ \leq x \leq 360^\circ$.</p> <p>(i) Range $1 \leq f(x) \leq 5$</p> <p>(ii)</p>  <p>$g: x \rightarrow 3 - 2\sin x$ for $0^\circ \leq x \leq 360^\circ$</p> <p>(iii) Maximum value of $A = 90$ or $\frac{1}{2}\pi$</p> <p>(iv) $y = 3 - 2\sin x$</p> <p>$g^{-1}(x) = \sin^{-1}\left(\frac{3-x}{2}\right)$</p> | <p>B2,1,0 [2]</p> <p>B2,1,0 [2]</p> <p>B1 [1]</p> <p>M1</p> <p>A1 [2]</p> | <p>Needs 1, 5, ≤. One off for each error.</p> <p>Must be exactly 1 full oscillation - this overrides the rest. Starts and ends at 3. Correct shape needed. Curves, not blatant lines.</p> <p>CAO</p> <p>Attempt to make x the subject and then to replace x by y. Needs $\sin^{-1}()$.</p> <p>Everything correct inc \sin^{-1}. Allow these marks anywhere.</p> |

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|--------|----------------------------|----------|-------|
| Page 3 | Mark Scheme | Sy11abus | Paper |
| | GCE AS/A LEVEL – JUNE 2005 | 9709 | 1 |

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| <p>8</p>  <p>(i) $BD = 9\sin(\pi - 2.4) = 6.08$ cm</p> <p>(ii) $OD = 9\cos(\pi - 2.4)$ or Pyth (6.64)</p> <p>Arc $AB = 9 \times 2.4$ Perimeter = $21.6 + 6.08 + 9 + 6.64$ → 43.3 cm</p> <p>(iii) Area of sector = $\frac{1}{2} 9^2 2.4$ Area of triangle = $\frac{1}{2} 6.08 \cdot 6.64$ → 117 cm²</p> | <p>M1 A1 [2]</p> <p>M1</p> <p>M1</p> <p>A1 [3]</p> <p>M1</p> <p>M1</p> <p>A1 [3]</p> | <p>Any valid method for BD (ans given)</p> <p>Any valid method - not DM mark - this could come in part (iii). Correct use of $s = r\theta$.</p> <p>CAO</p> <p>Correct use of $\frac{1}{2}r^2\theta$. Use of $\frac{1}{2}bh$. CAO</p> |
| <p>9</p> <p>$y = \frac{4}{\sqrt{x}}$</p> <p>(i) $dy/dx = -2x^{-1.5}$</p> <p>$= -\frac{1}{4}$ m of normal = 4 Eqn of normal $y - 2 = 4(x - 4)$ $P(3.5, 0)$ and $Q(0, -14)$</p> <p>Length of $PQ = \sqrt{(3.5^2 + 14^2)}$ $= 14.4$</p> <p>(ii) Area = $\int_1^4 4x^{-0.5} dx = \left[\frac{4x^{0.5}}{0.5} \right]$</p> <p>$= [8\sqrt{x}] = 16 - 8 = 8$</p> | <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1 [6]</p> <p>M1 A1</p> <p>DM1A1[4]</p> | <p>Reasonable attempt at differentiation with his power of x. CAO Use of $m_1m_2 = -1$ even if algebraic.</p> <p>Use of equation for a straight line + use of $x = 0$ and $y = 0$. Needs correct formula or method. CAO</p> <p>Attempt at integration. Correct unsimplified.</p> <p>Correct use of limits. CAO</p> |

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| Page 3 | Mark Scheme | Sy11abus | Paper |
| | GCE AS/A LEVEL – JUNE 2005 | 9709 | 1 |

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| <p>10 $y = x^2 - 3x + 4$</p> <p>(i) $dy/dx = 2x - 3$ $= 0$ when $x = 1.5$, $y = 1.75$ This is a minimum point, $1.75 > 0$ Curve lies above the x - axis.</p> <p>(ii) Decreasing function for $x < 1.5$.</p> <p>(iii) $y = x^2 - 3x + 4$ with $y + 2x = 6$ Eliminate y to give $x^2 - x - 2 = 0$ or eliminate x to give $y^2 - 10y + 16 = 0$ $\rightarrow (-1, 8)$ and $(2, 2)$</p> <p>(iv) $x^2 - 3x + 4 = k - 2x$ $\rightarrow x^2 - x + 4 - k = 0$ or $2x - 3 = -2$ Use of $b^2 - 4ac = 0$ or $x = \frac{1}{2} \rightarrow y = 2\frac{3}{4}$ $k = 3\frac{3}{4}$</p> | <p>M1 A1 A1✓ [3]</p> <p>A1✓ [1]</p> <p>M1 DM1 A1 [3]</p> <p>M1 M1 A1 [3]</p> | <p>Completing square or using calculus. Correct 1.75 from some method. Correct deduction for candidate's +ve y.</p> <p>Correct deduction for candidate's value of x. Allow \leq.</p> <p>Attempt at eqn in x or y and set to 0. Correct method of solution. All values.</p> <p>Equates and sets to 0 Uses $b^2 - 4ac$ on eqn = 0 CAO</p> |
| <p>11 $\vec{OA} = 2\mathbf{i} + 3\mathbf{j} - \mathbf{k}$ $\vec{OB} = 4\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$</p> <p>(i) $\vec{OA} \cdot \vec{OB} = 8 - 9 - 2 = -3$ $\vec{OA} \cdot \vec{OB} = \sqrt{14} \times \sqrt{29} \cos AOB$ $\rightarrow AOB = 99^\circ$</p> <p>(ii) $\vec{AB} = \mathbf{b} - \mathbf{a} = 2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k}$ Magnitude of $\vec{AB} = \sqrt{49} = 7$ \rightarrow Unit vector = $\frac{1}{7} (2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k})$</p> <p>(iii) $\vec{AC} = -2\mathbf{i} + 3\mathbf{j} + (p + 1)\mathbf{k}$ $4 + 9 + (p + 1)^2 = 49$ $\rightarrow p = 5$ or -7</p> | <p>M1 M1 M1 A1 [4]</p> <p>B1 M1 A1✓ [3]</p> <p>B1 M1 A1✓ A1 [4]</p> | <p>Correct use of $a_1a_2 + b_1b_2 + c_1c_2$ Modulus. Correct use of $ab \cos \theta$ CAO</p> <p>CAO Use of Pythagoras + division. CAO (use of \vec{BA} for \vec{AB} has max 2/3).</p> <p>CAO - condone $\mathbf{a} - \mathbf{c}$ here. Correct method for forming an equation CAO</p> |