

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

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 \checkmark " marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy.
- OW –1, 2 This is deducted from A or B marks when essential working is omitted.
- PA –1 This is deducted from A or B marks in the case of premature approximation.
- S –1 Occasionally used for persistent slackness.
- EX –1 Applied to A or B marks when extra solutions are offered to a particular equation.

JUNE 2004

GCE ORDINARY LEVEL

MARK SCHEME

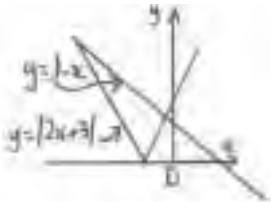

MAXIMUM MARK: 80

SYLLABUS/COMPONENT: 4037/01

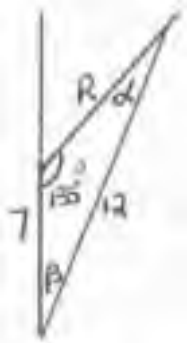
**ADDITIONAL MATHEMATICS
Paper 1**




Page 1	Mark Scheme	Syllabus	Paper
	ADDITIONAL MATHEMATICS– JUNE 2004	4037	1

<p>1. (i) $y=(3x-2)(x^2+5)$ $dy/dx = \frac{(x^2+5)3 - (3x-2)2x}{(x^2+5)^2}$</p> <p>(ii) Num = $15 + 4x - 3x^2 = 0$ when $\rightarrow x = -5/3$ or $x = 3$</p>	<p>M1 A1</p> <p>M1 A1</p> <p>[4]</p>	<p>Formula must be correct - allow unsimplified.</p> <p>Setting to 0 + attempt to solve. Both correct.</p>
<p>2. $x^3 = 5x-2$ $x^3 - 5x + 2 = 0$ Tries to find a value $x = 2$ fits $(x-2) \rightarrow x^2 + 2x - 1 = 0$ Solution $\rightarrow x = -1 \pm \sqrt{2}$</p>	<p>M1 A1 M1 DM1 A1</p> <p>[5]</p>	<p>Equating + attempt at a value by TI Co - allow for (x-2) or for f(2) Must be by (x-his value) As by quadratic scheme Co</p>
<p>3. (i)</p>  <p>$y = 2x+3$ -ve then +ve slope Vertex at (-h,0) $y = 1 - x$ Line, -ve m, (k,0)</p> <p>(ii) $x + 2x + 3 = 1 \rightarrow x = -2/3$ (-0.65 to -0.70) $x - (2x+3) = 1 \rightarrow x = -4$ (-3.9 to -4.1)</p>	<p>B1 DB1 B1</p> <p>[3]</p> <p>B1 M1 A1</p> <p>[3]</p>	<p>Must be 2 parts – ignore -2 to -1</p> <p>V shape-Vertex on -ve x-axis + lines</p> <p>-ve slope, crosses axes at x,y +ve – allow if only in 1st or 2nd quadrants</p> <p>From graph, or calculation or guess</p> <p>B2 if correct. M mark for any method. Squares both sides M1 quadratic A1 Answers A1</p>
<p>4. $x = a\sin(bx)+c$</p> <p>(i) $a = 2$ and $b = 3$</p> <p>(ii) $c = 1$</p> <p>(iii) 3 cycles (0 to 360) -1 to 3</p>  <p>Period 120° + all correct.</p>	<p>B1 B1 B1</p> <p>B1 B1 DB1</p> <p>[6]</p>	<p>Wrong way round - no marks. No labels - allow B1 if both correct. Co</p> <p>Even if starting incorrectly. Needs to be marked - allow for any trig graph. Everything in relatively correct position - needs both B's</p>

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<p>5. $xy + 24 = 0$ and $5y + 2x = 1$ Makes x or y the subject and subs $\rightarrow 5y^2 = y + 48$ or $2x^2 - x = 120$ Solution of quadratic = 0 $\rightarrow (8, -3)$ and $(-7.5, 3.2)$</p> <p>$d = \sqrt{(15.5^2 + 6.2^2)} = 16.7$</p>	<p>M1 A1 DM1 A1</p> <p>M1 A1 \checkmark [6]</p>	<p>x or y removed completely – condone poor algebra. A1 co. By scheme for quadratic = 0 Co</p> <p>M mark ind of anything before. A1 \checkmark on his 2 points.</p>
<p>6.</p> $(300 \quad 240) \begin{pmatrix} .6 & .3 & .1 \\ .5 & .4 & .1 \end{pmatrix} \begin{pmatrix} 4 \\ 6 \\ 8 \end{pmatrix}$ $\left[\text{or } (4 \quad 6 \quad 8) \begin{pmatrix} .6 & .5 \\ .3 & .4 \\ .1 & .1 \end{pmatrix} \begin{pmatrix} 300 \\ 240 \end{pmatrix} \right]$ $(300 \quad 186 \quad 54) \begin{pmatrix} 4 \\ 6 \\ 8 \end{pmatrix} \text{ or } (300 \quad 240) \begin{pmatrix} 5 \\ 5.2 \end{pmatrix}$ <p>Final answer \rightarrow \$2748</p>	<p>B2, 1.0</p> <p>M1 A1</p> <p>M1 B1 [6]</p>	<p>For 3 correct matrices – independent of whether they are conformable – allow with or without the factor of 100.</p> <p>1st product. Co. Matrices must be written in correct order – for M mark, the 2x3 or 3x2 must be used.</p> <p>2nd product. By any method, inc numerical. Omission of 100 loses last B1 only.</p>
<p>7.</p>  <p>$\frac{\sin \alpha}{7} = \frac{\sin 135}{12}$</p> <p>$\rightarrow \alpha = 24.4^\circ$</p> <p>= 20.6°. Bearing is 020.6°</p>	<p>B1</p> <p>M2</p> <p>A1</p> <p>A1 [5]</p>	<p>Correct triangle of velocities - must be 7, 12 and 135° opposite 12. Sine rule used in his triangle. If 45° or 135° between 7 and 12, allow M1 for cos rule, M1 for sine rule Co.</p> <p>Co. Allow 21°.</p>

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<p>8. $y = (ax+3)\ln x$ On x-axis, $y = 0$ $ax + 3 = 0 \rightarrow x$ is -ve \rightarrow no soln But $\ln x = 0 \rightarrow x = 1$</p> <p>$dy/dx = a\ln x + (ax+3).(1/x)$</p> <p>Use of $m_1 m_2 = -1$ Gradient of tangent = -1 $(-1/5)$</p> <p>$\rightarrow a = 2$</p>	<p>M1 A1 M1 B1 M1 A1 A1</p> <p>[7]</p>	<p>Needs an attempt at solution. Ignore other solutions at this stage. Correct use of "uv" formula. For $d/dx(\ln x)$, even if M0 given above. Could equate m with -1 (dy/dx) Co. Co.</p>
<p>9. (a) $\left(x - \frac{1}{2x^5}\right)^{18}$ ${}_{18}C_{15} (x)^{15} (1/2x^5)^3$ $\rightarrow 18.17.16(-1/8) \div 6$ $\rightarrow -102$</p> <p>(b) $(1 + kx)^n$ Coeff of $x^2 = {}_n C_2 k^2$ Coeff of $x^3 = {}_n C_3 k^3$</p> <p>Equating and changing to factorials $\rightarrow k = 3/(n-2)$ or equivalent without factorials</p>	<p>B1 B1 B1 B1 M1 A1</p> <p>[3] [4]</p>	<p>For ${}_{18}C_3$ or ${}_{18}C_{15}$ For $(\pm 1/2)^3$ – even if in $(1/2x)^3$ Co Co. Co. Needs attempt at nCr Co</p>
<p>10. (i) Area = Δ – sector BCA = $\pi - 1.4$ or height = $20\sin 0.7$</p>  <p>$\Delta = \frac{1}{2} \cdot 20^2 \sin(\pi - 1.4)$ or $\frac{1}{2}bh = 197.1$</p> <p>Sector = $\frac{1}{2} \cdot 20^2 \cdot 0.7 = 140$ \rightarrow Area = 57.1</p> <p>(ii) DC = $20 \times 0.7 (=14)$ AB = $2 \times 20\cos 0.7$ or cos rule BD = AB – 20 = 10.6 \rightarrow Perimeter = 44.6</p> <p>Could be [5] + [3] if AB used in part (i)</p>	<p>M1 M1 M1 A1 M1 M1 M1 A1</p> <p>[4] [4]</p>	<p>Award for either of these. Correct method for area of Δ Use of $\frac{1}{2}r^2\theta$ Co Use of $s = r\theta$ Correct trig – could gain this in (i) Co</p>

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<p>11. (i) $m = -a/x^3 \rightarrow y = \frac{1}{2}ax^{-2} (+c)$ Puts in (2, 3.5) $\rightarrow 28 = a + 8c$ Puts in (5, 1.4) $\rightarrow 70 = a + 50c$ Solution $\rightarrow a = 20, c = -1$</p> <p>(ii) $\int (10x^{-2} + 1)dx = -10x^{-1} + x$ $A = []^p - []^2 = -10/p + p + 3$ $B = []^5 - []^p = 10/p - p + 3$</p> <p>$P = \sqrt{10}$ or 3.16</p>	<p>M1 A1 DM1</p> <p>M1 A1 [5]</p> <p>M1 A1√ M1 M1</p> <p>A1 [5]</p>	<p>Any attempt to integrate. Co. Substitutes one of his points – even if +c missing</p> <p>Correct method of soln. Both co. (beware fortuitous ans. a = 20 given) N.B: assumes a = 20 without checking that both points work (M1A0DM1M0A1)</p> <p>Integrates his "curve" Use of limits correctly in either A or B or in A+B (2 to 5). Award M1 for each. (Can get these if only one integration) co</p>
<p>12 EITHER</p> <p>12 questions – 3 trig, 4 alg, 5 calc Answer 8 from 12.</p> <p>(a) (i) ${}_{12}C_8 = 495$ (ii) T and A $\rightarrow 0$ T and C $\rightarrow 1$ A and C $\rightarrow 9$ Total = 10</p> <p>8 dresses, A \rightarrow H</p> <p>(b) (i) ${}_8P_5 = 6720$ (ii) $\frac{1}{8}$ of (i) = 840 or ${}_7P_4$ (iii) $\frac{5}{8}$ of (i) = 4200 or 5 x (ii) or ${}_8P_5 - {}_7P_5$</p>	<p>M1 A1</p> <p>M1 A1 [4]</p> <p>M1 A1 M1 A1√ M1 A1√ [6]</p>	<p>${}_{12}C_8$ gets M1. Answer only gets both marks.</p> <p>Needs to have considered 2 of the possibilities.</p> <p>Must be ${}_8P_5$ for M1 – co for A1. Any method ok. $\sqrt{\quad}$ on (i) if appropriate Any method ok. $\sqrt{\quad}$ on (i) or (ii)</p>

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12 OR							
x	2	4	6	8	10		
y	9.8	19.4	37.4	74.0	144.4		
lgy	0.99	1.29	1.57	1.87	2.16		
(i) Finds values of lgy Draws graph accurately.						M1 A1	Knows what to do. Don't penalise incorrect scale. Points correct to ½ small square.
(ii) $lgy = lga + xlg b$ $m = lgb \rightarrow b = 1.4 (\pm 0.05)$ $c = lga \rightarrow A = 5.0 (\pm 0.2)$						[2] B1 M1 A1 M1 A1	Anywhere – even if no graph Gradient measured + equated to lgb. Intercept measured + equated to lga.
(iii) $lgy = xlg 2$ i.e Straight line $Y = 0.301x$ $x = 4.5 (\pm 0.2)$						[5] B1 M1 A1	Even if no line – give if line correct. Must be a line. To this accuracy.
Use of simultaneous eqns in part (ii) gets B1 only, unless both points used are on his line, in which case allow marks if to correct accuracy.						[3]	
DM 1 for quadratic equation. Equation must be set to 0 if using formula or factors.							
<u>Formula</u> Must be correct – ignore arithmetic and algebraic slips.			<u>Factors</u> Must attempt to put quadratic into 2 factors. Each factor then equated to 0.				

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GCE ORDINARY LEVEL

MARK SCHEME

MAXIMUM MARK: 80

SYLLABUS/COMPONENT: 4037/02

**ADDITIONAL MATHEMATICS
Paper 2**




Page 1	Mark Scheme	Syllabus	Paper
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1 [4]	$(i - 7j) + \lambda(0.6i + 0.8j) = 4i + kj$ $1 + 0.6\lambda = 4 \quad \Rightarrow \quad \lambda = 5$ $-7 + 0.8\lambda \quad \Rightarrow \quad -7 + 0.8 \times 5 = -3 = k$	M1 A1 M1 A1
2 [4]	Attempt at $\cos^{-1} 0.3 \Rightarrow [72.5^\circ \text{ A0}] = 1.266 [5.017, 7.549]$ accept 1.3 $x + 1 = 2.532, 10\,034, 15.098 \Rightarrow x = 14.1$ or better	M1 A1 M1 A1
3 [4]	(i) Some vegetarians in the college are over 180 cm tall [or equivalent] (ii) No cyclists in the college are over 180 cm tall [or equivalent] (iii) $B \cap C \subset A'$ [or equivalent]	B1 B1 B1 B1
4 [4]	$\left(1 + \frac{1}{\cos \theta}\right) \left(\frac{1}{\sin \theta} - \frac{\cos \theta}{\sin \theta}\right) \Rightarrow \frac{1 - \cos^2 \theta}{\cos \theta \sin \theta}$ $1 - \cos^2 \theta \equiv \sin^2 \theta$ Must be useful use of Pythagoras $\frac{\sin^2 \theta}{\cos \theta \sin \theta} \rightarrow \tan \theta$	M1 M1 B1 A1
5 [5]	$x = \frac{\sqrt{20} \pm \sqrt{20 - (4 \times 2)}}{2} = \sqrt{5} \pm \sqrt{3}$ or $\frac{\sqrt{20} \pm \sqrt{12}}{2}$ $\frac{1}{\sqrt{5} + \sqrt{3}} + \frac{1}{\sqrt{5} - \sqrt{3}}$ [or $\frac{2}{\sqrt{20} + \sqrt{12}} + \frac{2}{\sqrt{20} - \sqrt{12}}$] rationalising each fraction or bringing to common denominator Denominator = 2 [or 8] $\Rightarrow \frac{1}{c} + \frac{1}{d} = \sqrt{5}$	M1 A1 M1 A1 A1
6 [6]	(a) $2x^2 - 3x - 14 = 0 \Rightarrow (2x - 7)(x + 2) = 0 \Rightarrow x = -2, 3.5$ $\{x : x < -2\} \cup \{x : x > 3.5\}$ (b) Eliminate $y \Rightarrow x^2 + 4(8 - kx) = 20$ [or $x \Rightarrow \left(\frac{8 - y}{k}\right)^2 + 4y = 20$] $x^2 - 4kx + 12 = 0$ [or $y^2 + (4k^2 - 16)y + (64 - 20k^2) = 0$] Apply "b ² = 4ac" $16k^2 = 48$ [or $16k^4 = 48k^2$] $\Rightarrow k = \pm\sqrt{3}$	M1 A1 A1 M1 M1 A1

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7 [6]	<p>(i) $e^{2x-3} (=7) \Rightarrow x = \frac{1}{2}(3 + \ln 7) \approx 2.47 \sim 2.48$ (not 2.5)</p> <p>(ii) $h = 2e^x - 3$ (x, y or) $h > -3$ accept \geq</p> <p>(iii) h^{-1} (or y) = $\ln\{\frac{1}{2}(x+3)\}$ or $\ln(x+3) - \ln 2$ or $\lg\{\frac{1}{2}(x+3)\}/\lg e$ but $\ln\{\frac{1}{2}(y+3)\}$ M1 A0 \lg (or \log) $\{\frac{1}{2}(x+3)\}$ M1 A0</p>	<p>M1 A1</p> <p>B1 B1</p> <p>M1 A1 (M1 for logs taken in valid way)</p>
8 [8]	<p>(i) $\log_3(2x+1) - \log_3(3x-11) = \log_3 \frac{2x+1}{3x-11}$ [Or, later, give M1 for $\log + \log = \log(\text{product})$] $\log_3(\quad) = 2 \Rightarrow (\quad) = 3^2$ $2x+1 = 9(3x-11) \Rightarrow x = 4$</p> <p>(ii) $\log_4 y = \frac{\log_2 y}{\log_2 4} = \frac{1}{2} \log_2 y$ [or $\log_2 y = \frac{\log_4 y}{\log_4 2} = 2 \log_4 y$] $\frac{1}{2} \log_2 y + \log_2 y = 9$ [or $\log_4 y + 2 \log_4 y = 9$] $\Rightarrow y = 2^6$ or $4^3 = 64$</p>	<p>M1</p> <p>B1</p> <p>DM1 A1</p> <p>M1 A1</p> <p>DM1 A1</p>
9 [8]	<p>$6 + 4x - x^2 \equiv 10 - (x-2)^2$</p> <p>(i) $x = 2$ $y = 10$ Maximum</p> <p>(ii) $f(0) = 6, f(2) = 10, f(5) = 1 \Rightarrow 1 \leq f \leq 10$ [alternatively $1 \leq B1, \leq 10 B1$]</p> <p>(iii) f has no inverse; it is not 1:1</p>	<p>M1 A1</p> <p>B1√B1√B1</p> <p>M1 A1</p> <p>B1</p>
10 [10]	<p>(i) $m_{BC} = 3/5$ Equation of AD is $y - 4 = 3/5(x + 2)$ $m_{AC} = -1/4$ Equation of CD is $y - 2 = 4(x - 6)$</p> <p>(ii) Solve $x = 8, y = 10$</p> <p>(iii) Length of AC = Length of CD = $\sqrt{68}$</p>	<p>B1 M1 A1</p> <p>B1 M1 A1</p> <p>M1 A1</p> <p>M1 A1</p>
11 [10]	<p>(i) $d/dx (2x-3)^{3/2} = (2x-3)^{1/2} \times 3/2 \times 2$ $dy/dx = 1 \times (2x-3)^{3/2} + (x+1) \times \{\text{candidate's } d/dx (2x-3)^{3/2}\}$ $= \sqrt{2x-3} \{(2x-3) + 3(x+1)\} = 5x\sqrt{2x-3} \Rightarrow k = 5$</p> <p>(ii) $\delta y \approx dy/dx \times \delta x = (dy/dx)_{x=6} \times p = 90p$ $(y)_{x=6+p} = (y)_{x=6} + \delta y = 189 + 90p$</p> <p>(iii) $\int x\sqrt{2x-3} dx = 1/5 (x+1)(2x-3)^{3/2}$ $[]_2^6 = 1/5 (189 - 3) = 37.2$</p>	<p>M1 A1</p> <p>M1</p> <p>A1</p> <p>M1 A1</p> <p>A1√</p> <p>M1</p> <p>DM1 A1</p>

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<p>12 [11] EITHER</p>	<p>(i) $a = dv/dt = 5e^{-1/2t}$ $v = 8 = 10(1 - e^{-1/2t}) \Rightarrow e^{-1/2t} = 0.2 \Rightarrow a = 1$</p> <p>(ii) $s = \int v dt = \int (10 - 10e^{-t/2}) dt = 10t + 20e^{-t/2}$ $\left[\right]_0^6 = (60 + 20e^{-3}) - (20) \approx 41$</p> <p>(iii) 10</p> <p>(iv) </p>	<p>M1 A1 M1 A1 M1 A1 DM1 A1 B1 B2,1,0</p>
<p>12 [11] OR</p>	<p>(i) $d/d\theta \{(\cos\theta)^{-1}\} = -(\cos\theta)^{-2}(-\sin\theta) = \sin\theta/\cos^2\theta$</p> <p>(ii) $AX = 2\sec\theta \quad PX = 2\tan\theta$ $T = \frac{2\sec\theta}{3} + \frac{10 - 2\tan\theta}{5}$</p> <p>(iii) $\frac{dT}{d\theta} = \frac{2}{3} \frac{\sin\theta}{\cos^2\theta} - \frac{2}{5} \sec^2\theta$ $= 0 \text{ when } 5\sin\theta = 3 \Rightarrow \sin\theta = 3/5$ $PX = 2\tan\theta = 2 \times \frac{3}{4} = 1.5$</p>	<p>M1 A1 B1 B1 M1 A1 B1 B1√ M1 A1 A1</p>