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.

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE A AND AS LEVEL
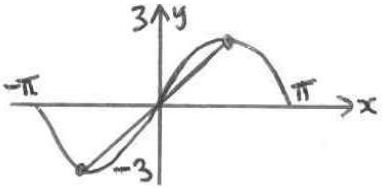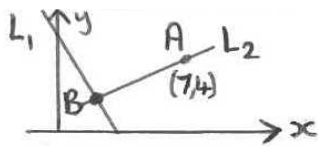
MARK SCHEME

MAXIMUM MARK: 75

SYLLABUS/COMPONENT: 9709/01
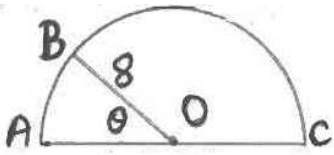
MATHEMATICS
Paper 1 (Pure 1)

UNIVERSITY *of* CAMBRIDGE
Local Examinations Syndicate

1.	$(2x – 1/x)^5$. 4th term needed. $\rightarrow {}_5C_3 = 5.4/2$ $\rightarrow x\ 2^2\ x\ (-1)^3$ $\rightarrow -40$	M1 DM1 A1 [3]	Must be 4th term – needs $(2x)^2 (1/x)^3$ Includes and converts ${}_5C_2$ or ${}_5C_3$ Co Whole series given and correct term not quoted, allow 2/3
2.	sin3x + 2cos3x = 0 tan3x = -2 x = 38.9 (8) and x = 98.9 (8) and x = 158.9 (8) NB. $\sin^2 3x + \cos^2 3x = 0$ etc. M0 But $\sin^2 3x = (-2\cos 3x)^2$ plus use of $s^2 + c^2 = 1$ is OK Alt. $\sqrt 5\sin(3x + \alpha)$ or $\sqrt 5\cos(3x - \alpha)$ both OK	M1 A1 A1√ A1√ [4]	Use of tan = sin ÷ cos with 3x Co For 60 + "his" For 120 + "his" and no others in range (ignore excess ans. outside range) Loses last A mark if excess answers in the range
3.	(a) dy/dx = $4 – 12x^{-3}$ (b) $\int = 2x^2 – 6x^{-1} + c$ (a) (quotient OK M1 correct formula, A1 co)	B2, 1 [2] 3 x B1 [3]	One off for each error (4, -, 12, -3) One for each term – only give +c if obvious attempt at integration
4.	a = -10 a + 14d = 11 d = $\dfrac{3}{2}$ a + (n – 1)d = 41 n = 35 Either S_n = n/2(2a + (n –1)d) or n/2(a + l) = 542.5	M1 M1 A1 M1 A1 [5]	Using a = (n – 1)d Correct method – not for a + nd Co Either of these used correctly For his d and any n
5.	(i) 2a + b = 1 and 5a + b = 7 $\rightarrow$ a = 2 and b = -3 (ii) f(x) = 2x - 3 ff(x) = 2(2x – 3)-3 $\rightarrow$ 4x – 9 = 0 when x = 2.25	M1 A1 [2] M1 DM1 A1 [3]	Realising how one of these is formed Co Replacing "x" by "his ax + b" and "+b" For his a and b and solved = 0 Co

6. (i)

B2, 1

[2]

For complete cycle, shape including curves, not lines, -3 to +3 shown or implied, for $-\pi$ to π. Degrees ok

(ii) $x = \pi/2$, $y = 3$ (allow if 90°)
$\rightarrow k = 6/\pi$ co.

M1
A1
[2]

Realising maximum is $(\pi/2, 3)$ + sub
Co (even if no graph)

(iii) $(-\pi/2, -3)$ – must be radians

B1
[1]

Co (could come from incorrect graph)

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7. (i)

Gradient of $L_1 = -2$
Gradient of $L_2 = \frac{1}{2}$
Eqn of L_2 $y - 4 = \frac{1}{2}(x - 7)$

B1
M1
M1A1√
[4]

Co – anywhere
Use of $m_1 m_2 = -1$
Use of line eqn – or $y = mx + c$. Line must be through (7, 4) and non-parallel

(ii) Sim Eqns
$\rightarrow x = 3$, $y = 2$

M1
A1

Solution of 2 linear eqns
Co

$AB = \sqrt{(2^2 + 4^2)} = \sqrt{20}$ or 4.47

M1A1
[4]

Correct use of distance formula. Co

---

8. (i) $\overrightarrow{BA} = \mathbf{a} - \mathbf{b} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$

$\overrightarrow{BC} = \mathbf{c} - \mathbf{b} = -2\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$
Dot product $= -2 + 8 - 6 = 0$

$\rightarrow$ Perpendicular

M1

M1A1

A1
[4]

Knowing how to use position vector for $\overrightarrow{BA}$ or $\overrightarrow{BC}$ – not for $\overrightarrow{AB}$ or $\overrightarrow{CB}$
Knowing how to use $x_1 y_1 + x_2 y_2 + x_3 y_3$. Co
Correct deduction. Beware fortuitous (uses $\overrightarrow{AB}$ or $\overrightarrow{CB}$ – can get 3 out of 4)

(ii) $\overrightarrow{BC} = \mathbf{c} - \mathbf{b} = -2\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$

$\overrightarrow{AD} = \mathbf{d} - \mathbf{a} = -5\mathbf{i} + 10\mathbf{j} + 5\mathbf{k}$
These are in the same ratio \ parallel

M1

M1

Knowing how to get one of these

Both correct + conclusion. Could be dot product $= 60 \rightarrow$ angle $= 0^o$

Ratio = 2:5 (or $\sqrt{24}: \sqrt{150}$)

M1A1
[4]

Knowing what to do. Co. Allow 5:2

9.	
	
	(i) θ = 1 angle BOC = π-θ
	   Area = ½r²θ = 68.5 or 32(π-1)
	   (or ½circle-sector)
		B1
		M1
		A1
		[3]
			For π-θ or for ½πr² – sector
			Use of ½r²θ
			Co
			NB. 32 gets M1 only

	(ii) 8 + 8 + 8θ = ½(8 + 8 + 8(π-θ))
	    Solution of this eqn
	
	    → 0.381 or ¹/₃(π-2)
		M1
		M1
		
		A1
		[3]
			Relevant use of s = rθ twice
			Needs θ – collected – needs
			perimeters
			Co.

	(iii) θ = π/3 AB = 8cm
	    BC = 2 x 8sinπ/3 = 8√3
	
	    Perimeter = 24 + 8√3
		B1
		M1
		
		A1
		[3]
			Co.
			Valid method for BC – cos rule, Pyth
			allow decimals here
			Everything OK. Answer given
			NB. Decimal check loses this mark

10.	y = √(5x + 4) (i) dy/dx = ½(5x + 4)^{-½} x 5 x = 1, dy/dx = 5/6	B1B1 B1 [3]	½(5x + 4)^{-½} x 5 B1 for each part Co

	(ii) dy/dt = dy/dx x dx/dt
	    = 5/6 x 0.03
	    → 0.025
		M1
		
		A1√
		[2]
			Chain rule correctly used
			
			For (i) x 0.03

	(iii) realises that area →
	     integration
	
	    ∫ = (5x + 4)^{3/2} ÷ ³/₂ ÷ 5
	
	    Use of limits→ 54/15 - 16/15
	    = 38/15 = 2.53
		M1
		
		A1A1
		
		DM1
		A1
		[5]
			Realisation + attempt – must be
			(5x + 4)^k
			
			For (5x + 4)^{3/2} ÷ ³/₂. For ÷ 5
			
			Must use "0" to "1"
			Co

11.	(i) $8x - x^2 = a - x^2 - b^2 - 2bx$ +
	    equating
	    $\rightarrow b = -4$
	    $a = b^2 = 16$ (i.e. $16 - (x - 4)^2$)
		M1
		 B1
		 A1
		 [3]
			Knows what to do – some equating
			 Anywhere – may be independent
			 For $16-(\ )^2$

	(ii) $dy/dx = 8 - 2x = o$ when $\rightarrow (4, 16)$ (or from $-b$ and a)	M1 A1 [2]	Any valid complete method Needs both values

	(iii) $8x - x^2 \geq -20$
	    $x^2 - 8x - 20 = (x - 10)(x + 2)$
	    End values -2 and 10
	    Interval $-2 \leq x \leq 10$
		M1
		 A1
		 A1
		 [3]
			Sets to 0 + correct method of solution
			 Co – independent of < or > or =
			 Co – including $\leq$ (< gets A0)

	g: $x \rightarrow 8x - x^2$ for $x \geq 4$		
	(iv) domain of g^{-1} is $x \leq 16$ range of g^{-1} is $g^{-1} \geq 4$	B1√ B1 [2]	From answer to (i) or (ii). Accept <16 Not f.t since domain of g given
	(v) $y = 8x - x^2 \rightarrow x^2 - 8x + y = 0$	M1	Use of quadratic or completed square expression to make x subject
	$x = 8 \pm \sqrt{(64 - 4y)} \div 2$ $g^{-1}(x) = 4 + \sqrt{(16 - x)}$	DM1 A1 [3]	Replaces y by x Co (inc. omission of -)
	or $(x - 4)^2 = 16 - y \rightarrow x = 4 + \sqrt{(16 - y)}$ $\rightarrow y = 4 + \sqrt{(16 - x)}$		

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/02

MATHEMATICS
Paper 2 (Pure 2)

1 *EITHER:* State or imply non-modular inequality $(x - 4)^2 > (x + 1)^2$,
or corresponding equation   B1
Expand and solve a linear inequality, or equivalent   M1
Obtain critical value 1½   A1
State correct answer $x < 1½$ (allow $\leq$)   A1

   OR: State a correct linear equation for the critical value e.g. $4 - x = x + 1$ B1
Solve the linear equation for x M1
Obtain critical value 1½, or equivalent   A1
State correct answer $x < 1½$ A1

   OR: State the critical value 1½, or equivalent, from a graphical method or by
inspection or by solving a linear inequality   B3
State correct answer $x < 1½$ B1

                                                                      [4]

2 (i) *EITHER:* Expand *RHS* and obtain at least one equation for a M1
Obtain $a^2 = 9$ and $2a = 6$, or equivalent   A1
State answer $a = 3$ only   A1

   OR: Attempt division by $x^2 + ax + 1$ or $x^2 - ax -1$, and obtain an equation in a M1
Obtain $a^2 = 9$ and either $a^3 - 11a + 6 = 0$ or $a^3 - 7a - 6 = 0$, or equivalent   A1
State answer $a = 3$ only   A1

   [Special case: the answer $a = 3$, obtained by trial and error, or by
inspection, or with no working earns B2.]   **[3]**

   (ii)   Substitute for a and attempt to find zeroes of one of the quadratic factors   M1
Obtain one correct answer   A1
State all four solutions ½$(-3 \pm \sqrt{5})$ and ½$(3 \pm \sqrt{13})$, or equivalent   A1

                                                                      [3]

3 (i)   State or imply indefinite integral of e^{2x} is ½e^{2x}, or equivalent   B1
Substitute correct limits correctly   M1
Obtain answer $R = ½ e^{2p} - ½$, or equivalent   A1

                                                                      [3]

   (ii)   Substitute $R = 5$ and use logarithmic method to obtain an equation
in $2p$ M1*
Solve for p M1 (dep*)
Obtain answer $p = 1.2$ (1.1989 ...)   A1

                                                                      [3]

4 (i)   Use tan ($A \pm B$) formula to obtain an equation in tan x M1

State equation $\dfrac{\tan x + 1}{1 - \tan x} = 4\dfrac{(1 - \tan x)}{1 + \tan x}$, or equivalent   A1

Transform to a 2- or 3-term quadratic equation   M1
Obtain given answer correctly   A1

[4]

(ii)   Solve the quadratic and calculate one angle, or establish that
$t = \frac{1}{3}$, 3 (only)   M1
Obtain one answer, e.g. $x = 18.4^\circ \pm 0.1^\circ$ A1
Obtain second answer $x = 71.6^\circ$ and no others in the range   A1

[Ignore answers outside the given range]   **[3]**

5 (i)   Make recognizable sketch over the given range of two suitable
graphs, e.g. $y = \ln x$ and $y = 2 - x^2$ B1+B1
State or imply link between intersections and roots and justify
given answer   B1

[3]

(ii)   Consider sign of $\ln x - (2 - x^2)$ at $x = 1$ and $x = 1.4$, or equivalent   M1
Complete the argument correctly with appropriate calculation   A1

[2]

(iii) Use the given iterative formula correctly with $1 \le x_n \le 1.4$ M1
Obtain final answer 1.31   A1
Show sufficient iterations to justify its accuracy to 2d.p.,
or show there is a sign change in the interval (1.305, 1.315)   A1

[3]

6 (i)   Attempt to apply the chain or quotient rule   M1
Obtain derivative of the form $\dfrac{k\sec^2 x}{(1 + \tan x)^2}$ or equivalent   A1

Obtain correct derivative $-\dfrac{\sec^2 x}{(1 + \tan x)^2}$ or equivalent   A1

Explain why derivative, and hence gradient of the curve, is
always negative   A1

[4]

(ii)   State or imply correct ordinates: 1, 0.7071.., 0.5   B1
Use correct formula, or equivalent, with $h = \frac{1}{8}\pi$ and three ordinates   M1
Obtain answer 0.57 (0.57220...) ± 0.01 (accept 0.18π)   A1

[3]

(iii)   Justify the statement that the rule gives an over-estimate   B1

                                                                                        [1]

7 (i)   State $\dfrac{dx}{d\theta}$ = 2 – 2cos 2θ or $\dfrac{dy}{d\theta}$ = 2sin 2θ B1

Use $\dfrac{dy}{dx} = \dfrac{dy}{d\theta} \div \dfrac{dx}{d\theta}$ M1

Obtain answer $\dfrac{dy}{dx} = \dfrac{2\sin 2\theta}{2 - 2\cos 2\theta}$ or equivalent   A1

Make relevant use of sin 2*A* and cos 2*A* formulae   (indep.) M1
Obtain given answer correctly   A1

                                                                                        [5]

(ii)   Substitute θ = ¼π in $\dfrac{dy}{dx}$ and both parametric equations   M1

Obtain $\dfrac{dy}{dx}$ = 1, *x* = ½π - l, *y* = 2   A1

Obtain equation *y* = *x* + 1.43 , or any exact equivalent   A1√

                                                                                        [3]

(iii)   State or imply that tangent is horizontal when θ = ½π or $^3/_2$π   B1
Obtain a correct pair of *x*, *y* or *x*- or *y*-coordinates   B1
State correct answers (π, 3) and (3π, 3)   B1

                                                                                        [3]

1 (i)   Use trig formulae to express *LHS* in terms of sin *x* and cos *x*   M1
     Use cos 60° = sin 30° to reduce equation to given form cos *x* = *k*   M1

                                                                                    [2]

   (ii)   State or imply that $k = -\dfrac{1}{\sqrt{3}}$ (accept -0.577 or -0.58)   A1

       Obtain answer *x* = 125.3° only   A1
       [Answer must be in degrees; ignore answers outside the given range.]

       [SR: if $k = \dfrac{1}{\sqrt{3}}$ is followed by *x* = 54.7°, give A0A1√.]

                                                                                    [2]

2   State first step of the form $kxe^{2x} \pm \int ke^{2x}\,dx$ M1
     Complete the first step correctly   A1
     Substitute limits correctly having attempted the further integration
     of ke^{2x} M1
     Obtain answer ¼ (e² + 1) or exact equivalent of the form $ae^2 + b$,
     having used e⁰ =1 throughout   A1

                                                                                    [4]

3 *EITHER*   State or imply non-modular inequality $(x-2)^2 < (3-2x)^2$, or
          corresponding equation   B1
          Expand and make a reasonable solution attempt at a 2- or 3-term
          quadratic, or equivalent   M1
          Obtain critical value *x* = 1   A1
          State answer *x* < 1 only   A1

   OR   State the relevant linear equation for a critical value,
          i.e. 2 - *x* = 3 - 2*x*, or equivalent   B1
          Obtain critical value *x* = 1   B1
          State answer *x* < 1   B1
          State or imply by omission that no other answer exists   B1

   OR   Obtain the critical value *x* = 1 from a graphical method, or by inspection,
          or by solving a linear inequality   B2
          State answer *x* < 1   B1
          State or imply by omission that no other answer exists   B1

                                                                                    [4]

4 (i) *EITHER* State or imply that $x - 2$ is a factor of f(x)   B1
Substitute 2 for x and equate to zero   M1
Obtain answer $a = 8$ A1

[The statement $(x - 2)^2 = x^2 - 4x + 4$ earns B1.]

   OR Commence division by $x^2 - 4x + 4$ and obtain partial quotient $x^2 + 2x$ B1
Complete the division and equate the remainder to zero   M1
Obtain answer $a = 8$ A1

   OR Commence inspection and obtain unknown factor $x^2 + 2x + c$ B1
Obtain $4c = a$ and an equation in c M1
Obtain answer $a = 8$ A1

                                                                 [3]

 (ii) *EITHER* Substitute $a = 8$ and find other factor $x^2 + 2x + 2$ by inspection
or division   B1
State that $x^2 - 4x + 4 \geq 0$ for all x (condone > for $\geq$)   B1
Attempt to establish sign of the other factor   M1
Show that $x^2 + 2x + 2 > 0$ for all x and complete the proof   A1
[An attempt to find the zeros of the other factor earns M1.]

   OR Equate derivative to zero and attempt to solve for x M1
Obtain $x = -½$ and 2   A1
Show correctly that f(x) has a minimum at each of these values   A1
Having also obtained and considered $x = 0$, complete the proof   A1

                                                                 [4]

5 (i) State or imply $w = \cos \dfrac{2}{3} \pi + \text{isin} \dfrac{2}{3} \pi$ (allow decimals)   B1

Obtain answer $uw = -\sqrt{3} - i$ (allow decimals)   B1√

Multiply numerator and denominator of $\dfrac{u}{w}$ by $-1 - i\sqrt{3}$, or equivalent   M1

Obtain answer $\dfrac{u}{w} = \sqrt{3} - i$ (allow decimals)   A1

                                                                 [4]

 (ii) Show U on an Argand diagram correctly   B1
Show A and B in relatively correct positions   B1√

                                                                 [2]

 (iii) Prove that $AB = UA$ (or UB), or prove that angle AUB = angle ABU
(or angle BAU) or prove, for example, that $AO = OB$ and angle
$AOB = 120°$, or prove that one angle of triangle UAB equals 60°   B1
Complete a proof that triangle UAB is equilateral   B1

                                                                 [2]

6 (i) *EITHER* State or imply $f(x) \equiv \dfrac{A}{2x+1} + \dfrac{B}{x-2} + \dfrac{C}{(x-2)^2}$ B1

State or obtain $A = 1$ B1
State or obtain $C = 8$ B1
Use any relevant method to find B M1
Obtain value $B = 4$ A1

OR State or imply $f(x) \equiv \dfrac{A}{2x+1} + \dfrac{Dx+E}{(x-2)^2}$ B1

State or obtain $A = 1$ B1
Use any relevant method to find D or E M1
Obtain value $D = 4$ A1
Obtain value $E = 0$ A1

      [5]

(ii) *EITHER* Use correct method to obtain the first two terms of the
expansion of $(1 + 2x)^{-1}$ or $(x – 2)^{-1}$ or $(x - 2)^{-2}$ or $(1 - \frac{1}{2}x)^{-1}$ or $(1 - \frac{1}{2}x)^{-2}$ M1
Obtain any correct sum of unsimplified expansions up to the
terms in x^2 (deduct A1 for each incorrect expansion)   A2√
Obtain the given answer correctly   A1

[Unexpanded binomial coefficients involving -1 or -2, e.g. $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ are not

sufficient for the M1.]

[f.t. is on *A, B, C, D, E.*]

[Apply this scheme to attempts to expand $(9x^2 +4)(1+2x)^{-1}(x - 2)^{-2}$, giving
M1A2 for a correct product of expansions and A1 for multiplying out and
reaching the given answer correctly.]

[Allow attempts to multiply out $(1 + 2x)(x - 2)^2 (1 - x + 5x^2)$, giving B1 for
reduction to a product of two expressions correct up to their terms in x^2,
M1 for attempting to multiply out as far as terms in x^2, A1 for a correct
expansion, and A1 for obtaining $9x^2 + 4$ correctly.]

[SR: *B* or *C* omitted from the form of partial fractions. In part **(i)** give the first
B1, and M1 for the use of a relevant method to obtain *A, B,* or *C*, but no
further marks. In part **(ii)** only the M1 and A1√ for an unsimplified sum are
available.]

[SR: *E* omitted from the form of partial fractions. In part **(i)** give the first B1,
and M1 for the use of a relevant method to obtain *A* or *D*, but no further
marks. In part **(ii)** award M1A2√A1 as in the scheme.]

OR Differentiate and evaluate $f(0)$ and $f'(0)$ M1
Obtain $f(0) = 1$ and $f'(0) = -1$ A1
Differentiate and obtain $f''(0) = 10$ A1
Form the Maclaurin expansion and obtain the given answer correctly   A1

      [4]

7 (i) State or imply that $\dfrac{dx}{dt} = k\,(100 - x)$ B1

Justify k = 0.02   B1

[2]

(ii) Separate variables and attempt to integrate $\dfrac{1}{100-x}$ M1

Obtain term $-\ln(100 - x)$, or equivalent   A1
Obtain term $0.02t$, or equivalent   A1
Use x = 5, t = 0 to evaluate a constant, or as limits   M1
Obtain correct answer in any form, e.g. $-\ln(100 - x) = 0.02t - \ln 95$ A1
Rearrange to give x in terms of t in any correct form,
e.g. $x = 100 - 95\exp(-0.02t)$ A1

[6]

[SR: $\ln(100 - x)$ for $-\ln(100 - x)$. If no other error and $x = 100 - 95\exp(0.02t)$ or equivalent obtained, give M1A0A1M1A0A1√]

(iii) State that x tends to 100 as t becomes very large   B1

[1]

8 (i) State derivative $\dfrac{1}{x} - \dfrac{2}{x^2}$, or equivalent   B1

Equate 2-term derivative to zero and attempt to solve for x M1
Obtain coordinates of stationary point $(2, \ln 2 + 1)$, or equivalent   A1+A1
Determine by any method that it is a minimum point,
with no incorrect work seen   A1

[5]

(ii) State or imply the equation $\alpha = \dfrac{2}{3 - \ln\alpha}$ B1

Rearrange this as $3 = \ln\alpha + \dfrac{2}{\alpha}$ (or *vice versa*)   B1

[2]

(iii) Use the iterative formula correctly at least once   M1
Obtain final answer 0.56   A1
Show sufficient iterations to justify its accuracy to 2 d.p., or show
there is a sign change in the interval (0.555, 0.565)   A1

[3]

9 (i) State or imply a correct normal vector to either plane,
e.g. $\mathbf{i} + 2\mathbf{j} - 2\mathbf{k}$ or $2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$ B1
Carry out correct process for evaluating the scalar product of both
the normal vectors   M1
Using the correct process for the moduli, divide the scalar product
of the two normals by the product of their moduli and evaluate the
inverse cosine of the result   M1
Obtain answer 40.4° (or 40.3°) or 0.705 (or 0.704) radians   A1
[Allow the obtuse answer 139.6° or 2.44 radians]

[4]

(ii) *EITHER* Carry out a complete strategy for finding a point on l M1
Obtain such a point e.g. (0, 3, 2)   A1

     EITHER   Set up two equations for a direction vector
         $a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$ of l, e.g. $a + 2b - 2c = 0$
         and $2a - 3b + 6c = 0$ B1
         Solve for one ratio, e.g. $a:b$ M1
         Obtain $a:b:c$ = 6: -10: -7, or equivalent   A1
         State a correct answer, e.g. $\mathbf{r} = 3\mathbf{j} + 2\mathbf{k} + \lambda (6\mathbf{i} - 10\mathbf{j} - 7\mathbf{k})$ A1√
     OR   Obtain a second point on l, e.g. (6, -7, -5)   A1
         Subtract position vectors to obtain a direction vector for l M1
         Obtain $6\mathbf{i} - 10\mathbf{j} - 7\mathbf{k}$, or equivalent   A1
         State a correct answer, e.g. $\mathbf{r} = 3\mathbf{j} + 2\mathbf{k} + \lambda (6\mathbf{i} - 10\mathbf{j} - 7\mathbf{k})$ A1√
     OR   Attempt to find the vector product of the two normal vectors   M1
         Obtain two correct components   A1
         Obtain $6\mathbf{i} - 10\mathbf{j} - 7\mathbf{k}$, or equivalent   A1
         State a correct answer, e.g. $\mathbf{r} = 3\mathbf{j} + 2\mathbf{k} + \lambda (6\mathbf{i} - 10\mathbf{j} - 7\mathbf{k})$ A1√

    OR   Express one variable in terms of a second   M1
Obtain a correct simplified expression, e.g. $x = (9 - 3y)/5$ A1
Express the same variable in terms of the third and form
a three term equation   M1
Incorporate a correct simplified expression, e.g. $x = (12 - 6z)/7$
in this equation   A1
Form a vector equation for the line   M1

State a correct answer, e.g. $\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 3 \\ 2 \end{pmatrix} + \begin{pmatrix} 1 \\ -5/3 \\ -7/6 \end{pmatrix} \lambda$, or equivalent   A1√

    OR   Express one variable in terms of a second   M1
Obtain a correct simplified expression, e.g. $y = (9 - 5x)/3$ A1
Express the third variable in terms of the second   M1
Obtain a correct simplified expression, e.g. $z = (12 - 7x)/6$ A1
Form a vector equation for the line   M1

State a correct answer, e.g. $\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 3 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ -5/3 \\ -7/6 \end{pmatrix}$, or equivalent   A1√

                                                               [6]

10 (i) *EITHER* Make relevant use of the correct sin 2A formula   M1
           Make relevant use of the correct cos 2A formula   M1
           Derive the given result correctly   A1

     OR   Make relevant use of the tan 2A formula   M1
          Make relevant use of $1 + \tan^2 A = \sec^2 A$ or $\cos^2 A + \sin^2 A = 1$ M1
          Derive the given result correctly   A1

                                                               [3]

(ii) State or imply indefinite integral is ln sin *x*, or equivalent   B1
State correct limits correctly   M1
Obtain given exact answer correctly   A1

[3]

(iii) *EITHER* State indefinite integral of cos 2*x* is of the form *k* ln sin 2*x*   M1
State correct integral ½ ln sin 2*x*   A1
Substitute limits correctly throughout   M1
Obtain answer ¼ 1n 3, or equivalent   A1

    OR   State or obtain indefinite integral of cosec 2*x* is of the form *k* ln tan *x*,
or equivalent   M1
State correct integral ½ ln tan *x*, or equivalent   A1
Substitute limits correctly   M1
Obtain answer ¼ ln 3, or equivalent   A1

[4]

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/04

MATHEMATICS
Paper 4 (Mechanics 1)

Mechanics 1

1	(i)	Tension is 8000 N or 800g Accept 7840 N (from 9.8) or 7850 (from 9.81)	B1	1
	(ii)	For using $P = \dfrac{\Delta W}{\Delta t}$ or $P = Tv$	M1	
		$\Delta W = 8000 \times 20$ or $v = \dfrac{20}{50}$	A1 ft	
		Power applied is 3200 W Accept 3140 W (from 9.8 or 9.81)	A1	3
		SR (for candidates who omit g) (Max 2 out of 3) P = 800 $\times$ 20 $\div$ 50 B1 Power applied is 320 W B1		
2	(i) (a)	For resolving in the direction PQ	M1	
		Component is 2 x 10cos30^o – 6cos60^o or 14.3 N or $10\sqrt{3} - 3$ N	A1	2
	(b)	Component is $\pm$ 6cos30^o – 6cos60^o or $\pm$ 5.20 N or $\pm 3\sqrt{3}$ N	B1	1
		SR (for candidates who resolve parallel to and perpendicular to the force of magnitude 6 N) (Max 2 out of 3) For resolving in both directions M1 For X = 6 – 10cos 30° or –2.66 N and Y = 10 + 10sin 30° or 15 N A1 **SR** (for candidates who give a combined answer for **(a)** and **(b)**) (Max 2 out of 3) For resolving in both directions M1 For (6cos30^o)**i** + (2 x10cos30^o – 6cos60^o)**j** or any vector equivalent A1		
	(ii)	For using Magnitude = $\sqrt{ans(i)^2 + ans(ii)^2}$	M1	
		Magnitude is 15.2 N ft only following sin/cos mix and for answer 5.66 N	A1 ft	2
3	(i)	Region under $v = 2t$ from t = 0 to t = T indicated	B1	1
	(ii)	For attempting to set up and solve an equation using area Δ = 16 or for using $s = \frac{1}{2} 2t^2$	M1	
		For 16 = $\frac{1}{2} 2T^2$	A1	
		$T = 4$	A1	3
		SR (for candidates who find the height of the Δ but do not score M1) (Max 1 out of 3) For h/T = 2 or h = 2T or v = 8 B1		

	(iii)	For using distance = 10 $\times$ ans **(ii)** or for using the idea that the distance is represented by the area of the relevant parallelogram or by the area of the trapezium (with parallel sides 9 and 4 and height 10) minus the area of the triangle (with base 5 and height 10)	M1	
		Distance is 40m	A1 ft	2
4	**(i)**	For differentiating *x*	M1	
		$\dot{x} = t + \dfrac{1}{10}t^2$	A1	
		Speed is 20 ms^{-1}	A1	3
	(ii)	$\ddot{x} = 1 + \dfrac{1}{5}t$	B1 ft	
		For attempting to solve $\ddot{x}(t) = 2\ddot{x}(0)$ $(1 + \dfrac{1}{5}t = 2)$	M1	
		$t = 5$	A1	3
5	**(i)**	For resolving forces on any two of *A*, or *B*, or *A* and *B* combined ($T_1 = W_A + T_2, T_2 = W_B, T_1 = W_A + W_B$)	M1	
		Tension in S_1 is 4 N or Tension in S_2 is 2 N Accept 0.4*g* or 3.92 (from 9.8 or 9.81) for T_1 Tension in S_2 is 2 N or Tension in S_1 is 4 N Accept 0.2*g* or 1.96 (from 9.8 or 9.81) for T_2 **SR** (for candidates who omit g) (Max 1 out of 3) $T_1 = 0.4$ and $T_2 = 0.2$ B1	B1 A1	3
	(ii)	For applying Newton's second law to *A*, or to *B*, or to *A* and *B* combined	M1	
		For any one of the equations $T + 2 – 0.4 = 0.2a$, $2 – T – 0.2 = 0.2a$, $4 – 0.4 – 0.2 = 0.4a$	A1	
		For a second of the above equations	A1	
		For solving the simultaneous equations for *a* and *T*	M1	
		Acceleration is 8.5 ms^{-2}, tension is 0.1 N Accept 8.3 from 9.8 or 8.31 from 9.81 **SR** (for candidates who obtain only the 'combined' equation) (Max 3 out of 5) For applying Newton's second law to *A* and *B* combined M1 For $4 – 0.4 – 0.2 = 0.4a$ A1 Acceleration is 8.5 ms^{-2} A1	A1	5

6	**(i)**	For using $F = \mu R$ and $R = mg$ $(F = 0.025 \times 0.15 \times 10)$	M1	
		Frictional force is 0.0375 N or 3/80 N Accept 0.0368 from 9.8 or 9.81	A1	2
	(ii)	For using $F = ma$ (-0.0375 = 0.15a) or $d = \mu g$	M1	
		Deceleration is 0.25 ms^{-2} (or $a = -0.25$) A.G.	A1	2
	(iii)	For using $s = ut + \frac{1}{2}at^2$ $(s = 5.5 \times 4 + \frac{1}{2}(-0.25)16)$	M1	
		Distance AB is 20m	A1	2
	(iv)	For using $v^2 = u^2 + 2as$ $(v^2 = 3.5^2 - 2 \times 0.25 \times 20)$	M1	
		Speed is 1.5 ms^{-1} (ft $\sqrt{(24.5 - (iii))/2}$)	A1 ft	2
	(v)	Return dist. $= \dfrac{3.5^2}{2 \times 0.25}$ or distance beyond $A = \dfrac{(iv)^2}{2 \times 0.25}$	M1	
		Total distance is 44.5 m (ft 24.5 + **(iii)** or 2((**iv**)^2 + **(iii)**))	A1 ft	2
7	**(i)**	PE gain = $mg(2.5\sin 60^\circ)$	B1	
		For using KE = ½ mv^2	M1	
		For using the principle of conservation of energy (½ $m8^2$ - ½ mv^2 = $mg(2.5\sin 60^\circ)$)	M1	
		Alternative for the above 3 marks: For using Newton's Second Law or stating $a = -g\sin 60^0$ $a = -8.66$ (may be implied) For using $v^2 = u^2 + 2as$ $(v^2 = 64 - 2 \times 8.66 \times 2.5)$	M1* A1 M1dep*	
		Speed is 4.55 ms^{-1} Accept 4.64 from 9.8 or 9.81	A1	4
	(ii)	For using ½ mu^2 (>) $mg\,h_{max}$ (½ 8^2 > 10 h_{max})	M1	
		For obtaining 3.2m A.G.	A1	2
	(iii)	Energy is conserved or absence of friction or curve BC is smooth (or equivalent) and B and C are at the same height or the PE is the same at A and B (or equivalent)	B1	1

(iv)	WD against friction is 1.4×5.2	B1	
	For WD = KE loss (or equivalent) used	M1	
	$1.4 \times 5.2 = \dfrac{1}{2} 0.4(8^2 - v^2)$ or $1.4 \times 5.2 = \dfrac{1}{2} 0.4((i)^2 - v^2) + 0.4 \times 10(2.5\sin 60°)$ (12.8 or 4.14 + 8.66)	A1	
	Alternative for the above 3 marks: For using Newton's Second Law $0.4g(2.5\sin 60^o \div 5.2) - 1.4 = 0.4a$ $\quad$ ($a = 0.6636$) For using $v^2 = u^2 + 2as$ with u $\neq$ 0 $(v^2 = 4.55^2 + 2 \times 0.6636 \times 5.2)$	M1* A1 M1dep*	
	Speed is 5.25 ms^{-1}	A1	4

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/05, 8719/05

MATHEMATICS AND HIGHER MATHEMATICS
Paper 5 (Mechanics 2)

Mechanics 2

1 The distance from the centre to the rod is $\sqrt{25^2 - 24^2}$ B1

For taking moments about the centre of the ring or about
the mid-point of the rod, or C.O.M. of frame
(correct number of terms required in equation)   M1

$(1.5 + 0.6)\bar{x} = 0.6 \times 7$ or $(1.5 + 0.6)(7 - \bar{x}) = 1.5 \times 7$
$1.5\bar{x} = 0.6(7 - \bar{x})$ A1

Distance is 2cm   A1
SR Allow M1 for $48.7 = (50\pi + 48)\bar{x}$

4

2 (i) $OQ = 4\tan 20^o$ (=1.456)   B1

$OG = 1.5$ B1

G not between O and Q (all calculations correct)   B1

3

(ii) Hemisphere does not fall on to its plane face   *B1 ft

Because the moment about P is clockwise or
the centre of mass is to right of PQ (dep)* B1 ft

2

3 (i) Rope is at 30° to wall, or beam is at 0° to the horizontal
or a correct trig. ratio used   B1

For taking moments about A or
For taking moments about P and resolving horizontally   M1

$2.5T = 45g \times 3\cos 30^o$ or
$5H = 45g \times 3\cos 30°$ and $H = T\sin 30°$ A1 ft

Tension is 468 N   A1

4

(ii) Horizontal component is 234 N   (ft ½ T)   B1 ft

For resolving forces vertically ($V = 45g - T\cos 30^o$)   M1

Magnitude of vertical component is 45 N   A1 ft
SR angle incorrect **(i)** B0, M1, A1 ft A0, **(ii)** B1 ft (T and angle), M1, A0

3

4 **(i)** For using Newton's second law with $a = v\dfrac{dv}{dx}$ M1

$-\dfrac{1}{3v} = 0.2v\dfrac{dv}{dx}$ A1

$3v^2\dfrac{dv}{dx} = -5$ from correct working   A1

           3

(ii) For separating the variables and attempting to integrate   M1

$v^3 = (A) - 5x$ A1

For using $x = 0$ and $v = 4$ to find A, and then substituting
$x = 7.4$ (or equivalent using limits)   M1

$v = 3$ A1

           4

5 **(i)** For resolving forces vertically (3 term equation)   M1

$T\cos 60^0 + 0.5 \times 10 = 8$ A1

Tension is 6 N   A1

           3

(ii) Radius of circle is $9\sin 60°$ (7.7942)   B1

For using Newton's second law horizontally with $a = \dfrac{v^2}{r}$ M1

$6\sin 60° = 0.5\dfrac{v^2}{(9\sin 60°)}$ A1 ft

Alternative for the above 2 marks:

For using Newton's second law perpendicular to the string with $a = \dfrac{v^2}{r}$ M1

$(8 - 0.5 \times 10)\sin 60° = 0.5\dfrac{v^2}{(9\sin 60°)}\cos 60°$ A1 ft

Speed is 9 ms^{-1} A1

           4

NB Use of $mr\omega^2$, the M1 is withheld until $v = r\omega$ is used
SR Lift perpendicular to the string:
(i) $8\sin 60° = 0.5g + T\cos 60° \rightarrow T = 3.86$: M1, A1, A1 (-1 MR) (2 out of 3 max);

(ii) $3.86\sin 60° + 8\cos 60° = \dfrac{0.5v^2}{9\sin 60°}$: B1, M1, A1√, A1 (-1 MR) (3 out of 4 max)

$\Rightarrow \underline{10}.7$

6 **(i)** For using $y = \dot{y}_0 t - \frac{1}{2}gt^2$ with $y = 0$ and $t = 10$ or

$\dot{y} = \dot{y}_0 - gt$ with $\dot{y} = 0$ and $t = 5$ M1

$0 = 60\sin\alpha \times 10 - \frac{1}{2} \times 10 \times 10^2$ or $0 = 60\sin\alpha - 10 \times 5$ A1

$\alpha = 56.4°$ A1

     3

(ii) For substituting $t = 5$ into $y = \dot{y}_0 t - \frac{1}{2}gt^2$ or $\dot{y} = 0$ into

$\dot{y}^2 = \dot{y}_0^2 - 2gy$ or $\dot{y} = 0$ and $t = 5$ into $y = \frac{\dot{y}_0 + \dot{y}}{2}t$ M1

Greatest height is 125m   A1

     2

(iii) $\dot{y} = 60\sin\alpha - gT$ B1

$\dot{x} = 60\cos\alpha$ B1

For attempting to solve $\dot{x} = \dot{y}$, or a complete method
for an equation in T using $\dot{x} = \dot{y}$ M1

$T = 1.68$ A1

     4

NB. Use of $\dot{y}_0 = 60$ in **(i)** and **(ii)** is M0

7 **(i)** For using $T = \dfrac{\lambda x}{L}$ ($\dfrac{130 \times 3}{10}$ or $\dfrac{130 \times 1.5}{5}$)   M1

Tension is 39 N   A1

     2

(ii) For resolving forces vertically (mg = 2 x 39 x $\dfrac{5}{13}$)   M1

Mass is 3kg   A1

     2

(iii) Extension = 20 - 10 (or 10 - 5)   B1

For using EPE = $\dfrac{\lambda x^2}{2L}$

(L must be 10 or 5; must be attempt at extension, e.g. x = 20 or
x = 8 - 2.5 is M0)

[EPE = $\dfrac{130 \times 10^2}{2 \times 10}$ or EPE = 2 x $\dfrac{130 \times 5^2}{2 \times 5}$]

(Allow M1 only for x = 2 or 3)   M1

EPE is 650 J (ft attempted extension in lowest position)   A1 ft

     3

(iv) Change in GPE = 3 x 10 x 8   B1 ft

For using the principle of conservation of energy with
KE, GPE and EPE all represented   M1

650 = ½3v^2 + 3 x 10 x 8 + $\dfrac{130 \times 2^2}{2 \times 10}$ A1 ft

Speed is 16 ms^{-1} A1

     4

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE A AND AS LEVEL
AICE

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/06, 0390/06

MATHEMATICS
Paper 6 (Probability and Statistics 1)

1	**(i)**	False zero	B1	**1**	Or any sensible answer

	(ii)	**(a)** Stem Leaf
		    3 45
		    4 145
		    5 02
		    6 2
		    7 339
		    8 344556679
		    9 1
		
		Key 3│4 rep 34, or stem width = 10
			B1
			B1
			
			B1
				
				3
					For correct stem, i.e. not 30, 40, 50 etc.
					For correct leaf, must be sorted
					
					For key, NB 30│4 rep 34 gets B1 here

		(b) 79	B1 ft	**1**	For correct answer, only ft from a sorted stem and leaf diagram

2	**(i)**	$P(N, \overline{N}) = \dfrac{3}{10} \times \dfrac{7}{9}$
		Mult. By 2 = 7/15 **AG**
		
		OR Total ways $_{10}C_2$ (= 45)
		    Total 1 of each
		      $_7C_1 \times {_3}C_1$ (= 21)
		    Prob = 21/45 = 7/15 **AG**
			M1
			
			A1
			
			M1
			
			A1
				
				2
				
				2
					For multiplying 2 relevant possibilities
					For obtaining given answer legitimately
					
					For both totals
					
					For obtaining correct answer

	(ii)	$P(N, N) - 3/10 \times 2/9$ (= 1/15) $P(\overline{N}, \overline{N}) = 7/10 \times 6/9$ (= 7/15) $\begin{array}{c\|ccc} x & 0 & 1 & 2 \\ \hline P(X=x) & 7/15 & 7/15 & 7/15 \end{array}$	M1 M1 B1	 **3**	For 2 correct numbers multiplied together, can be implied For 2 correct numbers multiplied together or subtracting from 1 All correct. Table correct and no working gets 3/3
	(iii)	$E(X) = 1 \times 7/15 + 2 \times 1/15$ = 3/5	B1 ft	**1**	For correct answer or equivalent. Only ft if $\sum p = 1$
3	**(i)**	$P(X > 120)$ $= 1 - \Phi\left(\dfrac{120-112}{17.2}\right)$ $= 1 - \Phi(0.4651)$ $= 1 - 0.6790 = 0.321$	 M1 M1 A1	 **3**	For standardising with or without the $\sqrt{}$, 17.2^2, but no cc. For finding the correct area, 1 – their $\Phi(z)$, NOT $\Phi(1 -$ their $z(0.4651))$ For correct answer

	(ii)	$z = -0.842$ $-0.842 = \dfrac{103 - 115}{\sigma}$	B1 M1		For z, ± 0.842 or ± 0.84 For solving an equation involving their z or $z = 0.7881$ or 0.5793 only, 103, 115 and σ or $\sqrt{\sigma}$ or σ^2, i.e. must have used tables
		$\sigma = 14.3$	A1	3	For correct answer
4	(i)	$(0.7)^{24}$ x $(0.3)^6$ x $_{30}C_{24}$	M1		For relevant binomial calculation
		$= 0.0829$	A1	2	For correct answer
		OR normal approx. $P(24) = \Phi((24.5 - 21)/\sqrt{6.3}))$ $- \Phi((23.5 - 21)/\sqrt{6.3}))$	M1		For subtracting the 2 phi values as written
		$= 0.9183 - 0.8404 = 0.0779$	A1	2	For correct answer
	(ii)	$\mu = 30$ x $0.7 = 21$, $\sigma^2 = 30$ x 0.7 x $0.3 = 6.3$	B1		For 21 and 6.3 seen
		$P(< 20) = \Phi\left(\dfrac{19.5 - 21}{\sqrt{6.3}}\right) =$ $\Phi(-0.5976)$	M1 M1 M1		For standardising process, must have $\sqrt{}$, can be + or – For continuity correction 19.5 or 20.5 For using 1 - some area found from tables
		$= 1 - 0.7251 = 0.275$	A1	5	For correct answer
5	(i)	$_6C_3$ x $_4C_2 = 120$	M1		For multiplying 2 combinations together, not adding, no perms, $_{10}C_3$ x $_{10}C_2$ or $_5C_3$ x $_5C_2$ would get M1
			A1	2	For answer 120
	(ii)	$_6C_4$ x $_4C_1$ $(= 60)$	M1		For reasonable attempt on option 4M 1W, or 5M, 0W, can have + here and perms
		$_6C_5$ x $_4C_0$ $(= 6)$	M1		For other option attempt
		Answer $= 186$	A1	3	For correct answer
	(iii)	Man and woman both on $_5C_2$ x $_3C_1$ $(= 30)$	M1		For finding number of ways of the man and woman being on together, need not be evaluated but must be multiplied
		$120 - 30 = 90$	M1		For subtracting a relevant number from their **(i)**
			A1	3	For correct answer

		OR $_5C_2$ x $_3C_2$ (= 30)	M1		Any 2 of man in, woman out
		$_3C_1$ x $_5C_3$ (= 30)	M1		Woman in, man out
		$_5C_3$ x $_3C_2$ (= 30)			Neither in
		$\sum$ = 90	A1	**3**	
		OR $_3C_1$ x $_5C_3$ (= 30)	M1		Woman in, man out
		$_3C_2$ x $_6C_3$ (= 60)	M1		Woman out, any man
		$\sum$ = 90	A1	**3**	For correct answer
		OR $_5C_2$ x $_3C_2$ (= 30)	M1		Man in, woman out
		$_5C_3$ x $_4C_2$ (= 60)	M1		Man out, any woman
		$\sum$ = 90	A1	**3**	For correct answer
6	**(i)**	P(*G*) = number of g'parents/total people	M1		For appreciating total g'parents/total people, can be implied
		= 6/16 = 3/8	A1	**2**	For correct answer
	(ii)	P(H1, *G*)+P(H2, *G*)+P(H3, *G*)	B1		For any correct 2-factor product, need not be evaluated
		$=\dfrac{1}{3}\times\dfrac{2}{7}+\dfrac{1}{3}\times\dfrac{3}{7}+\dfrac{1}{3}\times\dfrac{1}{2}=\dfrac{17}{42}$			
		(= 0.405)	M1		For addition of 3 relevant 2-factor products
			A1	**3**	For correct answer or equivalent
	(iii)	P(H1$\mid$*G*) + P(H2$\mid$*G*)	M1		For summing exactly 2 probability options
		$=\dfrac{2/21}{17/42}+\dfrac{3/21}{17/42}=\dfrac{10}{17}$	M1		For dividing by answer to **(ii)**, only if not multiplied as well, and p must be < 1
			A1		For one correct probability
			A1	**4**	For correct answer or equivalent
		OR P(H3$\mid$*G*) = 7/17	M1		For finding prob. options no parents
		Answer = 1 - 7/17	M1		For subt. from 1
		= 10/17	A2		For correct answer
7	**(i)**		M1		For using their mid-intervals (not end points or class widths)
		Mean = (2.5 x 11 + 7.5 x 20 + 15 x 32 + 25 x 18 + 35 x 10 + 55 x 6)/97 = 18.4	M1		For using $\dfrac{\sum fx^2}{\sum f}$ any *x*
			A1		For correct answer, cwo, 18.4 no wkg 3/3

		sd = $\sqrt{}$ (2.5^2 x 11 + 7.5^2 x 20 + 15^2 x 32 + 25^2 x 18 + 35^2 x 10 + 55^2 x 6)/97 - mean^2) = 13.3	M1 A1	 **5**	For using $\dfrac{\sum fx^2}{\sum f}$ - (their mean)^2 or equivalent, no $\sqrt{}$ needed, not $(\sum fx)^2/\sum f$ For correct answer
	(ii)	Freq. densities: 2.2, 4.0, 3.2, 1.8, 1.0, 0.2 	M1 A1 B1 B1	 **4**	For attempting a frequency density of some sort (or scaled frequency), can be upside down but not multiplied For correct heights on the graph For correct bars on uniform horiz. scale, i.e. from 0 to 5 etc. Freq. density or scaled freq. labelled on vertical axis, time or mins on horiz., 'class width' is not enough

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/07, 8719/07

MATHEMATICS AND HIGHER MATHEMATICS
Paper 7 (Probability and Statistics 2)

1 (i) 2.5   1.25 — B1 B1 **2** — For correct mean. For correct variance

(ii) 5   5 — B1ft B1ft **2** — For correct mean. For correct variance

2 $H_0 : p = 0.6$ $H_1 : p > 0.6$ — B1 — For correct H_0 and H_1

$P(X \geq 10) = {}_{12}C_{10}0.6^{10}0.4^2 +$
${}_{12}C_{11}0.6^{11}0.4^1 + 0.6^{12}$
$= 0.0834$

M1* — For one Bin term (n = 12, p = 0.6)
M1*dep — For attempt X = 10, 11, 12 or equiv.
A1 — For correct answer (or correct individual terms and dig showing 0.1)

Reject H_0, i.e. accept claim at 10% level — B1ft **5** — For correct conclusion

S.R. Use of Normal scores 4/5 max — B1 — For correct H_0 and H_1

$z = \dfrac{9.5 - 7.2}{\sqrt{2.88}}$

(or equiv. Using N(0.6, 0.24/12))
= 1.3552 — M1 — Use of N(7.2, 2.88) or N(0.6, 0.24/12) and standardising with or without cc

Pr(>9.5) = 1 – 0.9123 = 0.0877 — A1 — For correct answer or 1.3552 and 1.282 seen
Reject H_0, i.e. accept claim at 10% level — B1ft — For correct conclusion

3 (i) $31 \pm 2.326 \times \dfrac{3}{\sqrt{20}}$ — B1 — For correct mean

= (29.4, 32.6) — M1 — Calculation of correct form

$\bar{x} \pm z \times \dfrac{s}{\sqrt{n}}$

(must have $\sqrt{n}$ in denominator)

B1 — $z = 2.326$
A1 **4** — Correct answer

(ii) 30% is inside interval — ftB1*
Accept claim (at 2% level) — ftB1*dep **2** — S.R. Solutions not using (i) score B1ft only for correct working and conclusion

4 (i) $P(X > 1.5) = \left[x - \dfrac{x^2}{4} \right]_{1.5}^{2}$ — M1 — For substituting 2 and 1.5 in their $\int f(x)dx$ (or area method ½ their base x their height)

or $1 - \left[x - \dfrac{x^2}{4} \right]_{.0}^{1.5}$

= 0.0625 — A1 **2** — For correct answer

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(ii) $E(X) =$

$$\int_0^2 (x - \frac{1}{2}x^2)dx = \left[\frac{x^2}{2} - \frac{x^3}{6}\right]_0^2 \qquad \text{M1} \qquad \text{For evaluating their } \int xf(x)dx$$

$= 2/3$ A1   **2**   For correct answer

(iii) $m - \frac{m^2}{4} = 0.5$ M1   For equating their $\int f(x)dx$ to 0.5

   M1   For solving the related quadratic

$m = 0.586 \ (2-\sqrt{2})$ A1   **3**   For correct answer

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5 (i) $P(X < 1.7) = \Phi\left(\frac{1.7 - 2.1}{0.9/\sqrt{20}}\right)$ B1   For identifying prob Type I error

   M1   For standardising

$= 1 - \Phi(1.9876)$ A1   For correct standardising and correct area

$= 0.0234$ A1   **4**   For correct final answer

(ii) $P(\text{Type II error}) = P(X > 1.7)$ B1   For identifying prob for Type II error

$= 1 - \Phi\left(\frac{1.7 - 1.5}{0.9/\sqrt{20}}\right)$ M1   For standardising using 1.5 and their 1.7

   A1   For correct standardising and correct area

$= 1 - \Phi(0.9938) = 0.160$ A1   **4**   For correct final answer

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6 (i) $\lambda = 1.25$ M1   For attempting to find new λ and using it

$P(X < 4) =$

$e^{-1.25}\left(1 + 1.25 + \frac{1.25^2}{2} + \frac{1.25^3}{6}\right)$ M1   For summing P((0,) 1, 2, 3) or P(0, 1, 2, 3, 4) using a Poisson expression

$= 0.962$ A1   **3**   For correct answer

(ii) $X \sim N(182.5, 182.5)$ B1   For correct mean and variance

$P(> 200 \text{ breakdowns}) =$ M1   For standardising process with or without continuity correction

$1 - \Phi\left(\frac{200.5 - 182.5}{\sqrt{182.5}}\right)$

$= 1 - \Phi(1.332)$ A1ft   For correct standardising and correct tail

$= 0.0915 \ (0.0914)$ A1   **4**   For correct answer

(iii) $\lambda = 5$ for phone calls   B1

$\lambda = 6.25$ for total

$P(X = 4) = e^{-6.25}\left(\frac{6.25^4}{4!}\right)$ M1   For summing their two λs and using a Poisson expression OR alt. method using sep. distributions 5 terms req.

$= 0.123$ A1   **3**   For correct answer

7 (i) 20 of $A \sim A^*$
$\sim N(401, 20 \times 0.15^2)$ B1   For correct mean for either
$\sim N(401, 0.45)$
20 of $B \sim B^* \sim N(401, 1.458)$ B1   For variance 20×0.15^2 or 20×0.27^2

$A^* - B^* \sim N(0, 1.908)$ M1   For adding their two variances

$P(A^* - B^* > 2)$

$= 1 - \Phi\left(\dfrac{2-0}{\sqrt{1.908}}\right)$ M1   For consideration of their $A^* - B^* > 2$

$= 1 - \Phi(1.4479)$ M1   For standardising and finding correct area

$= 0.0738$ A1   **6**   For correct answer

OR $\overline{A} \sim N(20.05, 0.15^2/20)$,
$\overline{B} \sim N(20.05, 0.27^2/20)$ B1   For correct mean for either
   B1   For variance $0.15^2/20$ or $0.27^2/20$
$\overline{A} - \overline{B} \sim N(0, 0.00477)$ M1   For adding their variances

$P(\overline{A} - \overline{B} > 0.1)$ M1   For consideration of their $\overline{A} - \overline{B} > 0.1$

$= 1 - \Phi\left(\dfrac{0.1-0}{\sqrt{0.00477}}\right)$ M1   For standardising and finding correct area

$= 0.0738$ A1   **6**   For correct answer

(ii) $1.96 = \dfrac{20.07 - 20.05}{(0.15/\sqrt{n})}$ M1   For an equation of correct form on RHS involving $\sqrt{n}$

   B1   For 1.96 used
   M1   For solving an equation of correct form (any z)

$n = 216$ A1   **4**   For correct answer