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 Accuracy 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 is used to indicate that a particular M or B mark is dependent on an earlier M or B 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 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 are misread. 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.
- 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. The PA–1 penalty is usually discussed at the meeting.
- S–1 Occasionally used for persistent slackness – usually discussed at the meeting.
- EX–1 Applied to A or B marks when extra solutions are offered to a particular equation. Again this is usually discussed at the meeting.

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

JUNE 2002

INTERNATIONAL GCSE

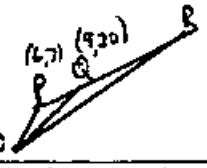
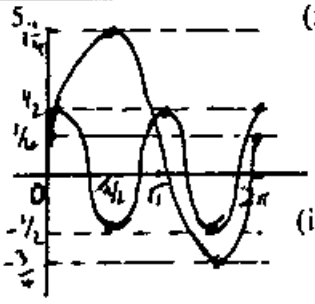
MARK SCHEME

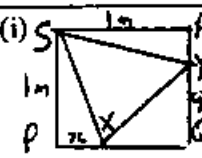
MAXIMUM MARK : 80

SYLLABUS/COMPONENT : 0606/1

ADDITIONAL MATHEMATICS

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

1.	$y+2x=7$ Complete elimination $y^2=xy-1$ of x or y. $\rightarrow 3y^2-7y+2=0$ or $6x^2-35x+50=0$ Solution $\rightarrow \quad (3\frac{1}{3}, \frac{1}{3})$ and $(2\frac{1}{2}, 2)$	M1 A1 DM1 A1 4	Either x or y must be completely removed Any multiple of this – needn't be =0. Correct method of solution – see end. All correct. (not 0.34)
2.	Attempts to integrate $\rightarrow \frac{1}{4}e^{4x} - e^{-x}$ Uses (0,3) to find C $\quad C = 3\frac{3}{4}$	B1 B1 M1 A1 4	Co. Needs to bring in the constant in an integrated expression. All correct.
3.	$\sqrt{18} = 3\sqrt{2} \quad 4\div\sqrt{2} = 2\sqrt{2}$ (i) $A = (2+3\sqrt{2})(5-2\sqrt{2}) = -2+11\sqrt{2}$ (ii) $D^2 = (4+12\sqrt{2}+18)+(25-20\sqrt{2}+8)$ $= 55 - 8\sqrt{2}$ $(A=10+5\sqrt{18} - 8\div\sqrt{2} - 12)$ still needs 1st two steps	M1 M1 A1 M1 A1 5	Anywhere. $4\div\sqrt{2}$ could be $8\div\sqrt{2}$ if multiplying first. Correct only. Reasonable squaring with Pythagoras. Correct only. Decimal work gets no credit anywhere. Possible to get 4 marks on (ii) alone.
4.	$\overrightarrow{PQ} = \begin{pmatrix}3\\13\end{pmatrix}$ $\overrightarrow{OR} = \overrightarrow{OQ}+\overrightarrow{QR} = \overrightarrow{OQ}+4\overrightarrow{PQ} = \begin{pmatrix}21\\72\end{pmatrix}$ (or $= \overrightarrow{OP}+\overrightarrow{PR} = \overrightarrow{OP}+5\overrightarrow{PQ} = \begin{pmatrix}21\\72\end{pmatrix}$ [or $\overrightarrow{OQ}=\frac{1}{5}(4\overrightarrow{OP}+\overrightarrow{OR}) \Rightarrow \overrightarrow{OR}=5\overrightarrow{OQ}-4\overrightarrow{OP}$ $= \begin{pmatrix}45\\100\end{pmatrix} - \begin{pmatrix}24\\28\end{pmatrix} = \begin{pmatrix}21\\72\end{pmatrix}$ $\lvert OR\rvert = \sqrt{[21^2+72^2]}$ Unit vector $= \frac{1}{75}\begin{pmatrix}21\\72\end{pmatrix}$ 	B1 M1 A1 [or M1 A2] M1 A1√ 5	Correct only. nb i,j throughout is ok. Complete method for M. A mark co. A1 for 5OQ-4OP co. Completely correct method. Follow through directly on his OR.
5.	 (i) Graph of $y=\frac{1}{2}\cos 2x$ Graph of $y=\frac{1}{4}+\sin x$ (ii) Equate the y's $\frac{1}{2}\cos 2x = \frac{1}{4}+\sin x$ $\rightarrow \quad 2\cos 2x = 1+4\sin x$ $\rightarrow \quad k = 4$	B2,1 B2,1 M1 A1 6	B0 unless 2 full cycles. Starts and finishes at max. $\pm\frac{1}{2}$ shown somewhere. B0 unless 1 full cycle. Starts and ends above the origin. $1\frac{1}{4}$ and $-\frac{3}{4}$ shown. Independent of graphs. For stating only. Could find x-value from accurate graph and substitute. (not from sketch) Correct only.

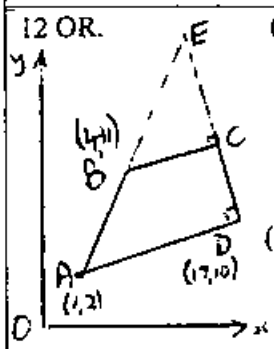
6. (a) Number = $5 \times 5!$ or $\frac{5}{6}$ of $6!$ = 600	M1A1	Correct method.
(b) Total = 9C4 = (126) Total with no women = 5C4 = 5 → Number of ways = 126 – 5 = 121	M1 B1 M1A1	No need for 126. Needs one step past 9C4 Needs 5. For "Total – 0 women". Ind of 1stM.
(or Ways with 1W 3M = 4C1×5C3 = 4 × 10 = 40 Ways with 2W 2M = 4C2×5C2 = 6 × 10 = 60 Ways with 3W 1M = 4C3×5C1 = 4 × 5 = 20 Ways with 4W = 1. ⇒Total = 121.)	or M1 B1 M1A1 6	For 1W,3M or 2W 2M or 3W,1M Needs one product of 2 nCr's. For 1.. Adding 4(or 3) events. Correct only.
7.(i) $(2-x^2)^5 = 2^5 + 5\times2^4(-x^2) + 10\times2^3\times(-x^2)^2$ etc Powers of 2 and $(\pm x^2)$ more or less correct. Binomial coefficients used correctly. → $32 - 80x^2 + 80x^4 - 40x^6 + 10x^8 - x^{10}$	M1 M1 A1	Correct use of powers – even if no (–)s. Correct use of binomial coeffs. All correct.
(ii) $(1 + x^2)^2 = 1 + 2x^2 + x^4$ Attempt to multiply and pick out 3 terms → $(-40 + 160 - 80)\,x^6 \Rightarrow 40$	B1 M1 A1 6	Independent of anything else. Reasonable attempt with 3 terms. Correct only.
8. (i)  $\Delta SRY = \frac{1}{2}\times1\times(1-qx)$ $\Delta = \frac{1}{2}\times qx\times(1-x)$ $A = 1 - \frac{1}{2}x - \Delta SRY - \Delta XYQ$ $= \frac{1}{2}(1 - x + qx^2)$	B1 B1 M1	Correct only – unsimplified Correct only – unsimplified For "square – 3 triangles" attempted No A mark since answer given.
(ii) $dA/dx = \frac{1}{2}(-1 + 2qx)$ $= 0$ when $qx = \frac{1}{2}$ ie QY = YR Minimum $A = \frac{1}{2}(1 - 1/(2q) + q/(4q^2))$ $= \frac{1}{2} - \frac{1}{8q}$	M1 DM1 A1 B1 7	Attempt at differentiation. Putting his differential to 0. Beware fortuitous answers – ans given. Correct only – any unsimplified form ok.
9. (i) $d/dx(\sqrt{(2x+5)} = \frac{1}{2}\times(2x+5)^{-\frac{1}{2}}\times2$ $dy/dx = \sqrt{(2x+5)} + (x-5)\times$ "above ans" → $k = 3$	M1 M1 A1 A1	Must have "×2" – ie fn of a fn. Must use product rule correctly – M mark is independent of first M mark.
(ii) $\delta y \approx [dy/dx]_{x=10}\times\delta x = \pm 6p$	M1A1√	Needs numerical dy/dx - $\delta x = \pm p$, not 10-p for the M mark.
(iii) $dy/dt = dy/dx \times dx/dt$ $\Rightarrow 3 = 6\,dx/dt$ $dx/dt = 0.5$ unit/s	M1 A1 8	Use of chain rule – must be for 3÷dy/dx. Correct only. Ignore units.
10. (i) $\begin{pmatrix}50 & 75 & 100\end{pmatrix}\times\begin{pmatrix}400 & 0 & 400 & 500 & 600\\ 300 & 0 & 0 & 300 & 600\\ 400 & 600 & 600 & 0 & 400\end{pmatrix}$	M1 A1	Could also be (5×3) × (3×1) . Must be compatible but needn't be in correct order.
$\begin{pmatrix}400 & 0 & 400 & 500 & 600\\ 300 & 0 & 0 & 300 & 600\\ 400 & 600 & 600 & 0 & 400\end{pmatrix}\times\begin{pmatrix}13\\7\\10\\5\\8\end{pmatrix} = \begin{pmatrix}16500\\10200\\18600\end{pmatrix}$	M1A1 B1	Could also be (1×5) × (5×3) ie (16500 10200 18600). Order needed for M. Allow B1 for arithmetic or wrong order..
(iii) $\begin{pmatrix}2.10 & 3.00 & 3.75\end{pmatrix}\begin{pmatrix}16500\\10200\\18600\end{pmatrix} = \$135\,000$	M1A1√ B1 8	Could be $\begin{pmatrix}16500 & 10200 & 18600\end{pmatrix}\times\begin{pmatrix}2.10\\3.00\\3.75\end{pmatrix}$ B mark anyhow.

11. $2x^2 - 8x + 5 \equiv 2(x-2)^2 - 3$	3× B1	B1 a=2 B1 for –2 in bracket. B1 for –3.
(i) Domain $0 \le x \le 5$ Range of f is -3 to 15.	B1B1√	B1 for 15. B1√ for bottom limit of "c".
(ii) f is not 1 to 1.	B1√	Correct explanation for his values.
(iii) k = x-value corr to min g = "–b" → k=2	B1√	k = "his –b".
(iv) Put $y=2(x-2)^2-3$ and make x the subject. Replace x by y → $g^{-1} = \sqrt{\frac{x+3}{2}} + 2$. (or reverse order ie +3, ÷2, √, +2)	M1 M1 A1 10	Knows what to do Reasonable order of operations Co
12. EITHER (a) $27=a\times2.25^n$ or $\lg27=\lg a+n\lg2.25$ $64=a\times4^n$ or $\lg 64 = \lg a + n\lg4$ →Elimination of a or lga or n →Solve for n (or a) n=1.50 a=8.00 →Substitute back for $p = 8(6.25)^n = 125$	 M1 M1 A1 M1A1	 First M1 is for completely eliminating a or lga or lna or n. The second M1 is for solving the resulting eqn – needs to be powers or logs. Both needed. Substitution into eqn or log eqn. Co.
(b) Plots ln m against t *		*See p4 for graph

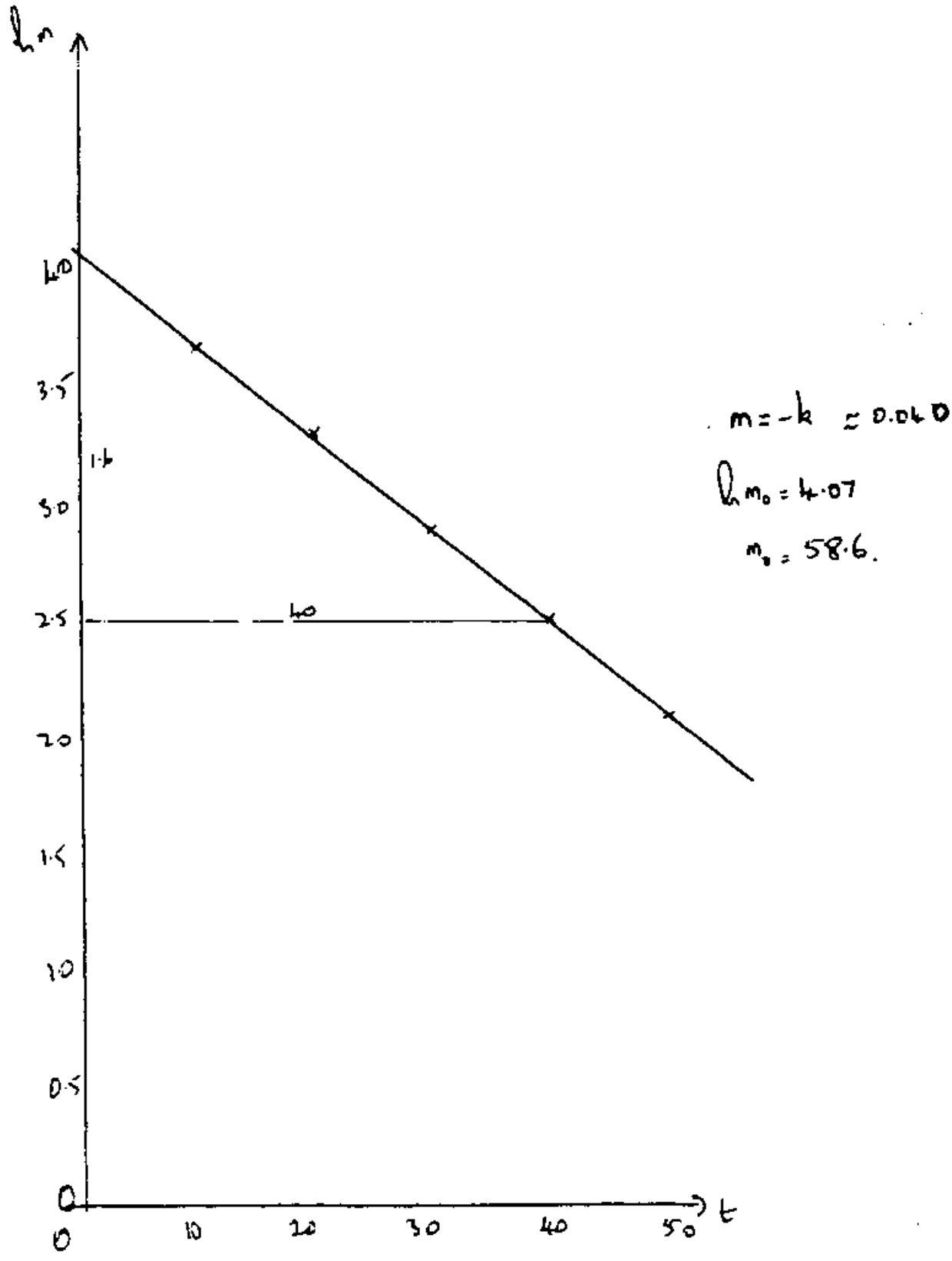
t	10	20	30	40	50
m	40.2	27.0	18.0	12.2	8.1
ln m	3.69	3.30	2.89	2.50	2.09

M1A1 Must be ln graph – not lg graph.

Gradient = -k ⇒ $k \approx 0.04$ (0.038-0.042) B1 B1
Intercept = $\ln m_0$ ⇒ $m_0 \approx 60$ (57-63) B1 B1
11

12 OR.  (i) (BC) y-11=½(x-4) Gradient of CD is –2 (CD) y-10=–2(x-17) Solution of sim eqns → C(14,16)	M1A1 M1 A1√ DM1 A1	M needs gradient + eqn. (2y=x+18) For use of $m_1 \times m_2 = -1$. Ind of 1stM. √ on his value of perpendicular.(y+2x=44) Both Ms needed. Correct only.
(ii) Line ratio BC=⅝ AD ⇒ BE=⅝ AE = 1⅔AB ⇒ E (9,26)	M1 A1	Completely correct method that leads to E Correct only.
or (AB) y=3x-1 (CD) y=–2x+44 ⇒ E (9,26)	(M1A1)	(completely correct method)
(iii) Ratio of small Δ to large similar Δ = 5 : 8 Ratio of areas of small Δ to large Δ = 25 : 64 Ratio of ΔEBC : trapezium = 25 : (64–25) ⇒ 25 : 39	M1 M1 A1	x steps – or lengths – or y-steps Squaring process Correct only
(or area of large Δ = ½×√320×√320 = 160 area of small Δ = ½×√125×√125 = 62.5 Ratio = 62.5 : 97.5 = 125 : 195 = 25 : 39	(M1 M1 A1) 11	Pythagoras for "length + ½bh" Or matrix method correctly used. Subtraction. Correct only. Any form ok, including 62.5: 97.5.
DM1 for quadratic equation. (a) Formula must be used correctly on "eqn=0". (b) Factors must be on eqn=0. Coeffs of x^2, x^0 ok		

Q12. "EITHER" (b).



$m = -k \simeq 0.040$

$\ln m_0 = 4.07$

$m_0 = 58.6.$