# MARK SCHEME for the November 2005 question paper

## 9709, MATHEMATICS

## 8719, HIGHER MATHEMATICS

**9709/05 and 8719/05    Paper 5        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*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

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

CIE is publishing the mark schemes for the November 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

**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.

UNIVERSITY *of* CAMBRIDGE
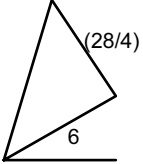International Examinations

- 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.

UNIVERSITY *of* CAMBRIDGE
International Examinations

| 1 |  | $\bar{x} = \frac{1}{4}\,28$ <br> $(\theta + \tan^{-1}(7/6) < 90)$ <br> $\theta < 40.6$ | B1 <br> M1 <br> A1   3 | For using $\theta + \tan^{-1}(\bar{x}/6) < 90$ |

| 2 | (i) | $(\frac{1}{2}\,\pi = \omega 50$ or $L = 220 \times 50)$ <br> $[220 = (\pi/100)r$ or <br>            $11000 = r(\frac{1}{2}\pi)]$ <br> Radius is approx. 7000 m | M1 <br> M1 <br><br> A1   3 | For using $\theta = \omega t$ or $L = vt$ <br> For using $v = \omega r$ or $L = r\theta$ |
|   | (ii) | Acceleration is 6.91ms$^{-2}$ | M1 <br> A1   2 | For using $a = v^2/r$ or $a = \omega^2 r$ |

| 3 | (i) |  | M1 | For obtaining an equation in $\bar{x}$ by taking moments about, for example, *BD* |
|   |     | $0.6\mathrm{W} \times 1 - 0.4\mathrm{W} \times (2/3) = \mathrm{W}\bar{x}$   or <br> $\frac{1}{2}(3 \times 1) \times 1 - \frac{1}{2}(2 \times 1) \times (2/3) =$ <br>                  $(3/2 + 1)\,\bar{x}$ | A1 | Any correct equation in $\bar{x}$, with or without *W* throughout. |
|   |     | Distance is 1/3 m | A1   3 | |
|   | (ii) | $3T = (8/3)W$   or $3F_C = (1/3)W$ | M1 | For taking moments about *C* or about *BD* |
|   |     | Tension is 8*W*/9 or force at *C* = *W*/9 | A1 ft | ft for $T = (1 - \bar{x}/3)W$     or |
|   |     | Force at *C* = *W*/9 or tension is 8*W*/9 | A1 ft   3 | $F_C = (\bar{x}/3)W$ |

| 4 | (i) | $u^2\sin^2\theta \div 2g = 10$ or $\frac{1}{2}(u\sin\theta + 0)T = 10$ | B1 | | Using maximum height |
|---|-----|-------------|----|----|---------------------|
|   |     | $2u^2\sin\theta\cos\theta \div g = 40$ or $u(2T)\cos\theta = 40$ or $uT\cos\theta = 20$ | B1 | | Using range (or half range) |
|   |     | $[\dfrac{\sin^2\theta}{\sin\theta\cos\theta} = \dfrac{2g(10)}{[g(40)\div 2]}$ or $\dfrac{\sin\theta}{\cos\theta} = \dfrac{2\times10}{40\div2}]$ | M1 | | For eliminating $u^2$ or $uT$ |
|   |     | $\theta = 45$ | A1 | | |
|   |     | $u^2 = 20\times10\div\frac{1}{2} \Rightarrow u = 20$ or $u\div\sqrt{2} = gT$ and $uT\div 2\sqrt{2} = 10$ $\Rightarrow u = 20$ | A1 | 5 | |
|   | (ii) | $y = x\tan45^\circ - gx^2 \div (2\times20^2\cos^2 45^\circ)$ | M1 | | For substituting for $u$ and $\theta$ in the general equation |
|   |     | $y = x - x^2/40$ | A1 | 2 | |

**OR**

| 4 | (ii) | $y = kx(40 - x)$ | M1 | | For quadratic equation with roots $x = 0$ and $x = 40$ |
|---|------|------------------|----|----|---------------------------------|
|   |      | $10 = 400k$ | M1 | | For using $y = 10$ when $x = 20$ |
|   |      | $y = x - x^2/40$ | A1 | 3 | |
|   | (i) | $1 = \tan\theta$ | M1 | | For equating coefficients of $x$ with that of general form |
|   |     | $\theta = 45^\circ$ | A1 | | |
|   |     | $-\dfrac{1}{40} = -\dfrac{10}{2u^2 \times 1/2}$ | M1 | | For equating coefficients of $x^2$ with that of general form with $\theta = 45^\circ$ substituted |
|   |     | $u = 20$ | A1 | 4 | |

| 5 | | Loss in GPE $= 0.2g\times5.25$ (10.5 J) | B1 | | |
|---|---|---------------------------------|----|----|---|
|   | | $AP$ is 3.25 initially and 5 finally | B1 | | |
|   | | | M1 | | For using EE $= \lambda x^2 \div (2L)$ $L$ must be correct (2.75 or 5.5) |
|   | | For any correct expression for Initial EPE or for Final EPE $[2\times0.5^2\lambda \div (2\times2.75)$ for initial or $2\times2.25^2\lambda \div (2\times2.75)$ for final] | A1 ft | | ft incorrect $AP$ |
|   | | Gain in EPE $= (81-4)\lambda/44 = 1.75\lambda$ | A1 | | Any correct expression |
|   | | | M1 | | For applying the principle of conservation of energy |
|   | | $1.75\lambda = 10.5$ | A1 ft | | For any correct equation in $\lambda$, ft only if initial and final EPE are used |
|   | | $\lambda = 6$ | A1 | 8 | |

| 6 | (i) | Radius of path = $4 + 5 \times 7/25$ ( =5.4m) | B1 | |
|---|---|---|---|---|
| | | $(T \times (24/25) = 24 \times 10)$  $(T = 250)$ | M1 M1 | For resolving forces vertically For applying Newton's second law horizontally and using $a = \omega^2 r$ |
| | | $24 \omega^2 \times 5.4 = 250 \times (7/25)$ | A1 ft | |
| | | $\omega = 0.735$ | A1  5 | |
| | (ii)(a) | Radius of path = $2 \times 4$ | B1 | Using $v$ is proportional to $r$ |
| | | $\sin \theta = 0.8$ | B1 | |
| | | $T = 400$ | B1ft  3 | ft wrong $\theta$ |
| | (b) | $(\dfrac{24 v^2}{8} = 400 \times \dfrac{4}{5})$ | M1 | For applying Newton's second law horizontally and using $a = v^2/r$ |
| | | Speed is 10.3 ms$^{-1}$ | A1  2 | |

| 7 | (i) | $a = (8 - 2x)(-2) = -16 + 4x$ | B1 | Any correct form |
|---|---|---|---|---|
| | | $-R = 0.25(-16 + 4 \times 1)$ | M1 | For using Newton's second law and substituting for $x$ |
| | | Magnitude of the force is 3 N | A1  3 | |
| | (ii) | $\int dt = \int \dfrac{dx}{8 - 2x}$ | B1 | |
| | | | M1* | For attempting to integrate |
| | | $t = -1/2 \ln(8 - 2x)$  $(+C)$ | A1 | |
| | | $(C = 1/2 \ln 8)$ | M1*dep | For using $x = 0$ when $t = 0$ to find $C$ |
| | | $2t = \ln \dfrac{8}{8 - 2x} \Rightarrow e^{2t} = \dfrac{8}{8 - 2x}$ | M1*dep | For converting to exponential form |
| | | $x = 4(1 - e^{-2t})$ | A1  6 | |
| | (iii) | $t \geq 0 \Rightarrow$ | M1 | |
| | | $0 < e^{-2t} \leq 1 \Rightarrow 0 \leq 1 - e^{-2t} < 1$ | | |
| | | $\Rightarrow 0 \leq x < 4$ | A1  2 | |

© University of Cambridge International Examinations 2005