**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the May/June 2007 question paper

## 9709 MATHEMATICS

**9709/04** Paper 4, maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began.

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 discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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**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.

| | | | | | |
|---|---|---|---|---|---|
| **1** | **(i)** | $[1.5^2 = 2.5^2 + 2a \times 4]$ | M1 | | For using $v^2 = u^2 + 2as$ |
| | | Deceleration is 0.5 $ms^{-2}$ | A1 | 2 | Accept a = -0.5 |
| | **(ii)** | | M1 | | For using Newton's second law or $a = (-)g\sin\alpha$ or $\frac{1}{2} m(v_B^2 - v_A^2) = mg(AB)\sin\alpha$ |
| | | $\alpha = 2.9$ | A1ft | 2 | ft $\alpha = \sin^{-1}(-0.1a)$ |
| **2** | **(i)** | $[8 + 8\cos\theta = 9]$ | M1 | | For an equation in $\theta$ using component 9N |
| | | $\theta = 82.8$ | A1 | 2 | |
| | **(ii)** | For showing $\theta$ or $(180° - \theta)$ or $\theta/2$, in a triangle representing the two forces and the resultant, or for using $Y = 8\sin\theta$ in $R^2 = X^2 + Y^2$ | B1 | | This mark may be implied by a correct equation for $R(\theta)$ in the subsequent working |
| | | $[R^2 = 8^2 + 8^2 - 2\times8\times8\cos(180 - \theta)$, $R^2 = 8^2 + 8^2 + 2\times8\times8\cos\theta$, $\cos(\theta/2) = (R/2) \div 8$, $R\cos(\theta/2) = 9$, $R\sin(\theta/2) = 8\sin\theta$, $R^2 = 9^2 + (8\sin\theta)^2$, $R^2 = (8 + 8\cos\theta)^2 + (8\sin\theta)^2]$ | M1 | | For an equation in R or $R^2$ |
| | | Magnitude is 12 N | A1 | 3 | |
| **3** | **(i)** | [DF = 18000/30] | M1 | | For using DF = P/v-may be scored in **(ii)** |
| | | [R = DF] | M1 | | For using a = 0 (may be implied) |
| | | R = 600 N | A1 | 3 | |
| | **(ii)** | | M1 | | For using Newton's second law (3 terms) |
| | | 18000/20 – 600 = 1200a | A1ft | | ft wrong R |
| | | Acceleration is 0.25$ms^{-2}$ | A1 | 3 | |
| **4** | **(i)** | | M1 | | For applying Newton's second law to P or to Q (3 terms) |
| | | 0.6 g – T = 0.6a | A1 | | |
| | | T – 0.2 g = 0.2a | A1 | | |
| | | | | | Allow B1 for 0.6 g – 0.2 g = (0.6 + 0.2)a as an alternative for either of the above A marks |
| | | Acceleration is 5 $ms^{-2}$ | B1 | | |
| | | Tension is 3 N | A1 | 5 | |
| | **(ii)** | $[0.9 = \frac{1}{2} 5t^2]$ | M1 | | For using $s = ut + \frac{1}{2} at^2$ |
| | | Time taken is 0.6 s | A1ft | 2 | ft $\sqrt{1.8/a}$ |

| | | | | | |
|---|---|---|---|---|---|
| **5** | **(i)** | | M1 | | For using KE = ½ $mv^2$ |
| | | Increase in KE<br>= ½ 12500($25^2 - 17^2$) | A1 | | |
| | | | | | Special case for candidates who assume the acceleration is constant (max 1 mark out of 2)<br>$25^2 - 17^2 = 2ad$, F = 12500×168/d,<br>KE gain = WD in increasing speed<br>= Fd = 12500×168 B1 |
| | | [WD = 2100 + 5000] | M1 | | For using<br>WD by DF = KE gain + WD v res |
| | | Work done by driving force is 7100 kJ (or 7100 000 J) | A1ft | 4 | ft only when units are consistent and both M marks are scored |
| | **(ii)** | | M1 | | For an equation with PE gain, WD by DF and WD v res (and KE loss if appropriate) in linear combination |
| | | PE gain = (7100 + 3300) – (5000 + 4800×500 ÷ 1000) or<br>PE gain = 3300 + 2100 – 4800×500 ÷ 1000 | A1ft | | Or equivalent in joules |
| | | [3000 000 = 12500×10h] | M1 | | For solving mgh = gain PE found |
| | | Height is 24m | A1 | 4 | |
| | | | | | Special case for candidates who assume the acceleration is constant (max 3 marks out of 4)<br>3300000/500 – 4800 – 12500×10sin$\theta$<br>= 12500(-0.336) B1<br>For using h = 500sin$\theta$ M1<br>Height is 24 m A1 |
| **6** | **(i)** | | M1 | | For using $s_Q = \int v_Q dt$ |
| | | $s_Q = 1.5t^2 - 0.1t^3$ (+ C) | A1 | | |
| | | | M1 | | For using limits 0 to 10 or equivalent (or 0 to 5 if the candidate states or implies that that $v_Q$ is symmetric about t = 5) |
| | | $s_Q$ (10) = 50 (or $s_Q$(5) = 25) | A1ft | | May be implied in subsequent working |
| | | | M1 | | For using ½ 10$v_{max}$ = $s_Q$ (10) (or ½ 5$v_{max}$ = $s_Q$ (5)) |
| | | Greatest velocity is 10 $ms^{-1}$ | A1 | 6 | AG |
| | | | | | Special case for final 2 marks (max 1 mark out of 2)<br>5v = 50 → v = 10 B1 |
| | **(ii)** | $a_P$ = 10/5 | B1 | | |
| | | [3 – 0.6t = 2] | M1 | | For differentiating to find $a_Q$(t) and equating to $a_P$ |
| | | t = 1.67 (or $1^2/_3$) | A1 | 3 | |

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| 7 | (i) | $T\cos60° = 75\cos30° \rightarrow T = 130$ | B1 | | Accept $75\sqrt{3}$ |
| | | | M1 | | For resolving forces vertically (4 terms) |
| | | $T\sin60° + 75\sin30° + R = 20g$ | A1ft | | ft consistent sin/cos mix |
| | | $[130\sin60° + 75\sin30° + R = 200]$ | M1 | | For substituting for T and solving for R |
| | | Magnitude is 50 N | A1 | 5 | Accept 49.9 |
| | (ii) | | M1 | | For resolving forces horizontally |
| | | $T\cos60° + 25 = 75\cos30°$ $(T = 79.9)$ | A1ft | | ft consistent sin/cos mix (T = 14.4) |
| | | $[79.9\sin60° + 75\sin30° + R = 200]$ | M1 | | For resolving forces vertically (4 terms) and substituting for T |
| | | $R = 93.3$ | A1 | | May be implied by final answer |
| | | $[\mu = 25/93.3]$ | M1 | | For using $\mu = 25/R$ |
| | | Coefficient is 0.268 $(= 2 - \sqrt{3})$ | A1ft | 6 | ft for $\mu$ = value obtained from 25/candidate's R, including her/his answer in **(i)** but excluding R = 20 g |