UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Advanced Subsidiary Level and GCE Advanced Level

# MARK SCHEME for the May/June 2011 question paper

# for the guidance of teachers

## 9709 MATHEMATICS

**9709/43** 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, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2011 question papers for most IGCSE, 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.

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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.

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| | | | | |
|---|---|---|---|---|
| 1 | | M1 | | For using WD = Fdcos $\alpha$ |
| | $8200 = 180 \times 50 \cos\alpha$ | A1 | | |
| | $\alpha = 24.3$ | A1 | **[3]** | |
| 2 | | M1 | | For using DF = P/v |
| | | M1 | | For using Newton's second law when v = 19 or when v = 30 |
| | $P/19 - R = 1250 \times 0.6$ and $P/30 - R = 1250 \times 0.16$ | A1 | | |
| | $[19R + 19 \times 1250 \times 0.6 = 30R + 30 \times 1250 \times 0.16]$ | M1 | | For attempting to eliminate P or R |
| | R = 750 or P = 28500 | A1 | | |
| | P = 28500 or R = 750 | B1ft | **[6]** | ft wrong answer for R or P substituted into a **correct** linear equation. |
| 3 | **(i)** $a_P = g\sin 30^o$ | B1 | | |
| | $3.2 = ½ g{t_q}^2$ | B1 | | |
| | $[6.4 = u(0.8) + ½\, 5 \times (0.8)^2]$ | M1 | | For applying $s = ut + ½ at^2$ to P |
| | u = 6 | A1 | **[4]** | |
| | **(ii)** $[v = 6 + 5 \times 0.8$ or $v^2 = 36 + 2\times5\times6.4]$ | M1 | | For using $v = u + at$ or $v^2 = u^2 + 2as$ for P |
| | Speed of P is $10\ ms^{-1}$ | A1 | **[2]** | |
| | **Alternative for Parts (i) and (ii) when a is not used:** | | | |
| | **<u>Part (i)</u>** | | | |
| | $3.2 = ½ g{t_q}^2$ | B1 | | |
| | For using KE gain = PE loss to obtain an equation in u and v $[½ (v^2 - u^2) = 6.4g\sin 30^o]$ | M1 | | |
| | For using $s = ½ (u + v)t$ to obtain a second equation in u and v $[6.4 = ½ (u + v) \times 0.8]$ | DM1 | | |
| | u = 6 | A1 | **[4]** | |
| | **<u>Part (ii)</u>** | | | |
| | Substitutes for u to find v | M1 | | |
| | Speed is $10\ ms^{-1}$ | A1 | **[2]** | |

| | | | | | |
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| 4 | (i) | For correct shading composite figure consisting of 2 rectangles: 1st has boundaries $t = 0$ & $t = 20$, $v = 0$ and $v = 2.5$; 2nd has boundaries $t = 20$ & $t = T$, $v = 0$ and $v = 4$ | B1 | [1] | |
| | (ii) | [$50 + 4(T – 20) = 70$ or $4T – 30 = 70$] | M1 | | For attempt to find equation in T |
| | | $T = 25$ | A1 | [2] | |
| | (iii) | [Distance = $70 + (4 – 2.5)20$ or $50 + 4[(T – 20) + 20] – 50$] | M1 | | For identifying and using area representing required distance |
| | | Distance between P and Q is 100 m | A1ft | [2] | ft 4T |
| | (iv) | For 2 straight line segments representing P, 1st with +ve slope and 2nd with steeper slope, $t = 20$ indicated appropriately | B1 | | |
| | | For Q, 1st & 2nd segments parallel to P's and displaced to the right, $t = 25$ and $t = 45$ indicated appropriately | B1ft | [2] | ft T and T + 20 |
| 5 | (i) | | M1 | | For resolving forces in the x direction or the y direction |
| | | $F_x – 6.1 – 5 \times 0.28 = 0$ and $F_y + 4.8 – 5 \times 0.96 = 0$ | A1 | | |
| | | Frictional force acts parallel to x axis and to the right | A1 | | |
| | | $F_y = 0 \rightarrow F = F_x$ $\rightarrow$ Frictional force has magnitude 7.5 N | A1 | [4] | AG |
| | (ii) | [$\mu = 7.5/(1.25 \times 10)$] | M1 | | For using $F = \mu R$ and $R = mg$ |
| | | Coefficient is 0.6 | A1 | [2] | |
| | (iii) | [$7.5 – 8.6 – 1.4 = 1.25a \rightarrow a = –2$] | M1 | | For applying Newton's second law |
| | | Magnitude of acceleration is 2 $ms^{–2}$ | A1 | | |
| | | Direction of acceleration is parallel to x axis and to the left | B1 | [3] | |

| | | | | | |
|---|---|---|---|---|---|
| 6 | (i) | Gain in PE = 15000g × 500sin2.5° J | B1 | | |
| | | WD against the resistance = 800 × 500 J | B1 | | |
| | | [3271454 + 400000] | M1 | | For using WD by driving force = Gain in PE + WD against resistance |
| | | Work done is 3670000 J or 3670 kJ | A1 | [4] | Alternatively,<br>For resolving forces up the plane M1<br>Driving Force = 800 + 15000gsin2.5° A1<br>For using<br>WD = Driving Force × 500 M1<br>Work done is 3670000J A1 |
| | (ii) | Work done by DF = 2000 × 500 J<br>Gain in KE = ½ 15000($v^2 – 20^2$) | B1<br>B1 | | |
| | | | M1 | | For using Gain in KE = Loss in PE – WD against resistance + WD by driving force |
| | | ½ 15000($v^2 – 20^2$) = 3271454 – 400000 + 1000000 | A1 | | |
| | | Speed of the lorry is 30.3 $ms^{-1}$ | A1 | [5] | Alternatively,<br>For applying Newton's second law M1<br>2000 + 15000gsin2.5 – 800 = 15000a A1<br>For using $v^2 = u^2 + 2as$ M1<br>$v^2 = 20^2 + 2 \times 0.5162 \times 500$ A1<br>Speed is 30.3 $ms^{-1}$ A1 |
| 7 | (i) | | M1 | | For using v(t) = $\int a dt$ |
| | | $v = \frac{1}{160}t^3 - \frac{1}{3200}t^4 \quad (+ C_1)$ | A1 | | |
| | | [0 = 8000/160 – 160000/3200 + $C_1$ → $C_1$ = 0] | M1 | | For using v(20) = 0 |
| | | Initial speed is zero | A1 | [4] | AG |
| | (ii) | [$t^2$/800(15 – t) = 0] | M1 | | For solving a = 0 |
| | | $v_{max}$ = v(15) = 5.27 $ms^{-1}$ | A1 | [2] | |
| | (iii) | | M1 | | For using s(t) = $\int v dt$ |
| | | $s = \frac{1}{640}t^4 - \frac{1}{16000}t^5 \quad (+ C_2)$ | A1ft | | |
| | | [250 – 200] | M1 | | For using limits 0 and 20 (or equivalent) |
| | | Distance AB is 50 m | A1 | [4] | |