UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 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 2008 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)

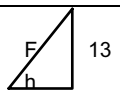
SOS See Other Solution (the candidate makes a better attempt at the same question)

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)**	[4.5 = 1.5 + 1.2a] Acceleration is 2.5 ms^{-2}	M1 A1	[2]	For using v = u + at
	(ii)	$\alpha = 14.5$	M1 A1	[2]	For using (m)gsin $\alpha°$ = (m)a
2	**(i)**	Distance is 2.5x12m **or** power = 851cos20° x 2.5 [WD = 851x30cos20°] Work done is 24 kJ	B1 M1 A1	[3]	For using WD = Tdcosα (or Pt) AG
	(ii)	Power is 2 kW	B1	[1]	
3		 [Fcosθ° = 10, Fsin θ° = 13;] [tanθ° = 13/10, $\sqrt{269}$ sinθ° = 13] θ = 52.4 [$F^2 = 10^2 + 13^2$, Fcos52.4° = 10] F = 16.4	M1 M1 A1 M1 A1	[5]	For resolving forces in **i** and **j** directions or sketching a triangle of forces (with 10, 13 and F shown) For an equation in θ only For an equation in F only
		Alternative scheme for candidates who use scale drawing: θ = 52.4 F = 16.4	M1 M1 A1 M1 A1	[5]	For scale drawing of correct triangle For measuring θ and finding a value in the range [51, 54] For measuring F and finding a value in the range [15.5, 17.5]
4	**(i)**	[KE = Loss of PE = 0.8g(2.4sin50°), KE = ½ 0.8 x 2(gsin50°)2.4] Kinetic energy at A is 14.7J	M1 A1	[2]	For using KE = PE loss = mgh **or** KE = ½ mv^2 and $v^2 = 2as$
	(ii)	[14.7 = ½ mv^2] Speed at C is 6.06ms^{-1}	M1 A1ft	[2]	For using KE at C = KE at A = ½ mv^2 ft v = (2.5 KE)^{½}
	(iii)	[½ $m8^2$ = mgH, ½ $m8^2$ – ½ $m6.06^2$ = mgh] h = 3.2 – 2.4sin50° or 10h = ½ ($8^2 – 6.06^2$) Depth is 1.36m	M1 A1ft A1	[3]	For using the principle of conservation of energy ft 10h = ½ ($8^2 – v_C^2$) SR in **(iii)** (max. mark 1/3) For depth = 1.36 from $v^2 = u^2 + 2gs$ B1

5	**(i)** $F = 0.5(0.6g)$	B1		
		M1		For applying Newton's second law to A or to B
	$0.4g - T = 0.4a$	A1		
				Alternative to either of the above equations:-
	$T - F = 0.6a$	A1		$0.4g - F = (0.4 + 0.6)a$ B1
				SR in lieu of the previous 3 marks (max. mark 1/3)
				$0.4g - T = 0.4ga$ and $T - F = 0.6ga$ B1
		M1		For substituting for F and solving for a or for T
	Acceleration is $1ms^{-2}$ and tension is 3.6N	A1	[6]	
	(ii)	M1		For using $s = (0) + ½ at^2$
	Time taken is 2.45s	A1ft	[2]	ft $t = (6/a)^{½}$
6	**(i)**	M1		For using $0 = u^2 + 2as$, **or** $0 = u + at$ and $s = ut + ½ at^2$, **or** $0 = u + at$ and $s = (u + 0)t/2$
	$0 = 5.2^2 - 2x10.4s_1$ or $s_1 = 5.2x0.5 - ½ 10.4x0.5^2$			
	or $s_1 = (5.2 + 0)x0.5/2$	A1		
	Greatest height is 7.5m	A1	[3]	
	(ii) $[v^2 = 2x9.6x7.5$, $v = 9.6x1.25$, $v = 2x7.5/1.25]$	M1		For using $v^2 = 0 + 2as$, **or** $s = ½ at^2$ and $v = at$, **or** $s = ½ at^2$ and $0 + v = 2s/t$
	Speed is $12ms^{-1}$	A1	[2]	
	(iii) PE loss = 0.6g x 6.2 (= 37.2) **or** Initial total energy = $0.6gx6.2 + ½ 0.6x5.2^2$ (= 45.312) **or** Energy loss upward $= ½ 0.6x5.2^2 - 0.6gx1.3$ (= 0.312)	B1		
	KE gain = $½ 0.6(12^2 - 5.2^2)$ (= 35.088) **or** Final total energy = $½ 0.6x12^2$ (= 43.2) Energy loss downward $= - ½ 0.6x12^2 + 0.6gx7.5$ (=1.8)	B1ft		ft ans **(ii)** For using WD = PE loss from the start – KE gain from the start **or** WD = Initial total energy – final total energy
	[WD = 37.2 – 35.088 or 45.312 – 43.2 or 0.312 + 1.8]	M1		WD = energy loss upward + energy loss downward
	Work done is 2.11(2) J	A1	[4]	Accept exact or 3sf

	Alternatively			
	[0.6g + R_{up} = 0.6x10.4 or 0.6g - R_{down} = 0.6x9.6]	M1		For applying Newton's second law to the upward motion or to the downward motion, and attempting to find R_{up} or R_{down}
	R_{up} = 0.24 or R_{down} = 0.24	A1		May be implied by final answer.
		M1		For using WD(upward) = 1.3R_{up} or WD(downward) = ans**(i)**R_{down}
	Work done is 2.11(2) J	A1ft	[4]	ft ans **(i)**
7	**(i)** (dv/dt) = -0.02t + 0.5 **or** v = -0.01[(t – T)^2 – 100V] where T = 25 and V = 5.25 (or equivalent)	B1		
		M1		For solving dv/dt = 0 or for selecting t = T or v_{max} = V May be implied when v_{max} = V is selected and T is 25 in the 'B1' expression for v
	t = 25	A1		
	Maximum velocity is 5.25ms^{-1}	A1	[4]	
	(ii)	M1		For integrating v(t)
	s_2 = -0.01t^3/3 + 0.5t^2/2 - t	A1		
		M1		For using limits 10 and 30
	s_2 = (-90 + 225 – 30) – (-10/3 + 25 – 10) (= 93.3m)	A1		
		M1		For evaluating v(10) and v(30)
	v(10) = 3 and v(30) = 5	A1		
		M1		For evaluating s_1 and s_3
	s_1 = ½ 3x10 and s_3 = ½ 5x50	A1ft		ft incorrect values of v(10) and/or v(30)
	Distance is 233m	A1ft	[9]	ft 140 + s_2 (depends on the 1stM1)
				SR for candidates who treat the first line segment as part of the curve in part **(ii)** (max. mark 6/9)
				Integration M1 A1 as scheme
				s_1 + s_2 = 105 A1
				v(30) = 5 B1
				s_3 = ½ 5x50 B1ft
				Distance is 230m A1ft (ft 125 + s1 + s_2)