CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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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)**	$[-(1 \div 3)(W\cos\alpha) - W\sin\alpha = (W/g)a]$	M1		For using Newton's 2nd law and $F = \mu R$
	$(-0.32 - 0.28)g = a$	A1		
	$a = -6$.	A1	3	AG
(ii)	$[0 = 5.4^2 + 2(-6)s]$ or $[mgs(0.28) = ½\ m(5.4)^2 - mgs(0.96)/3]$	M1		For using $0 = u^2 + 2as$ or for using PE gain = KE loss – WD against friction
	Distance is 2.43 m	A1	2	
2		M1		For using $a = (M - m)g/(M+m)$ or for applying Newton's 2nd law to A and to B and solving for a.
	$a = 5$	A1		
	When B reaches the floor $v^2 = 2 \times 5 \times 1.6$; speed is $4ms^{-1}$	B1ft		ft a $a \neq g$ $v = \sqrt{(3.2a)}$
		M1		For using $0 = u^2 - 2gs$ or for using PE gain = KE loss
	$0 = 16 - 20s$ $(s = 0.8)$	A1ft		ft speed
	$h + 1.6 + 0.8 = 3 \rightarrow h = 0.6$	B1	6	
3		M1		For resolving forces on P vertically
	$T_A(1/2.6) + T_B(1/1.25) = 10.5$	A1		
		M1		For resolving forces on P horizontally
	$T_A(2.4/2.6) = T_B(0.75/1.25)$	A1		
		M1		For solving for T_A and T_B
	Tension in AP is 6.5 N and tension in BP is 10 N.	A1	6	

	First Alternative			
		M1		For finding two angles in the triangle of forces
	$75.7(5)^o$ opposite to 10.5 N $36.8(7)^o$ opposite to T_A $67.3(8)^o$ opposite to T_B	A1		
		M1		For using the sine rule to find equations for T_A and T_B
	$T_A \div \sin 36.8(7) = 10.5 \div \sin 75.7(5)$ and $T_B \div \sin 67.3(8) = 10.5 \div \sin 75.7(5)$	A1		
		M1		For solving for T_A and T_B
	Tension in AP is 6.5 N and tension in BP is 10 N.	A1	6	
	Second Alternative			
		M1		For finding angles at P in the space diagram.
	$104.2(5)^o$ opposite to 10.5 N $143.1(3)^o$ opposite to T_A $112.6(2)^o$ opposite to T_B	A1		
		M1		For using Lami's rule to find equations for T_A and T_B
	$T_A \div \sin 143.1(3) = 10.5 \div \sin 104.2(5)$& $T_B \div \sin 112.6(2) = 10.5 \div \sin 104.2(5)$	A1		
		M1		For solving for T_A and T_B
	Tension in AP is 6.5 N and tension in BP is 10 N.	A1	6	
4	**(i)** $[W\sin\alpha + F = 40]$	M1		For resolving forces parallel to the plane
	$F = 40 - 300 \times 0.1$ (= 10)	A1		
	$R = 300\sqrt{(1 - 0.1^2)}$ (= 298.496..)	B1		
		M1		For using $\mu = F/R$
	Coefficient is 0.0335	A1	5	

(ii)	[The component of weight (30 N) is greater than the frictional force (10 N)]	M1		For comparing the weight component parallel to the plane and the frictional force or for using Newton's Second Law and finding the acceleration
	Box does not remain in equilibrium	A1	2	
5 (i)		B1		The sketch requires three straight line segments with +ve, zero and –ve slopes in order, which together with a segment of the t axis form a trapezium.
		M1		For using $v = at$ for T_1 or $u = -at$ for T_3
	$T_1 = V \div 0.3$, $T_3 = V$	A1	3	
(ii)	[$S = \frac{1}{2} T_1V + T_2V + \frac{1}{2} T_3V$]	M1		For using the area property for the distance travelled
		M1		For substituting for T_1, T_2 and T_3 in terms of V
	$S = 552V - V\{0.5(T_1 + T_3)\}$ $= 552V - 13V^2/6$	A1		
	$13V^2 - 3312V + 72000 = 0$	B1		AG
	$V = 24$	B1	5	
6 (i)	[$144000/v - 4800 = 12500a$]	M1		For using DF = P/v and Newton's 2nd law at A or at B
	Acceleration at A is 0.336 ms^{-2}	A1		
	The speed at B 24 ms^{-1}	A1	3	AG
(ii)	WD by DF = 5800 × 500 &			
	WD against res'ce = 4800 × 500	B1		
	Loss in KE = $\frac{1}{2}12500(24^2 - 16^2)$	B1		
		M1		For using WD by DF = PE gain – KE loss + WD against res'ce
	$5800 \times 500 = 12500gh - \frac{1}{2}12500(24^2 - 16^2) + 4800 \times 500$	A1		
	Height of C is 20 m	A1	5	

	(ii) Alternative			
	$[16^2 = 24^2 + 2 \times 500a]$	M1		For using $v^2 = u^2 + 2as$
	$a = -0.32$ ms^{-2}	A1		
		M1		For using Newton's second law
	$5800 - 4800 - 12500g \times (h \div 500)$ $= 12500(-0.32)$	A1		
	Height of C is 20 m	A1	5	
7 (i)	$[s = k_1t^2/2 - 0.005t^3/3 + (C)]$	M1		For using $s = \int v dt$
	$[k_1(60^2/2) - 0.005(60^3/3) = 540]$	DM1		For using limits 0 and 60 and equating to 540
	$k_1 = 0.5$	A1		
	$0.5 \times 60 - 0.005 \times 60^2 = k_2 \div \sqrt{60}$	M1		For using $v_1(60) = v_2(60)$
	$k_2 = 12\sqrt{60}$	A1	5	AG
(ii)		M1		For using $s = 540 + 12\sqrt{60}\int_{60}^{t} (t^{-1/2})dt$
	$[s = 540 + 12\sqrt{60}(2\sqrt{t} - 2\sqrt{60}) =]$ $24\sqrt{(60t)} - 900$	A1	2	Accept any other correct form for s if it is used in **(iii)**
(iii)	$[24\sqrt{(60t)} - 900 = 1260]$	M1		For solving $s(t) = 1260$ for t
	$t = 135$	A1		
	$v = 12\sqrt{60} \div \sqrt{135} \rightarrow$ speed is 8 ms^{-1}	B1	3	