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GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9709 MATHEMATICS

9709/42 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 May/June 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.

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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	**(i)**	[24 = μ30]	M1		For using R = W, F = T and F = μR
		Coefficient is 0.8	A1	[2]	
	(ii)		M1		For resolving forces vertically and using F = μR
		F = 0.8(30 – 25sin30°) (=14)	A1		
		[25 cos 30° – F = (30 ÷ g)a]	M1		For using of Newton's 2nd law
		Acceleration is 2.55 ms^{-2}	A1	[4]	
2	**(i)**		M1		For using work done by pulling force = increase in KE – decrease in PE + WD by resistance
		$1150 = ½\ 16 \times 10^2 - 16g(50 \times 0.05)$ + WD by resistance	A1		
		WD by resistance = 750 J	A1	[3]	
	(ii)	1150 = increase in KE + 16 g(50 × 0.05) + 750	M1		For WD by pulling force = KE gain + PE gain + WD by resistance
		KE gain = 0 → speed at top = speed at bottom	A1	[2]	AG
3			M1		For resolving forces acting on P horizontally or vertically
		$T_A \times (40/50) + T_B \times (40/104) = 21$ or $T_A \times (30/50) = T_B \times (96/104)$	A1		
		$T_A \times (30/50) = T_B \times (96/104)$ or $T_A \times (40/50) + T_B \times (40/104) = 21$	B1		
		Solve for T_A and T_B	M1		Solving for both
		Tension in AP is 20 N and tension in BP is 13 N	A1	[5]	Both $T_A = 20$ and $T_B = 13$
		First Alternative Marking Scheme			
3			M1		For using the sine rule in the triangle of forces
		21/sin 75.75 (or 75.7 or 75.8) = T_A/sin 67.4 (or T_B/sin 36.9)	A1		
		21/sin 75.75 (or 75.7 or 75.8) = T_B/sin 36.9 (or T_A/sin 67.4) or T_B/sin 36.9 = 20/sin 67.4	B1		
		Solve for T_A and T_B	M1		Solving for both

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		Tension in AP is 20N and tension in BP is 13N	A1	[5]	Both $T_A = 20$ and $T_B = 13$
Second Alternative Marking Scheme					
3			M1		For using Lami's Rule
		21/sin 104.3 = T_A/sin 112.6 (or T_B/sin 143.1)	A1		
		21/sin 104.3 = T_B/sin 143.1 (or T_A/sin 112.6) or T_B/sin 143.1 = 20/sin 112.6 or T_A/sin 112.6 = 13/sin 143.1	B1		
		Solve for T_A and T_B	M1		For using the equations to find T_A and T_B
		Tension in AP is 20 N and tension in BP is 13 N	A1	[5]	Both $T_A = 20$ and $T_B = 13$
4	**(i)**	$a = (16 \div 65)g$	B1		
		$[8^2 = 2(16 \div 65)gS]$	M1		For using $v^2 = 2as$ to find S
		S = 13	A1		
		$[v^2 = 2(16 \div 65)g \times 6.5$ or $v^2 \div 8^2 = ½]$	M1		For using $v^2 = 2a(½S)$ or $v^2 \propto s$
		Speed is 5.66 ms^{-1}	A1	[5]	
	(ii)	$[s = ½ a \times (64 \div 4a^2)$ or $s \div 13 = (½)^2]$	M1		For using $8 = 0 + aT$ and $s = ½a(T/2)^2$ or $s \propto t^2$
		Distance is 3.25 m	A1	[2]	
Alternative Marking Scheme					
4	**(i)**	$[½ m v^2 = mgh$ and $S = h \div \sin \alpha$	M1		For using KE gain = PE loss
		$S = (8^2 \div 20) \div (16 \div 65)$	A1		Or AEF
		S = 13	A1		
		$½ m v^2 = mg(½ 13 \times (16/65))$	M1		Or AEF
		Speed is 5.66 ms^{-1}	A1	[5]	
	(ii)		M1		For eliminating at^2 from $s = ½at^2$ and $13 = ½a(2t)^2$
		Distance is 3.25 m	A1	[2]	
5	**(i)**	Driving force = 1000P/25	B1		

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			M1		For using Newton's 2nd law
		$1000P/25 - 600 = 1000 \times 0.2$	A1		
		$P = 20$	A1	[4]	
	(ii)		M1		For using Newton's 2nd law with $a = 0$
		$20000/v_{max} - 600 = 0$	A1ft		ft for their P in (i)
		Steady speed is 33.3 ms^{-1}	A1	[3]	
6	**(i)**	For sketch of single valued, continuous graph consisting of 3 straight line segments with $+^{ve}$, then $-^{ve}$, then $+^{ve}$ slope	B1		
		Sketch appears to show $v(0) = 0$ and $v(8) > v(26) > v(20)$	B1	[2]	
	(ii)	For shading the triangle from $t = 0$ to $t = 8$, the trapezium from $t = 8$ to $t = 20$ and the trapezium from $t = 20$ to a value of t seen to be between 20 and 26	B1	[1]	
	(iii)		M1		For using area property to find s(20)
		$s(20) = ½(8 \times 8) + ½(8 + 2) \times 12 \quad (= 92)$	A1		
			M1		For using the gradient property to find acceleration in 3rd phase
		$a = (6.5 - 2)/6 \quad (= 0.75)$	A1		
		$[s(t) = 92 + 2(t - 20) + 0.375(t - 20)^2$	M1		
		Displacement is $0.375t^2 - 13t + 202$ metres	A1	[6]	
		Alternative Marking Scheme for final 2 marks of Q6			
		$[v(t) = 2 + 0.75(t - 20)$ $s(t) = 0.375t^2 - 13t + A$ where $92 = 0.375 \times 400 - 13 \times 20 + A]$	M1		For finding v(t), integrating and using s(20) = 92
		Displacement is $0.375t^2 - 13t + 202$ metres	A1		
6	**(iii)**	**First Alternative Marking Scheme for part (iii) of Q6**			
		$a = (6.5 - 2) / (26 - 20) = 0.75$	B1		
		$v = 0.75t$ (+ C1)	M1		Integrating
		$v = 0.75t - 13$	A1		Using $v(20) = 2$ or $v(26) = 6.5$

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	$s(20) = 92$ or $s(26) = 117.5$	B1		Using area in diagram
	$s = 0.375t^2 - 13t\ (+ C_2)$	M1		Integrating
	$s = 0.375t^2 - 13t + 202$	A1	[6]	Using s(20) or s(26) to find $C_2 = 202$
6 (iii)	**Second Alternative Marking Scheme for part (iii) of Q6**			
	$s = 0.375t2 - 13t + 202$			Given
	$v = 0.75t - 13$	M1		Differentiating
	$a = 0.75$	M1		Differentiating
	$a = (6.5–2)/(26–20) = 0.75$	B1		Check agreement from graph
	$v(20) = 0.75(20) - 13 = 2$ or $v(26) = 0.75(26) - 13 = 6.5$	B1		Check v agrees at a point between t = 20 and t = 26
	Show $s(20) = 92$ or $s(26) = 117.5$	B1		Using area under graph
	$s(20) = 0.375(20)^2 - 13(20) + 202 = 92$ or $s(26) = 0.375(26)^2 - 13(26) + 202 = 117.5$	B1		Check s agrees at a point between t = 20 and t = 26
7 (i)		M1		For applying Newton's 2nd law to A or B
	$T - 0.26g(16 \div 65) = 0.26a$ or $0.52g - T = 0.52a$	A1		
	For $\{0.52g - T = 0.52a$ or $T - 0.26g(16 \div 65) = 0.26a\}$ or $0.52g - 0.26g(16 \div 65) = (0.52 + 0.26)a$	B1		
	Acceleration is 5.85 ms^{-2}	B1		
	Tension is 2.16 N	A1	[5]	
(ii)	$[v^2 = 2 \times (76/13) \times 0.6]$	M1		For using $v^2 = 2as$
	Speed is 2.65 ms^{-1}	A1		
	$0 = 91.2/13 - 2(160/65)s$	M1		For using $0 = v_B^2 - 2(g \sin\alpha)s$
	$S = 57/40$ (= 1.425)	A1		
	[AP = 2.5 – 0.6 – 1.425]	M1		For using AP = 2.5 – 0.6 – s
	Distance AP is 0.475 m	A1	[6]	

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