CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 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 2014 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)**	DF = 22500 ÷ 18	B1		
			M1		For using Newton's second law with 3 terms
		22500/18 – R = 600 × 1.4	A1		
		R = 410 N	A1	4	
	(ii)	Rate of working is 6150 W	B1√	1	ft on incorrect R, i.e. R × 15
2	**(i)**		M1		For using $s = ut + \frac{1}{2}at^2$ to obtain an equation in T from $s_{AP} + s_{BP} = 10$
		½ $0.5T^2 + 0.75T = 10$	A1		
		$[T^2 + 3T – 40 = 0 = (T + 8)(T – 5)]$	M1		For solving the resulting 3 term quadratic equation either by factorising or formula and finding a value for T
		T = 5 only	A1	4	Reject/ignore T = – 8
		Alternative mark scheme for 2(i)			
	(i)	x = ½ ½ T^2 10 – x = ¾ T Eliminate T x = ¼ $[4/3(10– x)]^2$	M1		Set up an equation for x, the distance travelled by particle A
		x = 6.25	A1		Solve for x reject/ignore x = 16
		10 – 6.25 = ¾ T or 6.25 = ¼ T^2	M1		Substitute for x into either of the above equations
		T = 5	A1		Reject/ignore T = –5
	(ii)	Speed is 2.5 ms^{-1}	B1√	1	ft for speed = 0.5T
3			M1		For resolving forces acting on P horizontally (3 terms)
		$0.8T_1 + 0.96T_2 = 10$ or $T_1 \cos 36.9 + T_2 \cos 16.3 = 10$	A1		
			M1		For resolving forces acting on P vertically (3 terms)
		$0.6T_1 – 0.28T_2 = 0.7g$ or $T_1 \sin 36.9 – T_2 \sin 16.3 = 0.7g$	A1		
			M1		For solving simultaneous equations and finding both T_1 and T_2
		T_1 = 11.9 **and** T_2 = 0.5	A1	6	

4 (i)		M1		For differentiation to find *a(t)* for $t \geqslant 8$
	$a(t) = t^{-1/3}/3$	A1		
	[0.25 – (1/2) / 3 = 1/4 – 1/6]	M1		Decrease = $a(8^-) - a(8^+)$
	Decrease is $1/12\,\text{ms}^{-2}$	A1	4	AG
(ii)		B1		$s_1 = ½ ¼ 8^2 = 8$
	$s_2 = \int_8^{27} \frac{1}{2} t^{2/3} dt = [0.3t^{5/3}]_8^{27}$	M1		Using definite integration to find s_2
	Distance is 71.3 m	A1	3	$s_1 + s_2 = 71.3$
Alternative method for the final two marks				
	$s = \int \frac{1}{2} t^{2/3} dt = 0.3t^{5/3} + c$ $s(8) = 8$ gives $c = -1.6$	M1		Using indefinite integration to find *s* and finding the constant of integration by using the value of s_1
	$s(27) = 0.3(27)^{5/3} - 1.6 = 71.3$	A1		Finding *s*(27)
5 (i)	KE gain is $10.5v^2$ J	B1	1	
(ii) (a)	[PE Loss = 16 (10) x – 5 (10) x sin 30]	M1		For use of PE = mgh and Loss by system = loss by B – gain by A
	PE loss by system is $135x$ J	A1	2	
(b)	R = 5 (10) × (√3 ÷ 2)	B1		
	F = 25	B1		
	Work done is $25x$ J	B1√	3	ft incorrect F
(iii)	[$10.5v^2 = 135x - 25x$]	M1		For using 'Gain in KE = Loss in PE – WD against friction'
	$21v^2 = 220x$	A1	2	AG
6 (i)	$v^2 = 2 \times g \times 7.2$ ➔ speed at surface is $12\,\text{ms}^{-1}$	B1		
	[$6^2 = 12^2 + 2a \times 0.8$]	M1		For using $6^2 = v^2 + 2as$ and finding a
	Deceleration is $67.5\,\text{ms}^{-2}$	A1		
	[$0.2g - R = -0.2 \times 67.5$]	M1		For using Newton's 2nd law with three terms for P in the liquid
	R = 15.5	A1	5	

(ii)	$[3.6 = ½\ a \times 4^2]$	M1		For using $s = 0 + ½\ at^2$ and finding a
	$a = 0.45\ \text{ms}^{-2}$	A1		
	$[T – R – 0.2g = 0.2 \times 0.45]$	M1		For using Newton's 2nd law with P in the liquid
	Tension is 17.6 N (17.59 exact)	A1√	4	ft incorrect R
Alternative Energy Method				
(i)		M1		For using PE lost = WD by R in liquid + KE gain
	$0.2g \times 8 = R(0.8) + ½\ (0.2)\ 6^2$	A1		
	$R = 15.5$	A1		Finding R
	$0.2g – 15.5 = 0.2a$	M1		For using Newton's 2nd law in the liquid
	$a = –67.5$	A1	5	
(ii)		M1		For using $s = (0 + v)/2 \times t$ to find v at surface of liquid
	$3.6 = v/2 \times 4 \qquad v = 1.8$	A1		
	$T(3.6) = R(3.6) + 0.2g(3.6) + ½(0.2)1.8^2$	M1		For using WD by T = WD by R + PE gain + KE gain
	$T = 17.6\,\text{N}$	A1	4	
7 (i)	$[\ T_A – 2.5 = 0.25 \times a\ ] \qquad [\ 7.5 – T_B = 0.75 \times a\ ]$	M1		For applying Newton's 2nd law to either particle A or particle B
	$T_A = 2.5 + 0.25a$	A1		
	$T_B = 7.5 – 0.75a$	A1	3	
(ii)	$F = 0.4 \times 5$	B1		
	$[T_B – T_A – F = 0.5a]$	M1		For using Newton's 2nd law for P with friction and both tensions represented (4 terms)
	$7.5 – 0.75a\ – (2.5 + 0.25a) – 2 = 0.5a \rightarrow a = 2$	A1	3	AG

	Alternative method for (ii)			
(ii)	$F = 0.4 \times 5$	B1		
	$a = 2$ used to find $T_A = 3$, $T_B = 6$ and used in $T_B - T_A - F = 0.5 \times a$	M1		Assume given value of a, find T_A and T_B and use the values in 4 term Newton's 2nd law
	$a = 2$	A1		Justify the value $a = 2$
(iii)	$[v^2 = 2 \times 2 \times 0.36]$	M1		For using $v^2 = 2as$ with $s = 1 - ½ (5.28 - 4)$
	Speed is 1.2 ms^{-1}	A1	2	
(iv)	$-T_A - 2 = 0.5a$ and $T_A - 2.5 = 0.25a$	M1		For applying Newton's 2nd law to particle P **and** substituting for T_A
	Deceleration is 6 ms^{-2}	A1	2	$a = -6$ or $d = 6$