CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 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 2015 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

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 $\sqrt{\,}$ 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)	$\left[s = 0.3\times 5 + \frac{1}{2}\ \ 0.5\times 5^2\right]$ [$v = 0.3 + 0.5 \times 5 = 2.8$m] Complete method for finding s required	M1		For using $s = ut + \frac{1}{2}at^2$ **or** using $v = u + at$ followed by **either** $v^2 = u^2 + 2as$ **or** $s = \frac{(u+v)}{2}t$ **or** $s = vt - \frac{1}{2}at^2$
	Distance = 7.75 m	A1	2	
(ii)	[WD = 8 × 7.75 × 0.5]	M1		For using WD = $Td\cos 60^{o}$
	Work done is 31 J	A1	2	
2 (i)	$\left[\frac{P}{5} = 80\times 1.2\right]$	M1		For using DF = $\frac{P}{v}$ and Newton's 2nd law
	$P = 480$	A1	2	
(ii)	$\frac{450}{3.6} - 80g \times 0.035 = 80a$	M1 A1		For using $\frac{P}{v} - W\sin\alpha = ma$
	Acceleration is 1.21 ms^{-2}	A1	3	Allow $a = \frac{97}{80}$
3 (i)	KE gain $\left[= \frac{1}{2}\times 8\times 4.5^2\right] = 81$ J	B1		
	$\left[\text{Decrease} = 8g\times 12\times\left(\frac{1}{8}\right)\right]$	M1		For using PE = mgh and $h = d\sin\alpha$
	PE loss = 120 J	A1	3	
(ii)	[$81 = 120 - 12R$]	M1		For using KE gain = PE loss –WD by resistance
	Resisting force is 3.25 N	A1	2	Allow $R = \frac{13}{4}$

Alternative method for (ii)				
(ii)	$[4.5^2 = 2 \times a \times 12]$ ➔ $[a = \frac{27}{32} = 0.84375]$ $[8g\sin\alpha - R = 8 \times \frac{27}{32}]$	M1		For using $v^2 = u^2 + 2as$ to find a **and** using Newton's 2nd law to find R
	Resisting force is 3.25 N	A1	2	
4 (i)		M1		For integrating to obtain $v(t)$.
	$v(t) = 0.025t^3 - 0.75t^2 + 5t \quad (+0)$	A1		
		M1		For integrating to obtain $s(t)$.
	$s(t) = 0.00625t^4 - 0.25t^3 + 2.5t^2 \quad (+0)$	A1	4	
(ii)		M1		For setting $s = 0$ (t not zero) in their attempt at s which was obtained using integration only.
	$[t^4 - 40t^3 + 400t^2 = 0$ ➔ $t^2(t-20)^2 = 0]$	M1		For attempting to solve a quartic equation for $s = 0$ where s was obtained using integration only.
	Time taken is 20 s	A1	3	$t = 20$ only
5 (i)		M1		For using $v = u - gt$ to find the time taken by Q. Must be for a complete method for the total time taken to return to point A
	$-20 = 20 - 10t$ ➔ time taken is 4s or $0 = 20 - 10t$ ➔ time taken is 2×2s = 4s	A1		
	$[30 = 0 + 4a]$	M1		For using $v = u + at$ to find the acceleration of P
	Acceleration of P is 7.5 ms^{-2}	A1√	4	ft on an incorrect positive value of the time taken

(ii)		M1		For using $v^2 = u^2 + 2as$ **or** $s = \frac{(u+v)}{2}t$ **or** $s = ut + \frac{1}{2}at^2$ **or** $s = vt - \frac{1}{2}at^2$ to find the distance OA
	Either $30^2 = 2 \times 7.5 \times OA$ **or** $OA = \frac{(0+30)}{2} \times 4$ **or** $OA = \frac{1}{2} \times 7.5 \times 4^2$ **or** $OA = 30 \times 4 - \frac{1}{2} \times 7.5 \times 4^2$ ➔ Distance OA is 60 m	A1	2	
6 (i)	$\left[h = \frac{1}{2} \times 0.5 \times 2\right]$	M1		For using area property of the graph or constant acceleration formulae
	$h = 0.5$	A1	2	
(ii)	$[a = 2 \div 0.5]$	B1		State the value of a using the gradient property of the graph
	$[T - mg = ma$ and $(1 - m)g - T = (1 - m)a$ or $a = \{(1 - 2m) \div (1 - m + m)\}g]$	M1		For applying both • Newton's 2nd law to P (while Q is moving) • Newton's 2nd law to Q (while Q is moving) or using $a = [(M - m) \div (M + m)]g$
		M1		For eliminating T or rearranging to find m
	$m = 0.3$	A1		
	$[T - 0.3 \times 10 = 4 \times 0.3$ or $0.7 \times 10 - T = 4 \times 0.7]$	M1		For substituting a and m into • Newton's 2nd law to P (while Q is moving) • Newton's 2nd law to Q (while Q is moving) to find T (tension)
	Tension is 4.2 N	A1	6	

(iii)		M1		For using the gradient property of the graph with acceleration $-g$
	$(-2-2) \div (t-0.5) = -10$	A1		
	$T = 0.9$	A1	3	
	First Alternative method for (iii)			
(iii)	$[-2 = 2 - 10t]$	M1		For using $v = u + at$ to find the total time that string is slack
	$t = 0.4$	A1		
	Required time = 0.5 + 0.4 = 0.9	A1	3	
	Second Alternative method for (iii)			
(iii)	$t = 0.2$ s	B1		Obtaining the time taken from $v = 0$ to $v = 2$ OR $v = 0$ to $v = -2$
	$t = 0.2 \times 2 = 0.4$ s	B1		Obtaining the total time that the string is slack.
	Total time = 0.9 s	B1	3	For completing the solution using 0.4 + 0.5 = 0.9 s
7 (i)		M1		For resolving forces at J horizontally **or** vertically
	$0.8T_A + 0.6T_R = 5.6$	A1		Allow $T_A \cos 36.9 + T_R \cos 53.1 = 5.6$ oe
	$0.6T_A = 0.8T_R$	A1		Allow $T_A \sin 36.9 = T_R \sin 53.1$ oe
		M1		For solving the simultaneous equations for T_A and T_R
	Tension in AJ is 4.48 N **and** tension in RJ is 3.36 N	A1	5	
	First Alternative Method for (i)			
(i)	$\frac{5.6}{\sin 90} = \frac{T_A}{\sin\alpha} = \frac{T_R}{\sin(270-\alpha)}$ m	M1		For applying Lami's theorem to two of the three forces T_A, T_R, and 5.6 where α is an obtuse angle
	$\frac{5.6}{\sin 90} = \frac{T_A}{0.8} = \frac{T_R}{0.6}$ m	A1 A1		Allow sin126.9 for 0.8 and sin143.1 for 0.6 here
		M1		Solve for T_A **and** T_R
	$T_A = 4.48$ **and** $T_R = 3.36$	A1	5	

Second Alternative Method for (i)

(i)	$\frac{5.6}{\sin 90} = \frac{T_A}{\sin\alpha} = \frac{T_R}{\sin(90-\alpha)}$ m	M1		For applying triangle of forces to two of the three forces T_A, T_R, and 5.6
	$\frac{5.6}{\sin 90} = \frac{T_A}{0.8} = \frac{T_R}{0.6}$ m	A1 A1		Allow sin 53.1 for 0.8 and sin 36.9 for 0.6 here
		M1		Solve for T_A **and** T_R
	$T_A = 4.48$ **and** $T_R = 3.36$	A1	5	
(ii)	$0.2g + F = T_R \times \cos 36.9$	B1√		ft on T_R and 36.9
	$N = T_R \times \sin 36.9$	B1√		ft on T_R and 36.9
	$[0.2g + \mu \times T_R \times 0.6 = T_R \times 0.8]$	M1		For using $\mu = F \div N$ and obtaining an equation in μ
	$\mu = 0.688 \div 2.016 = 0.341$	A1	4	AG
(iii)	$[0.2g + mg = \mu N + 0.8T_R]$	M1		For a four term equation from resolving forces acting on R vertically.
	$0.2g + mg = 0.341 \times 2.016 + 3.36 \times 0.8$	A1		
	$m = 0.137$ or 0.138	A1	3	