

MARK SCHEME for the October/November 2015 series

9709 MATHEMATICS

9709/52

Paper 5, maximum raw mark 50

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	Cambridge International A Level – October/November 2015	9709	52

Mark Scheme Notes

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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 $\Rightarrow$ 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.

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- Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.
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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 $\frac{1}{2}$ ” 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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5	(i)	$0.2g = R + 21 \times \frac{0.05}{0.75}$ $R = 0.6 \text{ N}$	M1 A1	2	
	(ii)	$21 \left(\frac{0.8}{\cos \theta - 0.75} \right) / (0.75 \cos \theta) = 0.2g$ $e = 0.0735$ OR $\frac{21e}{0.75} \times \frac{0.8}{(e + 0.75)} = 0.2g$ $e = 0.073529\dots$	M1 A1 A1 M1 A1 A1	3	θ = angle of string with vertical Comp of tension = weight $\theta = 13.7(291\dots)$ $e = 0.8/\cos \theta - 0.75 = 0.073529\dots$ e = extension Comp of tension = weight
	(iii)	$\frac{0.2(3)^2}{2} + \frac{21(0.05)^2}{(2 \times 0.75)} = \frac{0.2v^2}{2} + \frac{21 \times 0.0735^2}{1.5}$ $v = 2.93 \text{ ms}^{-1}$	M1 A1 A1	3	Uses EE/KE balance
6	(i)	Mass of disc = $\pi(1.2^2 - 0.4^2 - 0.3^2)$ $0 = \pi(1.2^2 - 0.4^2 - 0.3^2)y - (0.4^2) \times 0.7$ $y = 0.0941 \text{ m}$	B1 M1 A1 A1	4	1.19π (or in (ii)) LHS = $\pi(1.2^2 - 0.3^2) \times 0$
	(ii)	$0 = \pi(1.2^2 - 0.4^2 - 0.3^2)x - \pi(0.3^2) \cdot 5$ $x = 0.0378 \text{ m}$	M1 A1 A1	3	LHS = $\pi(1.2^2 - 0.4^2) \times 0$
	(iii)	$\tan \theta = \frac{0.0941176}{0.0378151}$ $\theta = 68.1^\circ$	M1 A1	2	

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7	(i)	$(x =) V \cos 45t = V \cos 60(t+1)$ $t = 2.414$	AG	M1 A1 A1	3	Equates horizontal distances Terms correct
	(ii)	$(y =) V \sin 45t - \frac{gt^2}{2} =$ $V \sin 60(t+1) - \frac{g(t+1)^2}{2}$ $V\{\sin 60(3.414) - \sin 45(2.414)\} =$ $5\{(3.414)^2 - (2.414)^2\}$ $V = 23.3$		M1 A1 M1 A1	4	Equates vertical distances Terms correct Gathers terms correctly 23.32...
	(iii)	Greatest $H = \frac{23.32^2 \sin^2 60}{(2g)}$ $h = 23.3 \sin 60(3.414) - \frac{g(3.414)^2}{2}$ $h = 10.67$ Falls 9.72 m		B1 M1 A1 A1	4	20.39, ft cv(23.3) ² ×3/80

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1	$V_v^2 = 18^2 - (25\cos 50)^2$ $V_v = 8.1095656..$ $8.1095656... = 25\sin 50 - gt$ $t = 1.1(0)\text{ s}$	M1 A1 M1 A1	4	Finds vertical comp of velocity $v = u - gt$ vertically
2 (i)	$T\cos\theta = 0.2g$ $T \times \frac{0.4}{0.5} = 2$ $T = 2.5\text{ N}$	M1 A1	2	Weight = vertical comp of tension
(ii)	$2.5\sin\theta = \frac{0.2v^2}{r}$ $2.5 \times \frac{0.3}{0.5} = \frac{0.2v^2}{0.3}$ $v = 1.5\text{ ms}^{-1}$	M1 A1 A1	3	Horiz comp of tension and accn = v^2/r
3	$4V\cos\theta = 40\cos 30$ $4V\sin\theta - \frac{4^2g}{2} = 40\sin 30$ $V^2 = (10\cos 30)^2 + 25^2 \text{ or}$ $\tan\theta = \frac{25}{10\cos 30}$ $V = 26.5$ $\theta = 70.9$	B1 B1 M1 A1 A1	5	
4 (i)	$4 = 10r$ $\theta = 53.1^\circ$	B1 B1	2	$v = \omega r, r < 0.5$ From $\sin\theta = 0.4/0.5$
(ii) (a)	$0.4g = 6\cos\theta$ $\theta = 48.2^\circ$	M1 A1	2	
(b)	$6\sin\theta = 0.4\omega^2 \times 0.5\sin\theta$ $\omega = 5.48\text{ rad s}^{-1}$	M1 A1 A1	3	Accn = $\omega^2 \times 0.5\sin\theta$ Using cv(48.2), allow any acute θ
5 (i)	$0.5v \frac{dv}{dx} = -0.5g - 0.02v^2$ $v \frac{dv}{dx} = -10 - 0.04v^2$	M1 A1	2	

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(ii)	$\int_8^0 \frac{v}{-10 - 0.04v^2} dv = \int dx$	M1		Separates the variables and attempts to integrate
	$x = \left[-\ln(10 + 0.04v^2) / 0.08 \right]_8^0$	M1		Uses limits or finds constant
	$x = 2.85$	A1	3	
(iii)	$v \frac{dv}{dx} = 10 - 0.04v^2$	B1		
	$\int \frac{v}{10 - 0.04v^2} dv = \int_0^{2.85} dx$	M1		Integrates new acceleration
	$\ln[(10 - 0.04v^2) / 10] / -(0.08) = 2.85$	M1		Uses earlier answer as distance
	$v = 7.14 \text{ ms}^{-1}$	A1	4	
6 (i)	$d \cos \theta = h / \cos \theta$	M1		$\theta = \text{semi-vertical angle}$
	$\cos \theta = \frac{h}{\sqrt{(0.2^2 + h^2)}}$			
	$d = \frac{h}{(h^2 / (0.04 + h^2))}$	M1		
	$d = h + \frac{0.04}{h}$ AG	A1	3	
(ii)	$0.6 \times 4 + 0.9W = d(4 + W)$	M1		Table of moments idea
		A1		
	$d = 0.8 + \frac{0.2^2}{0.8}$	B1		0.85
	$2.4 + 0.9W = 0.85(4 + W)$	M1		
	$0.05W = 1$	A1		
	$W = 20$	A1	6	

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7	(i)	$Mg = \frac{12.5e}{0.8}$ $e = 0.64M$ AG	M1 A1	2	Uses $T = \lambda e/l$
	(ii)	$Mg(0.8 + e) = \frac{M \times 44^2}{2} + \frac{12.5e^2}{(2 \times 0.8)}$ $10M(0.8 + 0.64M) = 9.68M + \frac{12.5(0.64M)^2}{1.6}$ $8 + 6.4M = 9.68 + 3.2M$ $M = 0.525$	M1 A1 M1 A1 M1 A1	6	PE/KE/EE conservation $8M + 6.4M^2 = 9.68M + 3.2M^2$ Attempt to solve equation in M
	(iii)	$0.525gd = \frac{12.5(d - 0.8)^2}{(2 \times 0.8)}$ $0.672d = d^2 - 1.6d + 0.64$ $d = 1.94$	M1 M1 A1	3	PE/EE balance