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**MATHEMATICS**

**9709/05**

Paper 5

**For examination from 2017**

MARK SCHEME

Maximum Mark: 50

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**Specimen**

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This document consists of **8** printed pages.

**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  $\surd$  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  $\sqrt{\wedge}$ ” 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.

Question	Answer	Marks	Partial Marks	Guidance
<b>1</b>	$V_v^2 = 18^2 - (25\cos 50)^2$	1	<b>M1</b>	Finds vertical comp of velocity
	$V_v = 8.1095656..$	1	<b>A1</b>	
	$8.1095656... = 25\sin 50 - gt$	1	<b>M1</b>	$v = u - gt$ vertically
	$t = 1.1(0) \text{ s}$	1	<b>A1</b>	
		<b>4</b>		
<b>2(i)</b>	$T\cos\theta = 0.2g$ $T \times \frac{0.4}{0.5} = 2$	1	<b>M1</b>	Weight = vertical comp of tension
	$T = 2.5 \text{ N}$ AG	1	<b>A1</b>	
		<b>2</b>		
<b>2(ii)</b>	$2.5\sin\theta = \frac{0.2v^2}{r}$	1	<b>M1</b>	Horiz comp of tension and accn = $v^2/r$
	$2.5 \times \frac{0.3}{0.5} = \frac{0.2v^2}{0.3}$	1	<b>A1</b>	
	$v = 1.5 \text{ ms}^{-1}$	1	<b>A1</b>	
		<b>3</b>		

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Question	Answer	Marks	Partial Marks	Guidance
3	$4V\cos\theta = 40\cos 30$	1	B1	
	$4V\sin\theta - \frac{4^2g}{2} = 40\sin 30$	1	B1	
	$V^2 = (10\cos 30)^2 + 25^2$ or $\tan\theta = \frac{25}{10\cos 30}$	1	M1	
	$V = 26.5$	1	A1	
	$\theta = 70.9$	1	A1	
			5	
4(i)	$4 = 10r$	1	B1	$v = \omega r, r < 0.5$
	$\theta = 53.1^\circ$	1	B1	From $\sin\theta = 0.4/0.5$
			2	
4(ii)(a)	$0.4g = 6\cos\theta$	1	M1	
	$\theta = 48.2^\circ$	1	A1	
			2	
4(ii)(b)	$6\sin\theta = 0.4\omega^2 \times 0.5\sin\theta$	1	M1	Accn = $\omega^2 \times 0.5\sin\theta$
		1	A1✓	Using cv(48.2), allow any acute $\theta$
	$\omega = 5.48 \text{ rad s}^{-1}$	1	A1	
			3	

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Question	Answer	Marks	Partial Marks	Guidance
5(i)	$0.5v \frac{dv}{dx} = -0.5g - 0.02v^2$	1	M1	
	$v \frac{dv}{dx} = -10 - 0.04v^2$ AG	1	A1	
		2		
5(ii)	$\int_a^0 \frac{v}{-10 - 0.04v^2} dv = \int_0^x dx$	1	M1	Separates the variables and attempts to integrate
	$x = [-\ln(10 + 0.04v^2) / 0.08]_8^0$	1	M1	Uses limits or finds constant
	$x = 2.85$	1	A1	
		3		
5(iii)	$v \frac{dv}{dx} = 10 - 0.04v^2$	1	B1	
	$\int_0^v \frac{v}{10 - 0.04v^2} dv = \int_0^{2.85} dx$	1	M1	Integrates new acceleration
	$\ln[(10 - 0.04v^2) / 10] / -(0.08) = 2.85$	1	M1	Uses earlier answer as distance
	$v = 7.14 \text{ ms}^{-1}$	1	A1	
		4		

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Question	Answer	Marks	Partial Marks	Guidance
6(i)	$d \cos \theta = h / \cos \theta$	1	M1	$\theta =$ semi-vertical angle
	$\cos \theta = \frac{h}{\sqrt{(0.2^2 + h^2)}}$	1	M1	
	$d = \frac{h}{(h^2 / (0.04 + h^2))}$			
	$d = h + \frac{0.04}{h}$ AG	1	A1	
		3		
6(ii)	$0.6 \times 4 + 0.9W = d(4 + W)$	2	M1 A1	Table of moments idea
	$d = 0.8 + \frac{0.2^2}{0.8}$	1	B1	0.85
	$2.4 + 0.9W = 0.85(4 + W)$	1	M1	
	$0.05W = 1$	1	A1	
	$W = 20$	1	A1	
			6	
7(i)	$Mg = \frac{12.5e}{0.8}$	1	M1	Uses $T = \lambda e/l$
	$e = 0.64M$ AG	1	A1	
			2	

Question	Answer	Marks	Partial Marks	Guidance
7(ii)	$Mg(0.8 + e) =$	1	M1	PE/KE/EE conservation
	$\frac{M \times 44^2}{2} + \frac{12.5e^2}{(2 \times 0.8)}$	1	A1	
	$10M(0.8 + 0.64M) =$	1	M1	
	$9.68M + \frac{12.5(0.64M)^2}{1.6}$	1	A1	$8M + 6.4M^2 = 9.68M + 3.2M^2$
	$8 + 6.4M = 9.68 + 3.2M$	1	M1	Attempt to solve equation in $M$
	$M = 0.525$	1	A1	
			6	
7(iii)	$0.525gd = \frac{12.5(d - 0.8)^2}{(2 \times 0.8)}$	1	M1	PE/EE balance
	$0.672d = d^2 - 1.6d + 0.64$	1	M1	
	$d = 1.94$	1	A1	
			3	