

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

## MARK SCHEME for the October/November 2006 question paper

### 9709 MATHEMATICS

9709/05

Paper 5, maximum raw mark 50

This mark scheme is published as an aid to teachers and students, 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

The grade thresholds for various grades are published in the report on the examination for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2006 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

## 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  $\checkmark$  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 $\sqrt{}$ " 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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	GCE A/AS LEVEL - OCT/NOV 2006	9709	5

1	(i)	$y = \pm \frac{10x^2}{2 \times 8^2 \times 1^2}$ or $x = 8t, y = \pm \frac{1}{2}gt^2$	M1		For correct substitution into the trajectory formula ( in booklet)  For an attempt to eliminate t	
		$y = -\frac{5}{64}x^2$	A1	2		
	(ii)		M1		For using $h = -y(24)$ or substituting $t=3$ in $y = \frac{1}{2}gt^2$	
		Height = 45m	A1	2		4

2	(i)	$R = 0.6N$	B1			
		$F = 0.06 \times 3^2 \times 0.25$	M1		For using Newton's second law and $a = r\omega^2$	
		$F = 0.135$	A1	3		
	(ii)	$\mu \geq 0.225$	B1	1	From using $\mu \geq F/R$	4

3	(i)	$T \cos \alpha = 0.24g$ where $\sin \alpha = 0.35/1.25$	M1		For resolving forces vertically ( $\alpha = 16.26$ )	
		Tension is 2.5N	A1	2		
	(ii)		M1		For using Newton's second law (3 terms required)	
		$R + T \sin \alpha = 0.24 \times 8$	A1ft		ft for their T only	
		Force exerted is 1.22N	A1	3		5

4		Height at A = 16.8	B1			
		$25 \times 0.8t - \frac{1}{2}10t^2 =$ $25 \times 0.8 \times 1.2 - \frac{1}{2}10 \times 1.2^2$	M1			
		$t = (1.2), 2.8$	A1			
		$AB = 25(2.8 - 1.2)0.6$	M1		For using Distance = $V(t_B - t_A) \cos \theta$	
		Distance = 24m	A1	5		5

OR

4		$R = 2 \times 25^2 \times 0.8 \times 0.6 \div 10$ ( = 60)	B1		Using $R = 2V^2 \sin \theta \cos \theta / g$ ( $\theta = 53.13$ )	
			M1		For using Distance = $R - 2x(1.2)$	
			DM1		For using $x = Vt \cos \theta$	
		$AB = 2 \times 25^2 \times 0.8 \times 0.6 \div 10$ $- 2 \times 25 \times 1.2 \times 0.6$	A1ft			
		Distance is 24m	A1	5		5

OR

4		Height at A = 16.8	B1			
		$16.8 = 4x/3 - x^2/45$ or equivalent	M1		For using trajectory equation from formula booklet	
		$x = 18$ or $x = 42$	A1			
		Distance = $42 - 18$	M1			
		Distance is 24m	A1	5		5

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5	(i)		M1		For taking moments about A	
		$3g \times 1.5 = 2.5(T \cos 15^\circ)$	A1			
		$T = 18.6$	A1	3		
	(ii)	$T_A \sin \alpha = T \sin 15^\circ$ $T_A \cos \alpha + T \cos 15^\circ = 3g$ or $T_A \cos \alpha \times 2.5 = 3g \times 1$	M1		For resolving forces horizontally and vertically or taking moments about B.	
		$\tan \alpha = T \sin 15^\circ \div (3g - T \cos 15^\circ)$	M1		For eliminating $T_A$	
		$\alpha = 21.8$ or $21.9$	A1	3		6

6	(i)	Distance of centre of mass of semicircle from centre = $10/3 \pi$	B1			
		$2.5 \times 0.8 + (10/3 \pi) \times 0.6$	M1		$r \cos \theta + d \sin \theta$	
		Distance is $(2 + \frac{2}{\pi})m$	B1	3	From correct working (AG)	
	(ii)		M1		For using $\bar{A} \bar{x} = A_1 \bar{x}_1 + A_2 \bar{x}_2$ (3 terms required)	
		$(\frac{1}{2} \times 4 \times 3 + \frac{1}{2} \pi \times 2.5^2) \bar{x} =$ $\frac{1}{2} \times 4 \times 3 \times (4/3) +$ $(\frac{1}{2} \pi \times 2.5^2)(2 + \frac{2}{\pi})$	A1 B1 A1			
		Distance is 2.14m	A1	5	From correct working (AG)	8

7	(i)	$v \frac{dv}{dx} = 0.6x^{0.2}$	B1			
			M1		For separating and integrating	
		$0.5v^2 = 0.5x^{1.2} (+C_1)$	A1			
		$v = x^{0.6}$	A1	4		
	(ii)	$\int x^{-0.6} dx = \int dt$	M1		For using $v = dx/dt$ , separating and integrating	
		$x^{0.4} / 0.4 = t (+C_2)$	A1			
		$t = 2.5x^{0.4}$	A1	3		
	(iii)	$x = (10/2.5)^{2.5}$	M1		For substituting for t and solving for x	
		Distance is 32m	A1	2		9

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8	(i)	EE at A = $(5 \times 0.3^2) \div (2 \times 0.6)$	M1		For using EE = $\frac{\lambda x^2}{2L}$	
		PE loss at B = $0.2 \times 10 \times 0.3$	B1			
		$0.375 = \frac{1}{2} 0.2 v^2 - 0.6$	M1		For using EE at A = KE gain – PE loss (Allow sign errors)	
		Velocity is $3.12 \text{ms}^{-1}$	A1	4		
	(ii)	(a)	M1		For using EE at A = EE at C – PE loss	
		$0.375 = 5x^2 \div (2 \times 0.6) -$	A1			
		$0.2 \times 10(1.5+x)$				
		$x^2 - 0.48x - 0.81 = 0$	A1	3	From correct working (AG)	
OR	(ii)	(a)	(M1)		For using KE at B + PE at B = EE at C	
		$0.975 + 0.2 \times 10(1.2 + x) =$ $5x^2 / 1.2$	(A1)			
		$x^2 - 0.48x - 0.81 = 0$	(A1)	(3)		
		(b)	M1		For solving and adding 1.5 to +ve root	
		Distance is 2.67m	A1	2	From 1.5 + 1.17	9