

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2006 question paper

9709 MATHEMATICS

9709/04

Paper 4, 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 \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 $\sqrt{}$ " 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.

Page 3	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL - OCT/NOV 2006	9709	04

1	(i) [WD = $30 \times 20 \cos 10^\circ$] Work done is 591J	M1 A1	2	For using $WD = Fd \cos \beta$	
	(ii) [PE gain = $8 \times 10 \times 20 \sin 15^\circ$] PE gain is 414J	M1 A1	2	For using $PE = mgh$ and $h = d \sin \alpha$	
	(iii) Work done is 177J	B1ft	1	ft (ans(i) – ans(ii))	
2	(i) [$F + 5 \cos 30^\circ = 0.6g$] Frictional force is 1.67 N	M1 A1	2	For resolving forces vertically (3 terms needed)	
	(ii) $R = 5 \sin 30^\circ$ [= 2.5] Coefficient is 0.668	B1 M1 A1	3	Can be scored in (i) For using $1.67 = \mu R$	
	3	$F = 420/5$ [= 84]	B1 M1	For using Newton's second law in (i)	
3	(i) Acceleration is 1.12ms^{-2}	A1ft		From $F = 75a$	
	(ii) [$420/5 - 750 \sin 1.5^\circ = 75a$ or $a = 1.12 - g \sin 1.5^\circ$] Acceleration is 0.858ms^{-2}	M1 A1ft	5	For including weight component in N2 equation or for $a(\text{ii}) = a(\text{i}) - \text{wt. comp./m}$ ft ans(i) – 0.262	
	4	(i) $a(t) = 1.25 - 0.1t$ Initial acceleration is 1.25ms^{-2}	B1 B1	2	May be scored in (ii) Must follow an attempt to differentiate
4	(ii) [$t = 12$] $1.25t^2/2 - 0.05t^3/3$ (+C) [$1.25 \times 12^2/2 - 0.05 \times 12^3/3 = 90 - 28.8$] Displacement is 61.2m	M1 M1 A1 DM1 A1	5	For attempting to solve $dv/dt = 0.05$ For attempting to integrate $v(t)$ For using appropriate limits (0 to 12) or equivalent	
	5	(i) Loss of PE = $mg \times 2.45$ [$\frac{1}{2} mv^2 = 24.5m$] Greatest speed is 7ms^{-1}	B1 M1 A1	3	For using KE gain = PE loss
		(ii) KE = $0.5g(2.45 - 1.2)$ or KE = $\frac{1}{2} 0.5 \times 7^2 - 0.5g \times 1.2$ Kinetic energy is 6.25J	B1ft B1	2	SR(max 1 mark out of 2) For use of $v^2 = 2 \times 10(2.45 - 1.2)$ to obtain $v = 5$ and then KE = $\frac{1}{2} 0.5 \times 5^2 = 6.25$ B1
(iii) [$\frac{1}{2} 0.5v^2 = 6.25$] Least value is 5		M1 A1	2	For using KE found in (ii) = $\frac{1}{2} mv^2$ or $\frac{1}{2} m 7^2 - 1.2mg = \frac{1}{2} mv^2$	

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6	(i)	M1	For using
	P = 10 R = 26.9	A1 A1ft	$ X = \sqrt{X_1^2 + X_2^2}$ for P or R From $P^2 = (-2.8)^2 + 9.6^2$ From $R^2 = 10^2 + 25^2$ or $R^2 = 21.2^2 + 16.6^2$
		3	
	(ii)	M1	For using $\tan \alpha = 9.6/(\pm 2.8)$ or equivalent; may be scored in (i)
	$\alpha = 73.7$ (a) 24N (b) 7N	A1 A1ft A1ft	From c.w.o.; may be scored in (i) ft $25\cos(90 - \alpha)^\circ$ for $\alpha > 0$ ft $25\sin(90 - \alpha)^\circ$ for $\alpha > 0$
		4	
	(iii)	M1	For using $\cos \theta = X/R$, $\sin \theta = Y/R$ or $\tan \theta = Y/X$, finding X or Y or X and Y as necessary
	$\cos \theta = (24 - 2.8)/26.9 \dots$ or $\sin \theta = (7 + 9.6)/26.9 \dots$ or $\tan \theta = (7 + 9.6)/(24 - 2.8)$	A1ft	
			Alternative for the above 2 marks: For using $\theta = \tan^{-1}(Y/X) + \tan^{-1}(P/25)$ M1 $\theta = \tan^{-1}(7/24) + \tan^{-1}(10/25)$ A1ft
	$\theta = 38.1$	A1	3

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7	(i)	$R = mg\cos 21^\circ = 9.336m$	B1		
		$a = -5$	M1		For using $0 = 10 + at$
		$[-mg\sin 21^\circ - F = -5m]$	A1		
			M1		For using Newton's second law
					Alternative for the above 3 marks;
					For using WD by frictional force = KE at P – PE at highest point M1
					WD = $\frac{1}{2} m10^2 - mg\sin 21^\circ$ A1
					$s = 10$ (mark available in (ii) may be given here)
					For WD = Fs to find F DM1
		$F = 1.416m$	A1	5	
	(ii)	Coefficient is 0.152	B1	1	
	(iii)	$s = 10$	B1		From $s = (u + v)/2$ (upwards) or equivalent; may already have been scored for appropriate work in part (i)
					For using Newton's second law
		$mg\sin 21^\circ - 1.416m = ma$	M1		
		$[a = 2.167\dots]$	A1		
		$[v^2 = 2(g\sin 21^\circ - 1.416)10]$	M1		For using $v^2 = 2as$
					Alternative for the above 3 marks
					For using WD by frictional force (up and down) = $2Fs$ M1
					WD = $2(1.416m)10$ A1
					For using KE at P(down) = KE at P(initial) – WD by frictional force (up and down) M1
					$[\frac{1}{2} mv^2 = \frac{1}{2} m10^2 - 28.32m]$
					Second alternative for the above 3 marks
					WD by frictional force (down) = $1.416m \times 10$ B1
					PE loss (down) = $mg(10\sin 21^\circ)$ B1
					For using KE at P(down) = PE loss – WD by frictional force (down) M1
					$[\frac{1}{2} mv^2 = mg(10\sin 21^\circ) - 14.16m]$
		Speed is 6.58 ms^{-1}	A1	5	