

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

**MARK SCHEME for the October/November 2009 question paper
for the guidance of teachers****9709/41****9709 MATHEMATICS**

Paper 41, 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 must be read in conjunction with the question papers and the report on the examination.

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

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9709	41

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.

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9709	41

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 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9709	41

1	$[15000 = 750v_A, 15000 = 500v_B]$ Speeds are 20ms^{-1} and 30ms^{-1} $[KE \text{ gain} = \frac{1}{2} 1000(30^2 - 20^2)]$ Increase is 250 000J (or 250kJ)	M1 A1 M1 A1ft 4	For using $P = Fv$ For using $KE = \frac{1}{2} mv^2$ ft $500(v_B^2 - v_A^2)$
2	(i) $[mgh = \frac{1}{2} m6^2]$ Height is 1.8m ----- (ii) $\frac{1}{2} mv^2 = mg(1.8 + 0.65)$ or $\frac{1}{2} mv^2 - \frac{1}{2} m6^2 = mg \times 0.65$ Maximum speed is 7ms^{-1}	M1 A1 2 ----- B1ft B1 2	For using PE loss = KE gain
3	Q – $P\cos 60^\circ = 12\cos 80^\circ$ and $P\sin 60^\circ = 12\sin 80^\circ$ $Q\cos 80^\circ + P\cos 40^\circ = 12$ and $P\sin 40^\circ = Q\sin 80^\circ$ $[Q - 12\sin 80^\circ \cos 60^\circ / \sin 60^\circ = 12\cos 80^\circ]$ $Q\cos 80^\circ + Q\sin 80^\circ \cos 40^\circ / \sin 40^\circ = 12]$ $Q = 8.91$ (First alternative) $Q\cos 30^\circ = 12\cos 50^\circ$ $Q = 8.91$ (Second alternative) Angles opposite Q and 12 are 40° and 60° respectively $Q/\sin 40^\circ = 12/\sin 60^\circ$ $Q = 8.91$ (Third alternative) Angle between P and Q is 120° and between P and –R is 140° $[Q/\sin 140^\circ = 12/\sin 120^\circ]$ $Q = 8.91$	M1 A1 M1 A1 4 M2 A1 A1 4 M1 A1 M1 A1 4 M1 A1 M1 A1 4	For resolving forces parallel to or perpendicular to:– the force of magnitude QN, or the resultant For eliminating P For resolving forces perp. to P For triangle of forces with sides P, Q and 12, and values of any 2 angles shown or implied (Note P, Q and –R are in equil.) For using the sine rule For force diagram showing P, Q and –R, and values of any 2 angles at ‘O’ shown. For using Lami’s theorem

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9709	41

<p>4 (i) For angle between AP and vertical = 36.9° (or $\sin^{-1}0.6$) or for angle between PS and vertical = 53.1° (or $\sin^{-1}0.8$)</p> <p>[$T_{PS} + (T_{PA}\cos90^\circ) = 5\sin36.9^\circ$]</p> <p>.....</p> <p>(First alternative) For the angle between PA and the horizontal through P is 53.1° and the angle between PS and the horizontal through P is 36.9°</p> <p>[$0.6T_{PA} = 0.8T_{PS}$ and $0.8T_{PA} + 0.6T_{PS} = 5 \rightarrow$ $\{0.8(0.8/0.6) + 0.6\}T_{PS} = 5$]</p> <p>.....</p> <p>(Second alternative) For Δ of forces with sides T_{PA}, T_{PS} and 5, with angles opposite T_{PS} and 5 shown as 36.9° and 90°</p> <p>[$T_{PS} = 5\sin36.9^\circ$]</p> <p>.....</p> <p>(Third alternative) For force diag. showing T_{PA}, T_{PS} and 5, with angles between T_{PS} and T_{PA}, and between 5 and T_{PA} being shown as 90° and 143.1° [$T_{PS}/\sin143.1^\circ = 5/\sin90^\circ$]</p> <p>.....</p> <p>Tension is 3N</p>	<p>B1</p> <p>M1</p> <p>B1</p> <p>M1</p> <p>B1</p> <p>M1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1ft</p> <p>M1</p> <p>A1ft</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>A1ft</p> <p>B1ft</p> <p>B1</p> <p>B1</p>	<p>May be implied</p> <p>For resolving forces on P in the direction of PS (2 non-zero terms required)</p> <p>.....</p> <p>May be implied</p> <p>For resolving forces on P vertically and horizontally and eliminating T_{PA}</p> <p>.....</p> <p>May be implied</p> <p>For using trig. in Δ</p> <p>.....</p> <p>May be implied</p> <p>For using Lami's rule</p> <p>.....</p> <p>Accept 3.00</p> <p>-----</p> <p>For resolving forces on S horizontally</p> <p>Accept 2.40</p> <p>-----</p> <p>For resolving forces on S vertically</p> <p>ft $W = 7T/15$ or $W = 4F/3 - 1.8$</p> <p>-----</p> <p>For using Newton's second law</p> <p>For resolving forces normal to the plane</p> <p>-----</p> <p>B1ft</p> <p>B1</p> <p>SR For candidates who use 'a' for the upwards acceleration, instead of as defined in the question. $-0.6g\sin18^\circ + 0.546 = 0.6a \rightarrow a = -2.18$ B1 a = 2.18 accompanied by satisfactory explanation for dropping the minus sign. B1</p>
<p>5 (i)</p> <p>$-F - 0.6g\sin18^\circ = 0.6(-4)$ Frictional component is 0.546N</p> <p>[$R = 0.6g\cos18^\circ$] Normal component is 5.71N Coefficient is 0.096</p>	<p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>B1ft</p> <p>M1</p> <p>A1</p> <p>B1ft</p>	<p>For using Newton's second law</p> <p>For resolving forces normal to the plane</p> <p>-----</p> <p>6</p> <p>-----</p> <p>2</p> <p>-----</p> <p>2</p>
<p>(ii) $0.6g\sin18^\circ - 0.546 = 0.6a$ or $2(0.6g\sin18^\circ) = 0.6(a + 4)$ $a = 2.18$</p>	<p>B1ft</p> <p>B1</p>	<p>2</p>

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2009	9709	41

6 (i)				For using Newton's second law to P or Q, or for using $a = \frac{M - m}{M + m}g$
	0.55g – T = 0.55a and T – 0.45g = 0.45a or a = [(0.55 – 0.45)/(0.55 + 0.45)]g Acceleration is 1ms ⁻²	M1 A1 A1		3
(ii) (a)	Height of P is 3m and height of Q is 7m	M1 A1ft	2	For using $s = 5 - \frac{1}{2}at^2$ for P or $s = 5 + \frac{1}{2}at^2$ for Q ft 5 – 2a and 5 + 2a
	(b) Speed is 2ms ⁻¹	B1ft	1	ft 2a
(iii)	[3 = 2t _P + 5t _P ² , 7 = –2t _Q + 5t _Q ²] t _P = 0.6	M1 A1		For using $s = ut + \frac{1}{2}gt^2$ for P or for Q (NB a = g)
	t _Q = 1.4 Q is 0.8s later than P	A1 A1	4	Accept t _Q = 0.2 + 1.2 following consideration of upward and downward motion under gravity of Q separately AG
7 (i)	Speed is 6ms ⁻¹ a = 0.6	B1 B1ft	2	ft v/10
	(ii) a(t) = –1600/t ³ (second stage) [0.6 = 1600/t ³ → t ³ = (1600/0.6)] t = 13.9	M1 A1 M1 A1	4	For differentiating v(t) For attempting to solve a(t) = –0.6
(iii)	s ₁ = 30m s = (800t ⁻¹)/(–1) – 2t (+ C) s ₂ = (–40 – 40) – (–80 – 20) or s = –40 – 40 + 130 Displacement from A is 50m	B1 M1 A1 M1 A1 A1	6	SR in parts (i) and (ii) (treated as a single entity) for candidates who assume there is necessarily continuity of acceleration at t = 10 (max 5/6) Speed is 6ms ⁻¹ B1 For differentiating v(t) M1 a(t) = –1600/t ³ A1 a = a(10) = –1.6 B1 For $t = \sqrt[3]{\frac{-1600}{1.6}}$ B1