

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary and Advanced Level

MARK SCHEME for the June 2005 question papers

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 initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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*.

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

CIE is publishing the mark schemes for the June 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

Grade thresholds taken for Syllabus 9709 (Mathematics) in the June 2005 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 4	50	41	37	20

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

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.

June 2005

GCE A AND AS LEVEL

MARK SCHEME
MAXIMUM MARK: 50
SYLLABUS/COMPONENT: 9709/04 MATHEMATICS (Mechanics 1)

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1		$720 = 30(1.5 \times 20) \cos \theta$ $\theta = 36.9$	M1 A1 A1 3	For using $WD = Fd \cos \alpha$ or $P = WD/T$ and $P = (F \cos \alpha)v$
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2		$X = 7 + 5 \cos 50^\circ - 6 \cos 30^\circ$ $Y = 5 \sin 50^\circ - 6 \sin 30^\circ$ $R^2 = 5.01..^2 + 0.83..^2$ $\tan \theta = 0.8302/5.0178$ Magnitude is 5.09 N and direction is 9.4° anti-clockwise from force of magnitude 7 N	M1 A1 A1ft M1 M1 A1 6	For finding component X (3 terms) or component Y (2 terms) ft for sin/cos instead of cos/sin and/or 70° ($100 - 30$) instead of 60° ($90 - 30$) SR (max 1/3) for candidates who use $\Sigma \mathbf{F} + \mathbf{R} = 0$ or $\Sigma \mathbf{F} = 0$ (instead of $\Sigma \mathbf{F} = \mathbf{R}$). $X = +5.02$ or -5.02 and $Y = +0.83$ or -0.83 ----- For using $R^2 = X^2 + Y^2$ For using $\tan \theta = \frac{Y}{X}$
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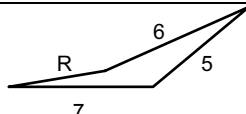
OR

2		10.9N and 20.6° anticlockwise from x-axis or 3.50 N and 59.0° clockwise from x-axis or 2.15 N and 157.3° anticlockwise from x-axis 5.09 N 9.4° anticlockwise from the x-axis	M1 A1 M1 A1 M1 A1 6	For finding the resultant \mathbf{R}_1 (in magnitude and direction) of any two of the forces. For finding the magnitude of the resultant of \mathbf{R}_1 and the third force. For finding the direction of the resultant of \mathbf{R}_1 and the third force.
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OR

2	 <p>$R = 5.09$ (A2) (or some value such that $4.9 \leq R \leq 5.3$ (A1))</p> <p>9.4° (A2) (or some value such that $9^\circ \leq \theta \leq 9.8^\circ$ (A1)) anticlockwise from the x-axis</p>	M2	6	For correct drawing to scale
		A2 (or A1)		

3	$2.25 = \frac{1}{2} a(1.5^2)$ $a = 2$ $R = mg \cos 30^\circ$ $mg \sin 30^\circ - \mu mg \cos 30^\circ = 2m$ Coefficient of friction is 0.346	M1	6	For using $s = \frac{1}{2} at^2$ For applying Newton's second law (3 terms) and $F = \mu R$ ft incorrect a or R or consistent sin/cos mix
		A1		

OR

3	KE gain = $\frac{1}{2} m3^2$ $R = mg \cos 30^\circ$ $2.25 \mu mg \cos 30^\circ = mg(2.25 \sin 30^\circ) - \frac{1}{2} m3^2$ Coefficient of friction is 0.346	M1	6	For using $(0 + v)/2 = s/t$ to find v_B and hence KE gain from $\frac{1}{2} mv_B^2$ For using $F = \mu R$ and $2.25F = \text{PE loss} - \text{KE gain}$ ft incorrect v_B or R or consistent sin/cos mix
		A1		

4	(i)	$T = 0.2g$ and $T = F$ $R = 0.3g$ and $0.2g = \mu R$ Coefficient is $2/3$	M1	4	For resolving forces vertically on A and horizontally on B For resolving forces vertically on B and using $F = \mu R$
			A1		
			B1		SR (max 1 / 4) for candidates who do not use $a = 0$ $0.2g - 0.3 \mu g = 0.5a$
	(ii)	$F = 2/3(0.3g - 1.8)$ (= 0.8) $X = 2.8$	B1ft	3	ft wrong μ For using $X = T + F$ (correct signs needed) ft incorrect values of T (from part (i)) and/or μ
			M1		

5	(i)	$x = 0.01t^3 \quad (+C)$ $2.5 = 0.01 \times 5^3 + C$ $x = 0.01t^3 + 1.25$	M1 A1 DM1 A1 ft 4	For attempting to use $x(t) = \int v dt$ For substituting $x = 2.5$ and $t = 5$ and attempting to find C ft candidate's a where $x = at^3 + C$
	(ii)	$0.01t^3 + 1.25 = 11.25$ $t = 10$ Velocity is 3ms^{-1}	M1 A1 B1ft 3	For attempting to solve $x(t) = 11.25$ (equation needs to be of the form $at^3 = b$) ft for value of $0.03t^2$

6	(i)	$\frac{1}{2} 5v_{\text{max}} = \pm 10$ Greatest speed is 4ms^{-1}	M1 A1 2	For using the idea that the area of the relevant triangle represents distance
	(ii)	$V/3 = 2$ or $V = 0 + 2 \times 3$ $V = 6$	M1 A1 2	For using the idea that the gradient represents acceleration or $v = 0 + at$
	(iii)	$\frac{1}{2} (T + 9.5)6 = 34.5$ or $\frac{1}{2} (t - 18 + 9.5)6 = 34.5$ Time is 2 s	M1 A1 ft 3	For an attempt to find the area of the trapezium in terms of T (or of t) and equate with 34.5 Any correct form of equation in T (or t)
	(iv)	$d = \frac{6}{24.5 - (18 + 2)}$ Deceleration is $4/3 \text{ms}^{-2}$	M1 A1ft 2	For using the idea that minus the gradient represents deceleration

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7	(i)	Driving force = $20\,000/10$ $DF - R = ma$ $2000 - 500 = 1200a$ Acceleration is 1.25ms^{-1}	B1 M1 A1 ft A1	4	For using Newton's second law (3 terms needed)
	(ii)	KE change = $\frac{1}{2} 1200 (25^2 - 10^2)$ Difference in KE is 315 000 J $20\,000 = \text{WD by car's engine}/30.5$ Work done is 610 000 J $610\,000 = 315\,000 +$ WD against resistance $500(AB) = 295\,000$ Distance is 590 m	M1 A1 M1 A1 M1 M1 A1 ft A1		