UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2008 question paper

9709 MATHEMATICS

9709/04 Paper 4, 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.

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 discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2008 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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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 √ 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 √" 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.

1 **(i)**	**(a)** $10 - 8\cos\theta$	B1		
	(b) $8\sin\theta$	B1	[2]	
(ii)		M1		For using $X^2 + Y^2 = R^2$ or for using the cosine rule in the relevant triangle
	$(10 - 8\cos\theta)^2 + (8\sin\theta)^2 = 8^2$ or			
	$10^2 + 8^2 - 2\text{x}10\text{x}8\cos\theta = 8^2$	A1ft		
	$\cos\theta = 5/8$	A1	[3]	AG
	First alternative for **(ii)**			
	[$\cos\varphi = (10 - 8\cos\theta)/8$ and $\sin\varphi = 8\sin\theta/8$]	M1		For using $\cos\varphi = X/R$ and $\sin\varphi = Y/R$
	$8\cos\varphi = (10 - 8\cos\theta)$ and $\varphi = \theta$	A1ft		
	$\cos\theta = 5/8$	A1		AG
	Second alternative for **(ii)**			
	[5, $\sqrt{39}$, 64]	M1		For assuming $\cos\theta = 5/8$ and hence finding exact values of $\sin\theta$, X, Y and $X^2 + Y^2$
	R = 8	A1		
	➔ assumption correct	A1		
	SR for **(ii)** (max 2/3)			
		M1		For assuming $\cos\theta = 5/8$ and hence finding $\theta = 51.3^\circ$ and the values of X, Y and $X^2 + Y^2$
	R = 8 or 8.0 or 8.00 or 7.997..			
	➔ assumption correct	A1		

2		M1		For resolving forces parallel to the plane (either case)
	[R = 197, F = 63.0]	M1		For using F = 0.32R and $R = 20g\cos10^\circ$ (or $20g\sin10^\circ$ if this is part of a consistent sin/cos interchange)
(i)	$P = F + 20g\sin10^\circ$	A1		
	Least magnitude is 97.8N	A1		

(ii)	$P = F - 20g\sin 10^o$	A1ft		ft with $P\cos 10^o$ instead of P or sign error or cos instead of sin in component of weight
	Least magnitude is 28.3N	A1	[6]	
	SR (for candidates who omit g) (max 3/6)			
	For $P = F + 20\sin 10^o$ in **(i)** and			
	$P = F - 20\sin 10^o$ in **(ii)**	B1		
		M1		For using $F = 0.32R$ and $R = 20\cos 10^o$
	Least magnitude is 9.78N in **(i)** and 2.83 in **(ii)**	A1		

3	**(i)**	M1		For applying Newton's second law (3 terms)
	$F - 900 = 1200a$	A1		
	$[18000/25 - 900 = 1200a]$	M1		For using $F = P/v$
	Deceleration is $0.15 ms^{-2}$	A1	[4]	Accept $a = -0.15$
(ii)	$18000/v - 900 = 0$	B1		
	Least speed is $20 ms^{-1}$	B1	[2]	AG

4	$[s = (0 + 0.5)/2 \times 7]$	M1		For using $(u + v)/2 = s/t$
	$s = 1.75m$	A1		May be implied
	PE gain = $160g \times 1.75$	B1ft		
	KE gain = $\frac{1}{2} 160 \times 0.5^2$	B1		
	[WD = 2800 + 20]	M1		For using WD = PE gain + KE gain
	Work done is 2820J	A1	[6]	
	SR (max 4/6) for candidates who use a non-energy method			
	$[s = (0 + 0.5)/2 \times 7]$	M1		For using $(u + v)/2 = s/t$
	$s = 1.75m$	A1		
	[a = 1/14, T = 160g + 160/14, WD = 1611.4... x 1.75]	M1		For finding the acceleration and using Newton's second law (3 terms) to find the tension in the rope, then multiplying by the distance
	Work done is 2820J	A1		

5	**(i)**	**(a)**	[5 = 0 + 2a]	M1	For using v = u + at with u = 0
			Acceleration is 2.5ms^{-2}	A1 [2]	
		(b)		M1	For applying Newton's second law to A (3 terms): (can be scored in **(ii)** by applying Newton's second law to B instead)
			0.5g – T = 0.5x2.5	A1ft	
			Tension is 3.75N	A1 [3]	
	(ii)		T – mg = 2.5m or 0.5g – mg = 0.5x2.5 + 2.5m	B1ft	ft from T – 0.5g = 0.5x2.5 in **(i) (b)** to allow mg – T = 2.5m or mg – 0.5g = 0.5x2.5 + 2.5m
			[(10 + 2.5)m = 3.75]	M1	For solving 3 term equation for m
			m = 0.3	A1 [3]	

6	**(i)**		• v is single valued, continuous and positive for 0 < t < 1000. • 1st segment has +ve slope And two or more of • v(0) = 0 • v(1000) = 0 • 2nd segment has zero slope • 3rd segment has -ve slope	M1	For sketching a graph consisting of 3 straight line segments, for which (see left):
			Correct sketch	A1 [2]	
	(ii)			M1	For using 'area under graph' represents distance of 20000m
			½ (600 + 1000)V = 20 000	A1	
			V = 25	A1 [3]	
	SR for candidates who assume 1st and 3rd time intervals are each 200 s (max 2/3)				
			½ Vx200 + Vx600 + ½ Vx200 = 20000	B1	
			V = 25	B1	

(iii)	[$V/t_1 = 0.15$ ➔ $t_1 = 166.6…$]	M1		For using the gradient property for acceleration (or $v = 0 + at$) to find t_1.
	$t_3 = 233.3…$	A1ft		ft 400 – V/0.15
	[$s_3 = ½\ 233.3...x25$]	DM1		For using the area property for distance or $(u + v)/2 = s/t$. Depends on previous M1
	Distance is 2920m	A1	[4]	
				Alternatively For using $V^2 = 2x0.15s_1$ M1 [➔ $s_1 = 2083.3..$] $s_2 = 15000$ B1ft (ft 600V) For $s_3 = 20000 – s_1 – s_2$ DM1 Distance is 2920m A1

7 (i)	[$v^2 = 2x10x1.25$ or $½\ mv^2 = mg(1.25)$, $1.25 = ½\ 10t^2$]	M1		For using $s = 1.25$ and $a = 10$ to find either v or t
	Speed of P is $5ms^{-1}$	A1		
	Time taken is 0.5s	A1	[3]	
(ii)		M1		For using $v = \int a(t)dt$
	$v = 10t – 0.15t^2$ (+C)	A1		
	$v = 10t – 0.15t^2 + 5$	A1ft		ft wrong answer in **(i)**
		M1		For using $x = \int v(t)dt$
	$x = 5t^2 – 0.05t^3 + 5t$	A1ft		
	[$x = 5x2.5^2 – 0.05x2.5^3 + 5x2.5$ (= 42.97)]	DM1		For substituting $t = 3 – t_1$ in x(t). Depends on both previous M1s.
	Distance OP is 44.2m	A1	[7]	