## MARK SCHEME for the October/November 2009 question paper

## for the guidance of teachers

# 9709 MATHEMATICS

9709/42

Paper 42, 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.

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UNIVERSITY of CAMBRIDGE International Examinations

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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.

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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.

GCE A/AS LEVEL - October/November 20099709421(i)For resolving forces parallel to the plane or for a correct triangle of forces or for resolving horizontally an vertically1(i)[P = Wsin40"]M1P = 7.71A12(ii)[Pcos40" = Wsin40"]M1P = 10.1A122(i)Loss in PE is $2.7 \times 10^6$ JB1(iii)WD is $2.1 \times 10^6$ JB11(iii)WD is $2.1 \times 10^6$ JB11(iii)KE change = ½ 15000(16 <sup>2</sup> - 14 <sup>2</sup> )B1WD by DF = Gain in KE + WD by resistanceSR for candidates who use Newton's Law method instead of energy (max) a = (16 <sup>2</sup> - 14 <sup>2</sup> )(2 × 2500) = 0.012 = 1780 WD = 1780 × 2500 = 4.45 × 10 <sup>6</sup> B13(i)[DF = 600 at max speed] [DF = 24000/v]M1For using DF = R at max. speed For using DF = P/v A13(ii)DF - R = ma] 24000/15 - 600 = 1250a Acceleration is 0.8 ms <sup>-2</sup> M1For using Newton's second law A14(i)[1.2 = mg cosa] Mass is 0.125 kgM1For using Newton's second law A14(i)[1.2 = mg cosa] Mass is 0.125 kgM1For using Newton's second law A1(iii)[-mg sina - P = ma] m o.125 × 10 × 0.28 - 0.4 = 0.125a a = -6 → deceleration is 6 ms <sup>-2</sup> A13(iii)[-mg sina - P = ma] m o.125 × 10 × 0.28 - 0.4 = 0.125a a = -6 → deceleration is 6 ms <sup>-2</sup> A13(iii)[-mg sina - P = ma] m o.125 × 10 × 0.28 - 0.4 = 0.125a a = -6 → deceleration is 6 ms <sup>-2</sup> A1	Paç		ge 4	Mark Scheme: Teachers' version					Syllabus	Paper
$ \begin{bmatrix} P = W\sin 40^{\circ} \end{bmatrix} & M1 & for using DF = R at max. speed  M1 & For using Newton's second law  At 0 & At 3 & AG & At 3 \\ \hline (ii) \begin{bmatrix} 1.2 = mg \cos a \\ Mass is 0.125 kg & At 2 & At 3 \\ \hline (iii) \begin{bmatrix} -mg sina - F = ma \\ -0.125 \times 10 \times 0.28 - 0.4 = 0.125a \\ a = -6 & deceleration is 6 ms^{-2} & At 3 \\ \hline (iii) \end{bmatrix}$				GCE A/AS LEVEL -	- October/N	ovemb	er 20	009	9709	42
$ \begin{bmatrix} P = Wsin40^{\circ} \end{bmatrix} & M1 & for a correct triangle of forces or for resolving horizontally ar vertically     P = 7.71 & A1 2 \\ \hline (ii) & [Pcos40^{\circ} = Wsin40^{\circ}] & M1 & A1 & 2 \\ \hline (ii) & US is in PE is 2.7 \times 10^{6} J & B1 & 1 & fi incorrect loss in PE \\ \hline (iii) & WD is 2.1 \times 10^{6} J & B1 & 1 & fi incorrect loss in PE \\ \hline (iii) & WD is 2.1 \times 10^{6} J & B1 & 1 & fi incorrect loss in PE \\ \hline (iii) & WD is 2.1 \times 10^{6} J & B1 & 1 & fi incorrect loss in PE \\ \hline (iii) & WD is 2.1 \times 10^{6} J & B1 & 1 & fi incorrect loss in NE & WD by DF = Gain in KE + WD by resistance \\ \hline (iii) & WD is 4.45 \times 10^{6} J & A1 & 3 & SR for candidates who use Newton's Law method instead of energy (max a a (16^{2} - 14^{2})/(2 \times 2500) = 0.012 & DF = 1600 + 15000 \times 0.012 & 1780 & WD = 1780 \times 2500 = 4.45 \times 10^{6} B1 \\ \hline (i) & [DF = 600 at max speed] & M1 & For using DF = R at max. speed For using DF = 24000/v] & Speed cannot exceed 40 ms^{-1} & A1 & 3 & AG \\ \hline (i) & DF - R = ma] & M1 & For using DF = P/v & A1 & 3 & AG \\ \hline (i) & DF - R = ma] & M1 & For using Newton's second law & A4000/15 - 600 = 1250a & A1 & A1 & 3 \\ \hline (i) & [1.2 = mg \cos a] & M1 & For using Newton's second law & A1 & A1 & 3 \\ \hline (ii) & [-mg sina - F = ma] & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For using Newton's second law & A1 & 3 \\ \hline (iii) & M1 & For comparing magnitudes of \mu R (0.4 and mg sing (0.35)) \\ \hline (iii) & M1 & For comparing magnitudes of \mu R (0.4 and mg sing (0.35)) \\ \hline (iii) & M1 & For comparing magnitudes of \mu R (0.4 and mg sing (0.35)) \\ \hline (iii) & M1 & For comparing magnitudes of \mu R (0.4 and mg sing (0.35)) \\ \hline (iii) & M1 & For comparing magnitudes of \mu $	1						Б		uin a fanaaa nanal	1-14-
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$\begin{bmatrix} WD = \frac{1}{2} 15000(16^2 - 14^2) + 1600 \times 2500 \end{bmatrix} M1 \\ A1 3 \\ \hline A1 3 \\ \hline SR \text{ for candidates who use Newton's Law method instead of energy (max is a = (16^2 - 14^2)/(2 \times 2500) = 0.012 \\ DF = 1600 + 15000 \times 0.012 = 1780 \\ WD = 1780 \times 2500 = 4.45 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 2500 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 2500 = 4.45 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 2500 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^6 \text{ B1} \\ \hline WD = 1780 \times 10^$		(111)	KE chang	$c = \frac{72}{1000}(10 - 14)$	Ľ	<b>D</b> 1	W	VD hy D	$\mathbf{F} = \mathbf{Gain}$ in $\mathbf{KF}$	+ WD by
WD is $4.45 \times 10^6 \text{ J}$ A13SR for candidates who use Newton's Law method instead of energy (max $a = (16^2 - 14^2)/(2 \times 2500) = 0.012$ DF = 1600 + 15000 $\times 0.012 = 1780$ WD = 1780 $\times 2500 = 4.45 \times 10^6 \text{ B1}$ G (i) [DF = 600 at max speed] [DF = 24000/v] Speed cannot exceed 40 ms <sup>-1</sup> M1For using DF = R at max. speed M1 For using DF = P/vG (ii) DF - R = ma] $24000/15 - 600 = 1250a$ Mass is $0.125 \text{ kg}$ M1For using Newton's second law A1G (i) [1.2 = mg cosa] Mass is $0.125 \text{ kg}$ M1 A1For resolving forces normal to the play A1G (ii) [-mg sina - F = ma] $- 0.125 \times 10 \times 0.28 - 0.4 = 0.125a$ $a = -6 \rightarrow$ deceleration is 6 ms <sup>-2</sup> M1 A1For using Newton's second law A1 A1M1 M1For comparing magnitudes of $\mu R$ (0.4 and mg sina (0.35)M1 HFor comparing magnitudes of $\mu R$ (0.4 and mg sina (0.35)			$WD = \frac{1}{2}$	$15000(16^2 - 14^2) + 1600$	× 25001 N	/[1		•		WD by
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							а	$=(16^2 -$	$(-14^2)/(2 \times 2500)$	= 0.012
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$\begin{array}{c} -0.125 \times 10 \times 0.28 - 0.4 = 0.125a \\ a = -6 \rightarrow \text{ deceleration is } 6 \text{ ms}^{-2} \end{array} \qquad \begin{array}{c} \text{A1ft} \\ \text{A1} \end{array} \qquad \begin{array}{c} \text{ft incorrect mass} \\ \text{A1} \end{array} \qquad \begin{array}{c} \text{A1ft} \\ \text{and } \text{mg sina} (0.35) \end{array}$		(ii)	[-mg sino	a - F = ma]	N	/11	F	or using	Newton's secor	nd law
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and mg sina $(0.35)$		(iii)			٨	//1	F	or comp	aring magnitude	es of $\mu R(0.4)$
•		()			1					
			$\mu R > mg s$	$\sin \alpha \rightarrow particle remains a$	t rest A	1 2		6		

(i (i (i	1 F [( C ii) F 1 A i) T A i) S H	GCE A/AS LEVEL – Octob $2 + 15\sin 30^\circ = R$ $5 = 15\cos 30^\circ$ $\mu = 15\cos 30^\circ/(12 + 15\sin 30^\circ)$ Coefficient is 0.666 $F = 0.666(12 - 15\sin 30^\circ)$ $5\cos 30^\circ - F = 1.2a$ Acceleration is 8.33 ms <sup>-2</sup> $F = 0.3g = 0.3a$ and $0.7g - T = 0.7a$ or $(0.7 + 0.3)a = (0.7 - 0.3)g$ Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^2/(2 \times 4)$ Height is 0.448 m	er/Nove M1 A1 B1 M1 A1 A1 A1 A1 A1 A1 A1 A1 A1 A1 A1 A1 A1	<u>mber</u> 5 4	20099709For resolving forces verticallyFor using $\mu = F/R$ AGFor using Newton's second lawFor applying Newton's second lawFor applying Newton's second or to B or for using $(M + m)a = (M - m)g$	
(i (i (i (1	1 F [( C ii) F 1 A i) T A i) S H	$F = 15\cos 30^{\circ} \ \mu = 15\cos 30^{\circ} / (12 + 15\sin 30^{\circ}]$ Coefficient is 0.666 $F = 0.666(12 - 15\sin 30^{\circ})$ $5\cos 30^{\circ} - F = 1.2a$ Acceleration is 8.33 ms <sup>-2</sup> F = 0.3g = 0.3a  and  0.7g - T = 0.7a  or  (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $F = 1.6^{2} / (2 \times 4)$	A1 B1 M1 A1 B1 M1 A1 A1 A1 A1 B1ft	4	For using $\mu = F/R$ AG For using Newton's second law For applying Newton's second or to B or for using	
(i (i (i (1	1 F [( C ii) F 1 A i) T A i) S H	$F = 15\cos 30^{\circ} \ \mu = 15\cos 30^{\circ} / (12 + 15\sin 30^{\circ}]$ Coefficient is 0.666 $F = 0.666(12 - 15\sin 30^{\circ})$ $5\cos 30^{\circ} - F = 1.2a$ Acceleration is 8.33 ms <sup>-2</sup> F = 0.3g = 0.3a  and  0.7g - T = 0.7a  or  (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $F = 1.6^{2} / (2 \times 4)$	A1 B1 M1 A1 B1 M1 A1 A1 A1 A1 B1ft	4	For using $\mu = F/R$ AG For using Newton's second law For applying Newton's second or to B or for using	
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(i (i (i	( ii) F 1 A i) T A ii) s H	Coefficient is 0.666 $F = 0.666(12 - 15\sin 30^{\circ})$ $5\cos 30^{\circ} - F = 1.2a$ Acceleration is 8.33 ms <sup>-2</sup> F - 0.3g = 0.3a and $0.7g - T = 0.7a$ or (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	A1 B1 M1 A1 A1 A1 A1 A1 B1ft	4	AG For using Newton's second law For applying Newton's second or to B or for using	
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(i (i (i	1 A i) T A ii) s H	$5\cos 30^{\circ} - F = 1.2a$ Acceleration is 8.33 ms <sup>-2</sup> T - 0.3g = 0.3a and $0.7g - T = 0.7a$ or (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	M1 A1 A1 M1 A1 A1 B1ft		For applying Newton's second or to B or for using	
(i (i (2	A i) T A ii) s H	Acceleration is 8.33 ms <sup>-2</sup> T - 0.3g = 0.3a  and  0.7g - T = 0.7a  or (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $T = 1.6^2/(2 \times 4)$	A1 A1 M1 A1 A1 B1ft		For applying Newton's second or to B or for using	
(i (i (2	A i) T A ii) s H	Acceleration is 8.33 ms <sup>-2</sup> T - 0.3g = 0.3a  and  0.7g - T = 0.7a  or (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $T = 1.6^2/(2 \times 4)$	A1 M1 A1 A1 B1ft		or to B or for using	law to A
(i (i (2	i) 7 <i>A</i> ii) s F	T - 0.3g = 0.3a  and  0.7g - T = 0.7a  or (0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $T_1 = 1.6^2/(2 \times 4)$	M1 A1 A1 B1ft		or to B or for using	law to A
(i (i (2	T A ii) s H	(0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	A1 A1 B1ft	3	or to B or for using	law to A
(i (4	A ii) s H	(0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	A1 A1 B1ft	3		
(i (4	A ii) s H	(0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	A1 A1 B1ft	3	(M+m)a = (M-m)g	
(i (4	A ii) s H	(0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	A1 B1ft	3		
(i (4	A ii) s H	(0.7 + 0.3)a = (0.7 - 0.3)g Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	B1ft	3		
(i (4	ii) s F	Acceleration is 4 ms <sup>-2</sup> $1 = 1.6^{2}/(2 \times 4)$	B1ft	3		
(i (4	ł					
(i (4	ł				ft acceleration	
(4		Height is 0.448 m			For using $0^2 = 1.6^2 - 2gs_2$	
(4			A1	3	From $s_1 + s_2 = 0.32 + 0.128$	
	III) $\iota_j$	$_{1} = 1.6/4$	B1ft		ft acceleration	
					(can be scored in (ii))	
			M1		For using $0 = 1.6 - gt_2$	
	Т	Time taken is 0.56 s	A1	3	From $t_1 + t_2 = 0.4 + 0.16$	
	 Altei	rnative for part (iii))	• •	•		•
		$t_2 = (s_1 + s_2)/0.8$	M1 A1		For observing that the average s the same for each of the two ph equal to $(0 + 1.6)/2 \text{ ms}^{-1}$	-
	-	taken is 0.56 s	A1	3		
-				C	[Similarly for finding $s_1 + s_2$ if found before ans(ii)]	ans(iii) i
(4	 Altei	rnatively for parts ii and iii using v-t				
		graph)				
			M1		Use of gradient to find $t_1$ or $t_2$	
t <sub>1</sub>	$_{1} = 1$ .	$6/4$ and $t_2 = 1.6/10$	A1			
		taken is 0.56s	A1			
					For use of area to find	
			M1		$s_1 \text{ or } s_2 \text{ or } s_1 + s_2$	
S		$.4 \times 1.6/2$ or $s_2 = 0.16 \times 1.6/2$ or				
	$h_1 = 0$		2 A1			
Н	$s_1 = 0$	$s_1 + s_2 = (0.4 + 0.16) \times 1.6/2$	Al	6		

Page 6	Mark Scheme: Tea	Syllabus	Paper			
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(i) $y = 1.2t - 1$	$-0.012t^2$	M1 A1		For usin	$g v(t) = \dot{s}(t)$	
					ag $a(t) = \dot{v}(t)$ and	evaluating
L ( )	$1.2 - 0.024 \times 50$ ]	M1		a(50)		
a = 0 $V = 30$		A1 B1	5	AG		
(ii) $s_1 = 0.6 >$	$(50^2 - 0.004 \times 50^3) = 1000)$	B1				
· · · _	$\frac{s_2}{s_2} = 27.5$	M1		For usin /total tin	g 'average speed =	= total distance
-	$30t_2 = 27.5(50 + t_2)$ ]	M1		For subs to solve	stituting $s_2 = Vt_2$ a for $t_2$	nd attempting
$t_2 = 150$ t = 200		A1 A1	5	ft 50 + t	2 (requires both M	marks)
(Alternative	••••••••••••••••••••••••••••••••••••••		•			
	$-0.004 \times 50^3 (= 1000)$	B1				
$[(1000 + s_2)/t]$ $(1000 + 30(t - s_2)/t]$	-	M1 A1ft			g 'average speed = ne' with $t_2 = t - 50$ d s <sub>1</sub> )	
[27.5t = 1000 t = 200]	+30(t-50)]	M1 A1	5	For atter	mpting to solve fo	r t