Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

MATHEMATICS **9709/42**

Paper 4 **October/November 2019**

MARK SCHEME

Maximum Mark: 50

Published

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

Cambridge Assessment International Education

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:
Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:
Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:
Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Mark Scheme Notes

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

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.

DM or **DB** 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 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.

FT 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.

Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
CWO	Correct Working Only
ISW	Ignore Subsequent Working
SOI	Seen Or Implied
SC	Special Case (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)
WWW	Without Wrong Working
AWRT	Answer Which Rounds To

Question	Answer	Mark	Guidance
1	$(v =)\ 3t^2 - 12t + 4$	*M1	Attempt at differentiation of s to find v
	$(a =)\ 6t - 12$	*M1	Attempt at differentiation of v to find a
	[When $a = 0$, $t = 2$]	DM1	Solve to find t when $a = 0$ and find v at this time
	$v = -8$ ms^{-1}	A1	
	Alternative method for question 1		
	$(v =)\ 3t^2 - 12t + 4$	M1	Attempt at differentiation of s to find v
	$(v =)\ 3(t-2)^2 - 8$ or $t = \frac{-b}{2a} = \frac{12}{6} = 2$	M1	For using the method of completing the square or using the value of '$\frac{-b}{2a}$' to find the t value of the minimum velocity
		M1	Use of the t value at minimum velocity to find v
	$v = -8$ ms^{-1}	A1	
		4	

Question	Answer	Mark	Guidance
2(i)	$\frac{(12-V)}{(35-30)}=0.8$ or $12 = V + 0.8 \times 5$	**M1**	Use gradient of graph or constant acceleration formulae to set up an equation in V
	$V=8$	**A1**	
		2	
2(ii)	$\left[25\times8+5\times10+15\times6+\frac{1}{2}\times(U+8)\times5=375\right]$	**M1**	Attempt to find total distance travelled by the tractor in 50s to set up an equation for U using EITHER areas OR suvat equations OR a combination of areas and suvat In either case total distance must be attempted
		A1FT	Correct equation FT on *their* V from **(i)**
	$U=6$	**A1**	
		3	

Question	Answer	Mark	Guidance
3	$T_A \times \frac{4}{5} + T_B \times \frac{3}{5} + 0.3g = 5$	M1	Resolving vertically
	$T_A \times \frac{3}{5} = T_B \times \frac{4}{5}$	M1	Resolving horizontally
		A1	Both correct
		M1	Solve for T_A or T_B
	$T_A = 1.6$ N and $T_B = 1.2$ N	A1	
	Alternative method for question 3		
	$\left[\frac{5-3}{\sin 90} = \frac{T_A}{\sin 126.9} = \frac{T_B}{\sin 143.1}\right]$	M1	Attempt one pair of Lami's equations
		M1	Attempt a second pair of Lami equations
		A1	Equations all correct
		M1	Evaluate T_A or T_B
	$T_A = 1.6$ N and $T_B = 1.2$ N	A1	

Question	Answer	Mark	Guidance
3	**Alternative method for question 3**		
	$T_A = 5\cos 36.9 - 3\cos 36.9 = 5\times\frac{4}{5} - 3\times\frac{4}{5}$	**M1**	Resolve along *PA*
	$TB = 5\cos 53.1 - 3\cos 53.1 = 5\times\frac{3}{5} - 3\times\frac{3}{5}$	**M1**	Resolve along *PB*
		A1	Both correct
		M1	Evaluate T_A or T_B
	$T_A = 1.6$ N and $T_B = 1.2$ N	**A1**	
	Alternative method for question 3		
	Forces 2N, T_A and T_B with angles 36.9 and 53.1	**M1**	Attempt to illustrate a triangle of forces
	[$T_A = 2\cos 36.9$, $T_B = 2\cos 53.1$]	**M1**	Use trigonometry in the triangle to find T_A and T_B
		A1	Both correct
		M1	Solve for T_A or T_B
	$T_A = 1.6$ N and $T_B = 1.2$ N	**A1**	
		5	

Question	Answer	Mark	Guidance
4(i)	$P = 3000 \times 30$	M1	Use of $P = Fv$ with F = resistance
	$P = 90000$ W = 90kW	A1	
		2	
4(ii)	PE gained = $25000gh$	B1	Correct expression for PE Allow PE = $25\,000\,g\,d \sin 2$
	Initial KE $= \frac{1}{2} \times 25000 \times 30^2$ [= 11 250 000] Final KE $= \frac{1}{2} \times 25000 \times 25^2$ [= 7 812 500]	B1	For either correct [KE loss = 3 437 500]
	Initial KE = Final KE + $25000gh + \frac{3000h}{\sin 2}$ OR Initial KE = Final KE + $25000gd\sin 2 + 3000d$	M1	For a 4 term work-energy equation, correct dimensions
		A1	Correct work-energy equation involving h or d
	$h = 10.2$ m (10.2318…)	A1	
		5	

Question	Answer	Mark	Guidance
5(i)	$h_A = 20t - \frac{1}{2}\times 10t^2$ or $h_B = \pm\frac{1}{2}\times 10(t-1)^2$	B1	OE $h_A = 20(T+1) - \frac{1}{2}\times 10(T+1)^2$ or $h_B = \pm\frac{1}{2}\times 10T^2$
	[Meet when $20t - \frac{1}{2}\times 10t^2 + \frac{1}{2}\times 10(t-1)^2 = 40$]	*M1	Set up an equation using *their* h_A, *their* h_B and 40
	$10t - 35 = 0$	DM1	Solve for t and attempt to find the height at collision.
	$t = 3.5$ so height at collision = 8.75 m	A1	$T = 2.5$ and height at collision = 8.75 m
	Alternative method for question 5(i)		
	$h_A = 20\times 1 - \frac{1}{2}\times 10\times 1^2 = 15, v = 20 - 10\times 1 = 10$	B1	Finding distance travelled by A and its speed after 1 second
	$H_A + H_B = 25$ $\left(10T - \frac{1}{2}\times 10\times T^2\right) + \frac{1}{2}\times 10\times T^2 = 25$	*M1	T is the time beyond 1s until the particles reach same level H_A and H_B are distances travelled by A and B in T seconds.
	[$10T = 25 \to T = 2.5$]	DM1	Solve for T and attempt to find the height at collision
	$t = 3.5$ so height = 8.75 m	A1	
		4	

Question	Answer	Mark	Guidance
5(ii)	$v_A = 20 - gt = -15$ **or** $v_A^2 = 20^2 + 2(-g)(8.75)$	M1	Use of *their t* or *their h* $\leqslant$ 20 from **5(i)** in a constant acceleration formula which would lead to finding v_A
	$v_B = -g(t-1) = -25$ **or** $v_B^2 = 2(g)(40 - 8.75)$	M1	Use of *their t* $\pm$ 1 or *their* 40 – *h* from **5(i)** in a constant acceleration formula which would lead to finding v_B
	Difference = 10 ms^{-1}	A1	CWO
		3	

Question	Answer	Mark	Guidance
6(i)	$4.5 = 0 + \frac{1}{2} \times a \times 5^2$	M1	For use of $s = ut + \frac{1}{2}at^2$ to find a
	$a = 0.36$	A1	
	$6 \times \frac{24}{25} - F = 3 \times 0.36$	M1	Resolving horizontally. Allow use of $\theta = 16.3$
	$F = 4.68$ N	A1	
		4	
6(ii)	$R = 3g - 6\sin 16.3 = 3g - 6 \times \frac{7}{25}$ $[= 28.32]$	B1	
	$4.68 = \mu \times 28.32$	M1	Use of $F = \mu R$
	$\mu = 0.165$ (0.165254…)	A1	AG. Allow $\mu = \frac{39}{236}$
		3	

Question	Answer	Mark	Guidance
6(iii)	$v = 5 \times 0.36$ [= 1.8] or $v = \sqrt{(2 \times 0.36 \times 4.5)}\,[= 1.8]$	B1FT	For velocity at $t = 5$ ft on *their* a from **6(i)**
	$3a = -0.165 \times 3g$	M1	Using Newton's second law with new frictional force
	$0 = 1.8 - 0.165gt$ $(t = 1.09)$	M1	Using constant acceleration equations which would lead to a positive value of t
	Total time = 5 + 1.09 = 6.09 s	A1	
		4	

Question	Answer	Mark	Guidance
7(i)		M1	Use of Newton's second law for P or Q or the system
	For P: $T - 0.3g \times \frac{3}{5} = T - 0.3g\sin 36.9 = 0.3a$ For Q: $0.2g - T = 0.2a$ System: $0.2g - 0.3g \times \frac{3}{5} = (0.2 + 0.3)a$ or $0.2g - 0.3g\sin 36.9 = (0.2 + 0.3)a$	A1	Two correct equations Allow use of $\theta = 36.9$
	$[0.2g - 0.18g = 0.5a]$	M1	For solving either the system for a or for solving a pair of simultaneous equations for a or T
	$a = 0.4$ ms^{-2}	A1	
	$T = 1.92$ N	A1	
		5	

Question	Answer	Mark	Guidance
7(ii)	$0.8 = 0 + \frac{1}{2} \times 0.4 \times t^2$ a	**M1**	For use of the constant acceleration equations with *their a* from **7(i)** and $a \neq \pm g$ for a complete method to find t
	$t = 2$ s	**A1**	
		2	
7(iii)	Speed when Q hits the floor = 2 × 0.4 (= 0.8) or $v = \sqrt{(2 \times 0.4 \times 0.8)}\,[= 0.8]$	**B1FT**	Using $v = u + at$ with $u = 0$ Allow FT for *their* unsimplified $v = at$ or $v^2 = 2as$ with a from **(i)**, t from **(ii)** and $s = 0.8$
	$-0.3g \times \frac{3}{5} = -0.3g \sin 36.9 = 0.3a \quad [a = -6]$	**M1**	Using Newton's second law for P to find $a \neq \pm g$
	$0 = 0.8t + \frac{1}{2} \times (-6)t^2 \; (t = 0.2666...)$ or $0 = 0.8 - 6T$ ($T = 0.13333 = \frac{2}{15}$ and $t = 2T = 0.26666 = \frac{4}{15}$)	**M1**	Use of the constant acceleration equation(s) to find the time taken for P to return to the position where the string first became slack.
	Total time = 2 + 0.266... = $2 + \frac{4}{15} = 2.27 = \frac{34}{15}$ s	**A1**	
		4	