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MATHEMATICS **9709/42**

Paper 4 **October/November 2018**

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 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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

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 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. 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/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 – often written by a ‘fortuitous’ answer

ISW Ignore Subsequent Working

SOI Seen or implied

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.

Question	Answer	Marks	Guidance
1	[$T\cos 45 + T\cos 45 = 2.5\cos 45$]	**M1**	For resolving horizontally
	$T = 1.25$ N	**A1**	
	[$2.5\sin 45 = mg$]	**M1**	For resolving vertically
	Mass of ring = 0.177 kg	**A1**	Allow $m = \sqrt{2}/8$
	First alternative method for Q1		
	[$2.5 = T + mg\cos 45$]	**M1**	Resolve forces along BR
	[$T = mg\cos 45$]	**M1**	Resolve forces perpendicular to BR and eliminate T or m
	$T = 1.25$ N	**A1**	
	Mass of ring = 0.177 kg	**A1**	Allow $m = \sqrt{2}/8$
	Second alternative method for Q1		
	$\frac{2T\cos 45}{\sin 135} = \frac{2.5}{\sin 90} = \frac{mg}{\sin 135}$ or $\frac{2.5 - T}{\sin 135} = \frac{T}{\sin 135} = \frac{mg}{\sin 90}$	**M1**	Attempt to apply Lami's theorem,
		M1	All three terms of Lami attempted
	$T = 1.25$ N	**A1**	
	Mass of ring = 0.177 kg	**A1**	Allow $m = \sqrt{2}/8$
		4	

Question	Answer	Marks	Guidance
2	$R = 5g \cos 6$	**B1**	
	$[F = 0.3 \times 5g \cos 6]$	**M1**	Use of $F = \mu R$
	$[T = 5g \sin 6 + F]$	**M1**	For resolving along the plane
	$T = 20.1$ N (20.14425...)	**A1**	
		4	

Question	Answer	Marks	Guidance
3(i)	Acceleration = -1 m s^{-2}	**B1**	Allow deceleration = 1 m s^{-2}
		1	
3(ii)	[$V/4 = 1$ or $(V + 2)/6 = 1$]	**M1**	Use of gradient of line between $t = 4$ and $t = 10$ or use of similar triangles to find V
	$V = 4$	**A1**	
		2	
3(iii)	[Distance = Area = ½ (6 + 2) × 2 = 8]	**M1**	Attempt distance travelled in first 6 seconds
	Distance AB = 3 × 8 = 24 m	**A1**	
	[½ × (T – 6) × 4 = 24]	**M1**	Attempt to find the distance travelled from $t = 6$ to $t = T$ and set up an equation for T
	$T = 18$	**A1**	
		4	

Question	Answer	Marks	Guidance
4(i)	$T = 0.7g$	**B1**	
	$R = 0.4g \times {}^4/_5$ [$= {}^{16}/_5 = 3.2$]	**B1**	Normal reaction on particle *P*
	[$X + 0.4g \times {}^3/_5 - F - T = 0$]	**M1**	Attempt to resolve forces along the plane
	$X = 6.2$	**A1**	**AG**
		4	
4(ii)	[$0.7g - T = 0.7a$] [$T - 0.8 - 0.4g \times {}^3/_5 - F = 0.4a$] [$0.7g - 0.8 - 0.4g \times {}^3/_5 - F = (0.7 + 0.4)a$] System	**M1**	For using Newton's 2nd law for both particle *P* and particle *Q* or the system equation
		A1	Both equations correct or system equation correct
		M1	Solve either the system equation or solve two simultaneous equations to find *a*
	$a = 2\ \text{m s}^{-2}$	**A1**	
		4	

Question	Answer	Marks	Guidance
5(i)	[$1.2T^{1/2} - 0.6T = 0$]	**M1**	Attempt to find time of maximum v, set $a = 0$ and solve for T
	$T^{1/2} = 2 \rightarrow T = 4$	**A1**	
		2	
5(ii)	[$\mathrm{d}a/\mathrm{d}t = 0.6t^{1/2} - 0.6$]	**M1**	Attempt to differentiate a
	$t = 1$	**A1**	Solve $\mathrm{d}a/\mathrm{d}t = 0$ and find t
	[$v = 0.8t^{3/2} - 0.3t^2$ (+ C)]	**M1**	Attempt to integrate a to find v
		A1	Correct integration
	[$C = 1$]	**M1**	Use $v = 1$ at $t = 0$ either finding C or by using limits as $v(1) - v(0) = [0.8(1)^{3/2} - 0.3(1)^2] - [0.8(0)^{3/2} - 0.3(0)^2]$
	Velocity when acceleration is max is 1.5 ms^{-1}	**A1**	$v = 1.5$
		6	

Question	Answer	Marks	Guidance
6(i)	Power = 350 × 15 = 5250 W	**B1**	Allow 5.25 kW
		1	
6(ii)		**B1**	Using Driving force DF = *P*/15
	DF + 1200*g* sin 1 – 350 = 1200 × 0.12	**M1**	For using Newton's 2nd law down the slope
	P = 4270 W (4268.56...)	**A1**	
		3	
6(iii)	[1200*g* sin 1 – 350 = 1200*a*]	**M1**	Using Newton's 2nd law down the slope
		A1	Correct equation
	[$18^2 = 20^2 + 2as$]	**M1**	Using constant acceleration formulae with a complete method to find distance, *s*, travelled.
	Distance travelled *s* = 324 m (324.39)	**A1**	

Question	Answer	Marks	Guidance
6(iii)	**Alternative method for Q6(iii)**		
	PE loss = $1200g \times s \sin 1$ KE loss = $\frac{1}{2} \times 1200 \times (20^2 - 18^2)$	**M1**	Attempt either PE loss or KE loss
		A1	Both PE loss and KE loss correct
	[$1200g \times s \sin 1 + \frac{1}{2} \times 1200 \times (20^2 - 18^2) = 350s$]	**M1**	Apply work-energy equation to the car
	Distance travelled s = 324 m (324.39)	**A1**	
		4	

Question	Answer	Marks	Guidance
7(i)	At liquid surface, speed = 0 + $g \times 0.8$ [= 8] or $0.3g \times ½ (0 + v) \times 0.8 = ½ (0.3) v^2 \rightarrow v = 8$	**B1**	Using constant acceleration equation $v = u + at$ or PE loss = KE gain
	PE lost in water = $0.3g \times 1.25$ [= 3.75]	**B1**	
	[$½ \times 0.3 \times (8^2 – v^2) + 0.3g \times 1.25 = 1.2$]	**M1**	Using work-energy for downward motion in the tank PE loss + KE loss = Work done against resistance
	$v = 9$ m s$^{–1}$	**A1**	
	Alternative method for Q7(i)		
	Height above tank = $½ \times g \times 0.8^2$ [= 3.2]	**B1**	
	Total PE loss = $0.3g \times (3.2 + 1.25)$ [= 13.35]	**B1**	
	[$0.3g \times (3.2 + 1.25) = ½ \times 0.3 \times v^2 + 1.2$]	**M1**	Work-energy equation for the total downward motion
	$v = 9$ m s$^{–1}$	**A1**	
		4	

Question	Answer	Marks	Guidance
7(ii)	[$-0.3g - 1.8 = 0.3a$]	**M1**	Using Newton's 2nd law for the upward motion in the tank
	$a = -16$	**A1**	
	[$1.25 = 7T + ½ \times (-16) \times T^2$]	**M1**	Using constant acceleration equations to find the time, T, for the particle to travel from the bottom to the surface of the liquid
	$T = 0.25$ (or 0.625, on the way down)	**A1**	
	[v at surface $= 7 + (-16) \times 0.25 = 3$]	**B1**	Using $v = u + aT$ or equivalent to find v at surface
	[$0 = 3 - gt \rightarrow t = 0.3$]	**M1**	Attempt to find the time, t, taken for the particle to travel from the surface to reach maximum height using their $v \neq 7$
	Total time $= T + t = 0.55$ s	**A1**	

Question	Answer	Marks	Guidance
7(ii)	**Alternative method for Q7(ii)**		
	$[-0.3g - 1.8 = 0.3a]$	**M1**	Using Newton's 2nd law for the upward motion in the tank
	$a = -16$	**A1**	
	$v^2 = 7^2 + 2 \times (-16) \times 1.25 = 9 \rightarrow v = 3$	**B1**	Using constant acceleration equations to find v at the surface
	$1.25 = ½\,(7 + 3) \times T$ or $3 = 7 + (-16) \times T$	**M1**	Using $s = ½\,(u + v) \times T$ or $v = u + aT$ to find the time, T, for the particle to travel from the bottom to the surface of the liquid
	$T = 0.25$	**A1**	
	$[0 = 3 - gt \rightarrow t = 0.3]$	**M1**	Attempt to find the time, t, taken for the particle to travel from the surface to reach maximum height using their $v \neq 7$
	Total time $= T + t = 0.55$ s	**A1**	

Question	Answer	Marks	Guidance
7(ii)	**Second Alternative method for Q7(ii)**		
	[½ × 0.3 × (7^2 – v^2) = 0.3g × 1.25 + 1.8 × 1.25]	**M1**	Work-energy equation for motion from bottom to surface
		A1	Correct equation
	v = 3	**B1**	Find v at surface from rearrangement of work-energy
	[1.25 = ½ (7 + 3) × T]	**M1**	Using s = ½ (u + v) × T to find the time T, for the particle to travel from the bottom to the surface of the liquid
	T = 0.25	**A1**	
	[0 = 3 – 10t → t = 0.3]	**M1**	Attempt to find the time, t, taken for the particle to travel from the surface to reach maximum height using their $v \neq 7$
	Total time = T + t = 0.55 s	**A1**	
		7	