

GCE AS Mathematics (8AM0) – Shadow Paper (Set 1) 8MA0-22 Mechanics

October 2020 Shadow Paper mark scheme

Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide, indicating where marks are given for correct answers. As such, it may not show follow-through marks (marks that are awarded despite errors being made) or special cases.

It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme from the original paper.

This document is intended for guidance only and may differ significantly from the examiners' final mark scheme for the original paper which was published in December 2020.

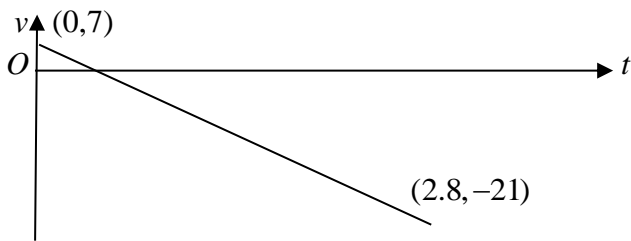
Guidance on the use of codes within this document

M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.

A1 – accuracy mark. This mark is generally given for a correct answer following correct working.

B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.

Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer).

Question	Scheme	Marks	AOs
1.(a)	$21^2 = (-U)^2 + 2 \times 10 \times 19.6$ (Allow use of $g = 9.8$ for this M mark)	M1	2.1
	$U = 7 *$	A1*	1.1b
		(2)	
	For consistent use of $g = 9.8$ in parts (b), (c) and (d), treat as a MR. i.e. max (b) M1A0 (c)M1A0M(A)0A1ft (d)B1B1ft		
(b)	$19.6 = -7 + 10T$ OR $19.6 = \frac{(-7 + 21)}{2} T$ OR $19.6 = -7T + \frac{1}{2} \times 10T^2$ OR $19.6 = 21T - \frac{1}{2} \times 10T^2$	M1	2.1
	$T = 2.8$	A1	1.1b
		(2)	
(c)	$1.6 = -7t + \frac{1}{2} \times 10 \times t^2$	M1	2.1
	$5t^2 - 7t - 1.6 = 0$	A1	1.1b
		M(A)1	1.1b
	$t = 1.6$ (s)	A1	1.1b
		(4)	
(d)		B1 shape	1.1b
	(0,7) and (2.8,-21) Allow these to be marked on the axes.	B1ft	1.1b
		(2)	
(e)	Greater since air resistance would slow the ball down.	B1	3.5a
		(1)	

(f)	Take into account: spin, wind effects, use a more accurate value of g , not model the ball as a particle	B1	3.5c
		(1)	
(12 marks)			

Notes:		
(a)	M1	Complete method to find U , condone sign errors and use of $g = 9.8$
	A1*	$U = 7$ cao correctly obtained – allow U^2 instead of $(-U)^2$. Allow verification.
(b)	M1	Complete method to find T , condone sign errors
	A1	$T = 2.8$
(c)	M1	Complete method to find t , condone sign errors
	A1	Correct equation with at most one error
	(A)1	Correct equation
	A1	$t = 1.6$ (s)
(d)	B1	Graph could be reflected in the t -axis.
	B1ft	Follow through on their T value. If graph is reflected, (0,7) and (2.8, -21)
(e)	B1	Any similar appropriate comment
(f)	B1	B0 if any incorrect extras e.g. weight/mass included

Question	Scheme	Marks	AOs
2(a)	Equation of motion for P with usual rules	M1	3.3
	$T - 2mg = 2ma$	A1	1.1b
	Equation of motion for Q with usual rules	M1	3.3
	$5mg - T = 5ma$	A1	1.1b
	Solve these equations for T (does not need to be in terms of mg)	M1	1.1b
	$T = \frac{20mg}{7}$	A1	1.1b
	$T =$ in any form (does not need to be a single term)		
	Force on pulley = $2T$	M1	3.4
	$\frac{40mg}{7}$ Accept $5.7mg$ or better	A1	1.1b
	(8)		
2(b)	Weight of the rope or extensibility of rope Or: pulley may not be smooth	B1	3.5b
		(1)	
(9 marks)			
Notes:			
(a)	M1	Translate situation into the model and set up the equation of motion for P M0 if they omit m 's i.e. $T - 2g = 2a$	
	A1	Correct equation	
	M1	Translate situation into the model and set up the equation of motion for Q M0 if they omit m 's i.e. $5g - T = 5a$	
	A1	Correct equation	
		N.B. Condone either of the above equations being replaced by the 'whole system equation': $5mg - 2mg = 7ma$ (N.B. $a = \frac{3g}{7}$) N.B. a replaced by $-a$ consistently can score all the marks	
	M1	Solve equations for T	
	A1	$T = \frac{20mg}{7}$ oe	
	M1	T does not need to be substituted.	
	A1	$\frac{40mg}{7}$ oe <u>Must be in terms of m and g</u> and be a single term	
(b)	B1	B0 if any incorrect extras are given	

Question	Scheme		Marks	AOs
3(a)	$v = 5t - 3t^2 + 8$ and differentiate		M1	3.1a
	$a = \frac{dv}{dt} = 5 - 6t$ or $(8 - 3t) - 3(t + 1)$ using product rule		A1	1.1b
	$5 - 6t = 0$ and solve for t		M1	1.1b
	$t = \frac{5}{6}$ oe		A1	1.1b
			(4)	
3(b)	Solve problem using $v = 0$ to find a value of t $\left(t = \frac{8}{3}\right)$		M1	3.1a
	$v = 5t - 3t^2 + 8$ and integrate		M1	1.1b
	$s = \frac{5t^2}{2} - t^3 + 8t$		A1	1.1b
	Substitute $t = \frac{8}{3}$ into their s expression (M0 if using <i>suvat</i>)		M1	1.1b
	$s = \frac{544}{27} = 20.148148\dots(m)$ Accept 8 or better		A1	1.1b
			(5)	
(9 marks)				
Notes:				
(a)	M1	Multiply out and attempt to differentiate, with at least one power decreasing		
	A1	Correct expression		
	M1	Equate their a to 0 and solve for t		
	A1	cao		
(b)	M1	Uses $v = 0$ to obtain a value of t		
	M1	Attempt to integrate, with at least one power increasing		
	A1	Correct expression		
	M1	Substitute in their value of t , which must have come from using $v = 0$, into their s (must have integrated)		
	A1	8 or better		