AS Further Mathematics 8FM0

Specimen Paper - Further Mechanics 1 Mark Scheme

Question	Scheme	Marks	AOs
1	Using the model and the conservation of energy principle	M1	3.4
	$\frac{1}{2}m(6^2 - v^2) = mg \times 5\sin\alpha$	A1	1.1b
		A1	1.1b
	Solve for v	M1	1.1b
	v = 4.7 or 4.69 (m s^{-1})	A1	1.1b
		(5)	
			(5 marks)
Notes:			
M1: Correct no. of terms and dimensionally correct **A1:** Correct equation, condone 1 error. **A1:** Correct equation **M1:** Must be solving a three term equation **A1:** Since g = 9.8 has been used, only these two answers			

Question	Scheme	Marks	AOs
2(a)	Using the Impulse-momentum principle	M1	3.1b
	$\frac{5mu}{3} = m(v - -u)$	A1	1.1b
	$v = \frac{2u}{3}$	A1	1.1b
	Using the model and the work-energy principle **OR**: $F = ma$ and $v^2 = u^2 + 2as$	M1	3.4
	$\frac{mgd}{6} = \frac{1}{2}mv^2$ oe	A1**ft**	1.1b
	Using correct strategy to solve the problem by linking the two equations and sub for v and solve for d	M1	3.1b
	$d = \frac{4u^2}{3g}$	A1	1.1b
		(7)	
(b)	Make the resistance dependent on the speed	B1	3.5c
		(1)	
			(8 marks)

Notes:

(a)

M1: Correct no. of terms, condone sign errors

A1: Correct equation

A1: Correct expression

M1: work-energy principle **or** $F = ma$ and $v^2 = u^2 + 2as$

A1ft: Correct equation but v does not need to be substituted

M1: Solve for d in terms of u and g only

A1: Any equivalent expression

(b)

B1: Appropriate comment

Question	Scheme	Marks	AOs
3(a)	Driving Force = Power / speed = 25000 / 20 = 1250	M1	1.1b
	Using model to form equation of motion	M1	3.4
	$1250 - 500g.\frac{1}{14} - (100 + C) = 0$	A1	1.1b
	Using complete strategy to solve the problem	M1	3.1b
	$C = 800$	A1	1.1b
		(5)	
(b)	Driving Force = $\frac{25000}{U}$	M1	1.1b
	Using model to form equation of motion	M1	3.4
	$\frac{25000}{U} - (5U + 800) = 0$	A1 **ft**	1.1b
	$U^2 + 160U - 5000 = 0$ oe	A1 **ft**	1.1b
	Using complete strategy to solve the problem	M1	3.1b
	$U = 27$	A1	1.1b
		(6)	
			(11 marks)

Notes:

(a)
M1: For attempt to find the driving force
M1: Correct number of terms with weight resolved
A1: Correct equation
M1: Solve for C
A1: 800

(b)
M1: Must find the driving force
M1: Correct number of terms
A1ft: Correct equation, follow through on their C
A1ft: Correct 3 term quadratic = 0, follow through on their C
M1: This mark can be implied by a correct answer, but otherwise must see an explicit attempt to solve.
A1: 27 (2 SF)

Question	Scheme	Marks	AOs
4(a)	Use of conservation of momentum	M1	2.1
	$mu = mv_P + mv_Q$	A1	1.1b
	Use of NLR	M1	3.4
	$eu = v_P - v_Q$	A1	1.1b
	Using a correct strategy to solve the problem by setting up two equations (need both) in v_P and v_Q and solving for v_P	M1	3.1a
	$v_P = \frac{u}{2}(1+e)$ *	A1*	2.2a
		(6)	
(b)	$v_Q = \frac{u}{2}(1-e)$	B1	1.1b
		(1)	
(c)	KE Loss = Initial KE – Final KE	M1	1.1b
	$= \frac{1}{2}mu^2 - \left\{\frac{1}{2}m\left[\frac{u}{2}(1+e)\right]^2 + \frac{1}{2}m\left[\frac{u}{2}(1-e)\right]^2\right\}^2$	A1	1.1b
		A1	1.1b
	Using a correct strategy to solve the problem: $\frac{1}{4}mu^2(1-e^2) = \frac{3mu^2}{16}$ and solve for e	M1	3.1a
	$e = \frac{1}{2}$	A1	1.1b
		(5)	
(d)	After 1st impact: $e = 1 \Rightarrow v_P = u$ and $v_Q = 0$	B1	1.1b
	After 2nd impact (P and wall): Using NLR with $e = 1$, $v_P = u$	M1	3.1a
	Since $v_P = u$ and $v_Q = 0$, 3rd impact is a 'repeat' of 1st impact so $v_Q = u$ and $v_P = 0$	B1	2.2a
	Motion continues in the same way, with one particle coming to rest and the other moving with speed u	B1	3.2
		(4)	
			(16 marks)

Question 4 notes:

(a)

M1: Correct no. of terms, condone sign errors

A1: Correct equation (allow if *m* has been cancelled or extra *g*'s)

M1: *e* must be on correct side of equation.

A1: Correct equation in any form

M1: Solving for v_Q

A1*: PRINTED ANSWER

(b)

B1: Any equivalent form

(c)

M1: Correct no. of terms and dimensionally correct. Allow Final KE – Initial KE

A1: Correct expression, condone 1 error

A1: Correct expression in any form

M1: Equate to $\frac{3mu^2}{16}$ and solve for *e*

A1: $e = 0.5$

(d)

B1: Need both $v_Q = 0$ and $v_P = u$

M1: Using NLR for impact with the wall to obtain $v_P = u$

B1: Clear explanation

B1: Clear description