AS Further Mathematics 8FM0

Specimen Paper - Further Mechanics 2 Mark Scheme

Question	Scheme	Marks	AOs
1(a)	From AB : 0 $2a$ $4a$ $3.5a$	B1	1.2
	From BC : a 0 $0.5a$ a	B1	1.2
	Mass ratios: 2 4 1 1 8	B1	1.2
	$2\times0+4\times2a+1\times4a+1\times3.5a=8\bar{x}$	M1	2.1
	(i) $\bar{x}=\frac{31a}{16}$	A1	1.1b
	$2\times a+4\times0+1\times0.5a+1\times a=8\bar{y}$	M1	2.1
	(ii) $\bar{y}=\frac{7a}{16}$	A1	1.1b
		(7)	
(b)	Uniform $\Rightarrow$cm at mid-pt so used in 'distances' OR uniform $\Rightarrow$mass proportional to length so used in mass ratios	B1	2.4
		(1)	
(c)	Recognition that G will be vertically below A and use of $\tan\theta=\frac{\bar{x}}{2a-\bar{y}}$, either way up	M1	2.1
	$\tan\theta=\frac{31}{25}$ (may not be simplified)	A1**ft**	1.1b
(d)	$\theta=51^\circ$ or 0.89 rad or better	A1	1.1b
		(3)	
	Moments about mid-point of BC	M1	2.1
	$Mg(2a-\frac{31a}{16})=kMg(a+0.5a)$ ft on their $\bar{x}$	A1**ft**	1.1b
		A1**ft**	1.1b
	$k=\frac{1}{24}$	A1	1.1b
		(4)	
			(15 marks)

Question 1 notes:

(a)
B1: Correct distances from AB seen or implied
B1: Correct distances from BC seen or implied
B1: Correct mass ratios seen or implied

(i)
M1: Correct no. of dimensionally correct terms
A1: At least 2 SF if decimal multiple
(ii)
M1: Correct no. of dimensionally correct terms
A1: At least 2 SF if decimal multiple

(b)
B1: Either use

(c)
M1: Accept either way up
A1 ft: Follow through on their answers from (a)
A1: cao

(d)
M1: All relevant dimensionally correct terms included, with no extras
A1 ft: Follow through on their answers from (a), allow one slip
A1 ft: Follow through on their answers from (a), all correct
A1: Correct answer for k : $\frac{1}{24}$, 0.042 or better

Question	Scheme	Marks	AOs
2(a)	Resolving vertically	M1	3.4
	$R\cos\alpha = mg$	A1	1.1b
	Equation of motion	M1	3.4
	$R\sin\alpha = \frac{mv^2}{40}$	A1	1.1b
	Eliminate R and solve for v	M1	1.1.
	$v = 17$ or 17.1 (m s^{-1})	A1	1.1b
		(6)	
(b)	Resolving vertically	M1	3.4
	$R\cos\alpha = mg + F\sin\alpha$	A1	1.1b
		A1	1.1b
	Equation of motion	M1	3.4
	$R\sin\alpha + F\cos\alpha = \frac{m39^2}{40}$	A1	1.1b
		A1	1.1b
	Recognition that max speed implies use of $F = \mu R$	B1	3.1b
	Eliminate R to form equation in μ only	M1	2.1
	Solve for μ	M1	1.1b
	$\mu = 0.80$ or 0.801	A1	1.1b
		(10)	
			(16 marks)

Question 2 notes
(a) **M1:** Correct number of terms with R resolved **A1:** A correct equation **M1:** Correct number of terms with R resolved **A1:** A correct equation **M1:** Must have two equations **A1:** Answer depends on $g = 9.8$ so only two possible answers
(b) **M1:** Correct number of terms with R and F resolved **A1:** A correct equation,condone 1 error **A1:** A correct equation **M1:** Correct number of terms with R and F resolved **A1:** **:** A correct equation,condone 1 error **A1:** A correct equation **B1:** Must be used in an equation **M1:** Must have two equations **M1:** Must have two equations **A1:** Answer depends on $g = 9.8$ so only two possible answers

Question	Scheme	Marks	AOs
3(a)	Use $\frac{dv}{dt}$ and separate the variables	M1	3.4
	$\frac{dv}{dt} = \frac{50}{v} - \frac{v}{8} \Rightarrow \int dt = \int \frac{8v\ dv}{400 - v^2}$	A1	1.1b
	Integrate both sides	M1	1.1b
	$t = -4\ln(400 - v^2) + C$	A1	1.1b
	Use initial conditions of the model to give $t = -4\ln(400 - v^2) + 4\ln 375$	M1	3.4
	Rearrange to make v^2 the subject	M1	1.1b
	$v^2 = 400 - 375e^{-\frac{1}{4}t}$	A1	1.1b
		(7)	
(b)	$(375)e^{-\frac{1}{4}t} \to 0$ as t increases, so $v^2 \to 400$	M1	2.4
	Hence $v \to 20$	A1	2.1
		(2)	

(9 marks)

Notes:

(a)
M1: Uses model to set up DE
A1: A correct separated expression in v and t only
M1: Clear attempt (must be a ln) to integrate both sides
A1: Correct indefinite integrals
M1: Using $t = 0$, $v = 5$ to find a particular solution of the DE
A1: Correct expression for v^2

(b)
M1: Clear explanation
A1: Correct deduction