

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
	$2 \times 0 + 4 \times 2a + 1 \times 4a + 1 \times 3.5a = 8\bar{x}$	M1	2.1
	(i) $\bar{x} = \frac{31a}{16}$	A1	1.1b
	$2 \times a + 4 \times 0 + 1 \times 0.5a + 1 \times a = 8\bar{y}$	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)	A1ft	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}	A1ft	1.1b
		A1ft	1.1b
	$k = \frac{1}{24}$	A1	1.1b
		(4)	
			(15 marks)

AS Further Mathematics 8FM0

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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

AS Further Mathematics 8FM0

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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)			

AS Further Mathematics 8FM0

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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

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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)	$(375)e^{-\frac{1}{4}t} \rightarrow 0$ as t increases, so $v^2 \rightarrow 400$	M1	2.4
	Hence $v \rightarrow 20$	A1	2.1
			(2)
(9 marks)			
Notes:			
<p>(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</p>			
<p>(b) M1: Clear explanation A1: Correct deduction</p>			