adamjee maths

A-LEVEL MATHS / EDEXCEL / FREE RESOURCES

Moments

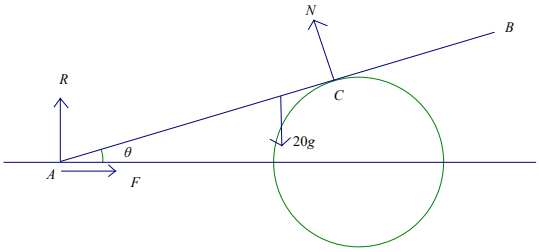
Mark scheme

1 questions

Exam questions and marking instructions remain credited to their board.

Contents

1 June 2019 - Paper 3 Mechanics - Q4

4(a)	Drum **smooth**, or no friction, (therefore reaction is perpendicular to the ramp)	B1	2.4
		(1)	
(b)	**N.B.** In (b), for a moments equation, if there is an extra $\sin\theta$ or $\cos\theta$ on a length, give M0 for the equation e.g. M(A): $20g\times 4\cos\theta = 5N\sin\theta$ would be given M0A0		
			
	Possible equns ($\nearrow$): $F\cos\theta + R\sin\theta = 20g\sin\theta$ ($\nwarrow$): $N + R\cos\theta = 20g\cos\theta + F\sin\theta$ ($\uparrow$) $R + N\cos\theta = 20g$ ($\rightarrow$): $F = N\sin\theta$ M(A): $20g\times 4\cos\theta = 5N$ M(B): $3N + R\times 8\cos\theta = F\times 8\sin\theta + 20g\times 4\cos\theta$ M(C): $R\times 5\cos\theta = F\times 5\sin\theta + 20g\times\cos\theta$ M(G): $R\times 4\cos\theta = F\times 4\sin\theta + N$	M1 A1 M1 A1 M1 A1	3.3 1.1b 3.4 1.1b 3.4 1.1b
	(The values of the 3 unknowns are: $N = 150.528$; $F = 42.14784$; $R = 51.49312$)		
	Alternative 1: using cpts along ramp (X) and perp to ramp(Y) Possible equations: ($\nearrow$): $X = 20g\sin\theta$ ($\nwarrow$): $Y + N = 20g\cos\theta$ ($\uparrow$): $X\sin\theta + Y\cos\theta + N\cos\theta = 20g$ ($\rightarrow$): $X\cos\theta = Y\sin\theta + N\sin\theta$ M(A): $20g\times 4\cos\theta = 5N$ M(B): $20g\times 4\cos\theta = 8Y + 3N$ M(C): $20g\times\cos\theta = 5Y$ M(G): $4Y = N\times 1$	M1 A1 M1 A1 M1 A1	3.3 1.1b 3.4 1.1b 3.4 1.1b
	(The values of the 3 unknowns are: $N = 150.528$; $X = 54.88$; $Y = 37.632$)		

	Alternative 2: using horizontal cpt (*H*) and cpt perp to ramp (*S*) $(\nearrow): H\cos\theta = 20g\sin\theta$ $(\nwarrow): S + N = H\sin\theta + 20g\cos\theta$ $(\uparrow): S\cos\theta + N\cos\theta = 20g$ $(\rightarrow): H = S\sin\theta + N\sin\theta$ $\text{M}(A): 20g\times 4\cos\theta = 5N$ $\text{M}(B): 20g\times 4\cos\theta + H\times 8\sin\theta = 8S + 3N$ $\text{M}(C): 20g\times\cos\theta + H\times 5\sin\theta = 5S$ $\text{M}(G): 4S = N\times 1 + H\times 4\sin\theta$	M1 A1 M1 A1 M1 A1	3.3 1.1b 3.4 1.1b 3.4 1.1b
	(The values of the 3 unknowns are: $N = 150.528$; $H = 57.1666\ldots$; $S = 53.638666\ldots$)		
	Solve their 3 equations for F and R **OR** X and Y **OR** H and S	M1	1.1b
	$\lvert\text{Force}\rvert = \sqrt{R^2 + F^2}$ Main scheme **OR** $= \sqrt{X^2 + Y^2}$ Alternative 1 **OR** $= \sqrt{(H^2 + S^2 - 2HS\cos(90^o - \theta)}$ Alternative 2	M1	3.1b
	Magnitude = 67 or 66.5 (N)	A1	2.2a
		(9)	
(c)	Magnitude of the normal reaction (at *C*) will **decrease**.	B1	3.5a
		(1)	
		(11)	

Marks		Notes
4a	B1	Ignore any extra incorrect comments.
		Generally 3 independent equations required so **at least one moments equation.**: M1A1M1A1M1A1. More than 3 equations, give marks for the best 3. For each: M1 All terms required. Must be dimensionally correct so if a length is missing from a moments equation it's M0 Condone sin/cos confusion. A1 For a correct equation (trig ratios do not need to be substituted and allow e.g. cos(24/25) if they recover Enter marks on ePEN in order in which equations appear. **N.B.** If reaction at C is not perpendicular to the ramp, can only score marks for M(C) Allow use of (μR) for F
4b	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.
	A1	Correct unsimplified equation
	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.
	A1	Correct unsimplified equation
	M1	All terms required, dim correct, condone sin/cos confusion
	A1	Correct unsimplified equation
		N.B. They can find F and R using only TWO equations, the 1st and 7th in the list. Mark the better equation as M2A2 (-1 each error). Mark the second equation as M1A1
Alt 1	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.
	A1	Correct unsimplified equation
	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.
	A1	Correct unsimplified equation
	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.
	A1	Correct unsimplified equation
		N.B. They can find X and Y using only TWO equations, the 1st and 7th in the list. Mark the better equation as M2A2 (-1 each error). Mark the second equation as M1A1
Alt 2	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.
	A1	Correct unsimplified equation
	M1	All terms required. Must be dimensionally correct. Condone sin/cos confusion.

	A1	Correct unsimplified equation
	M1	All terms required. Must be dimensionally correct.
	A1	Correct unsimplified equation
		N.B. They can find *H* and *S* using only TWO equations, the 1st and 7th in the list. Mark the better equation as M2A2 (-1 each error). Mark the second equation as M1A1
	M1	Substitute for trig and solve for their two cpts. This is an independent mark <u>but must use 3 equations (</u>unless it's the special case when 2 is sufficient<u>)</u>
	M1	Use Pythagoras to find magnitude (this is an <u>independent</u> M mark but must have found a value for *F* (or *X*) and a value for *R* (or *Y*)) **OR** a complete method to find magnitude e.g. cosine rule but must have found a value for *H* and a value for *S*
	A1	Correct answer only
	B1	Ignore reasons

Question	Scheme	Marks	AO
	In this question mark parts (a) and (b) together.		