

November 2003

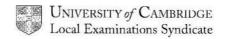
GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/04

MATHEMATICS Paper 4 (Mechanics 1)



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1	(i)	The force is 320 N	B1	1
	(ii)	For using Newton's second law (3 terms needed)	M1	
		$320 - R = 100 \times 0.5$	A 1 √	
		Resistance is 270 N	A 1	3
2	(i)	Speed is 20 ms ⁻¹	B1	1
	(ii)	For using $s = \frac{1}{2} gt^2$ $45 = \frac{1}{2} 10t^2$	M1	
		Time taken is 3 s	A 1	2
	(iii)	For using $v^2 = u^2 + 2gs$ $(40^2 = 30^2 + 2 \times 10s)$	M1	
		Distance fallen is 35 m	A1	2
3	(i)	For using the idea of work as a force times a distance $(25 \times 2\cos 15^{\circ})$	M1	
		Work done is 48.3 J	A1	2
	(ii)	For resolving forces vertically (3 terms needed)	M 1	
		$N + 25 \sin 15^{\circ} = 3 \times 10$ ($\sqrt{\cos \text{ instead of sin following sin instead of cos in (i)})$	A 1 √	
		Component is 23.5 N	A 1	3
4	(i)	KE (gain) = $\frac{1}{2} 0.15 \times 8^2$	B1	
		For using PE loss = KE gain	M1	
		Height is 3.2 m	A1	3
	(ii)	For using WD is difference in PE loss and KE gain	M1	
		$WD = 0.15 \times 10 \times 4 - \frac{1}{2} \cdot 0.15 \times 6^{2}$	A 1	
		Work Done is 3.3 J	A 1	3
	(implie (i) s = (ii) a =	r candidates who treat AB as if it is straight and vertical citly or otherwise) Max 2 out of 6 marks. $8^2 \div (2 \times 10) = 3.2$ $8^2 \div (2 \times 4) = 4.5$ and $8^2 \div (2 \times 4) = $		

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5	(i)	For applying Newton's second law to A or to B (3 terms needed)	M 1	
		T - 0.6 = 0.4a or $0.1g - T = 0.1a$	A 1	
		For a second of the above 2 equations or for $0.1g - 0.6 = 0.5a$ [Can be scored in part (ii)] (Sign of a must be consistent with that in first equation)	B1	
		Tension is 0.92 N	A 1	4
	(ii)	a = 0.8	B1	
		For using $v = at$	M 1	
		$Speed = 1.2 \text{ ms}^{-1}$	A 1	3
6	(i)	$T_{\rm BM} = T_{\rm AM}$ or $T_{\rm BM} \cos 30^{\circ} = T_{\rm AM} \cos 30^{\circ}$	B 1	
		For resolving forces at M horizontally $(2T \sin 30^{\circ} = 5)$ or for using the sine rule in the triangle of forces $(T \div \sin 60^{\circ} = 5 \div \sin 60^{\circ})$ or for using Lami's theorem $(T \div \sin 120^{\circ} = 5 \div \sin 120^{\circ})$	M1	
		Tension is 5 N A.G.	A 1	3
	(ii)	For resolving forces on <i>B</i> horizontally $(N = T \sin 30^{\circ})$ or from symmetry $(N = 5/2)$ or for using Lami's theorem $(N \div \sin 150^{\circ} = 5 \div \sin 90^{\circ})$	M 1	
		For resolving forces on B vertically (3 terms needed) or for using Lami's theorem	M 1	
		$0.2 \times 10 + F = T \cos 30^{\circ}$ or $(0.2g + F) \div \sin 120^{\circ} = T \div \sin 90^{\circ}$	A 1	
		For using $F = \mu R$ (2.33 = 2.5 μ)	M 1	
		Coefficient is 0.932	A 1	5
	(iii)	$(0.2 + m)g - 2.33 = 5\cos 30^{\circ} \text{ or } mg = 2(2.33)$ m = 0.466	B1 √ B1	2
7	(i)	For using the idea that area represents the distance travelled.	M 1	
		For any two of $\frac{1}{2} \times 100 \times 4.8$, $\frac{1}{2} \times 200(4.8 + 7.2)$,	. 1	
		$\frac{1}{2} \times 200 \times 7.2$ (240, 1200, 720)	A1	

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(ii)	For using the idea that the initial acceleration is the gradient of the first line segment or for using $v = at$ (4.8 = 100a) or $v^2 = 2as$ (4.8 ² = $2a \times 240$)	M1	
	Acceleration is 0.048 ms ⁻²	A 1	2
(iii)	a = 0.06 - 0.00024t	B1	
	Acceleration is greater by 0.012 ms^{-2} [$\sqrt{\text{ for } 0.06 - \text{ans(ii)}}$ (must be +ve) and/or wrong coefficient of t in $a(t)$] [Accept 'acceleration is 1.25 times greater']	В1 √	2
(iv)	<i>B</i> 's velocity is a maximum when $0.06 - 0.00024t = 0$ [$\sqrt{\text{wrong coefficient of } t \text{ in } a(t)}$]	В1 √	
	For the method of finding the area representing $s_A(250)$	M1	
	$240 + \frac{1}{2} (4.8 + 6.6)150 or 240 + (4.8 \times 150 + \frac{1}{2} 0.012 \times 150^{2}) (1095)$	A 1	
	For using the idea that s_B is obtained from integration	M 1	
	$0.03t^2 - 0.00004t^3$	A 1	
	Required distance is 155 m (√ dependent on both M marks)	A 1√	6