

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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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	A AND AS LEVEL – NOVEMBER 2003	9709	4

1	(i)	The force is 320 N	B1	1
	(ii)	For using Newton's second law (3 terms needed)	M1	
		$320 - R = 100 \times 0.5$	A1 $\checkmark$	
		Resistance is 270 N	A1	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	A1	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)	M1	
		$N + 25 \sin 15^\circ = 3 \times 10$ ($\checkmark$ cos instead of sin following sin instead of cos in (i))	A1 $\checkmark$	
		Component is 23.5 N	A1	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	
		$WD = 0.15 \times 10 \times 4 - \frac{1}{2}0.15 \times 6^2$	A1	
		Work Done is 3.3 J	A1	3

SR For candidates who treat AB as if it is straight and vertical
(implicitly or otherwise) Max 2 out of 6 marks.

(i) $s = 8^2 \div (2 \times 10) = 3.2$ B1

(ii) $a = 6^2 \div (2 \times 4) = 4.5$ and $R = 0.15 \times 10 - 0.15 \times 4.5 = 0.825$ and
 $WD = 4 \times 0.825 = 3.3$ B1

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5	(i)	For applying Newton's second law to A or to B (3 terms needed)	M1	
		$T - 0.6 = 0.4a$ or $0.1g - T = 0.1a$	A1	
		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	A1	4
	(ii)	$a = 0.8$	B1	
6		For using $v = at$	M1	
		Speed = 1.2 ms^{-1}	A1	3
	(i)	$T_{\text{BM}} = T_{\text{AM}}$ or $T_{\text{BM}} \cos 30^\circ = T_{\text{AM}} \cos 30^\circ$	B1	
		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.	A1	3
	(ii)	For resolving forces on B horizontally ($N = T \sin 30^\circ$) or from symmetry ($N = 5/2$) or for using Lami's theorem ($N \div \sin 150^\circ = 5 \div \sin 90^\circ$)	M1	
		For resolving forces on B vertically (3 terms needed) or for using Lami's theorem	M1	
		$0.2 \times 10 + F = T \cos 30^\circ$ or ($0.2g + F$) $\div \sin 120^\circ = T \div \sin 90^\circ$	A1	
		For using $F = \mu R$ (2.33 = 2.5μ)	M1	
		Coefficient is 0.932	A1	5
7	(iii)	$(0.2 + m)g - 2.33 = 5 \cos 30^\circ$ or $mg = 2(2.33)$ $m = 0.466$	B1 $\checkmark$ B1	2
	(i)	For using the idea that area represents the distance travelled.	M1	
		For any two of $\frac{1}{2} \times 100 \times 4.8$, $\frac{1}{2} \times 200(4.8 + 7.2)$, $\frac{1}{2} \times 200 \times 7.2$ (240, 1200, 720)	A1	
		Distance is 2160 m	A1	3

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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} A1 2
- (iii) $a = 0.06 - 0.00024t$ B1
- Acceleration is greater by 0.012 ms^{-2} [$\sqrt$ for $0.06 - \text{ans(ii)}$ (must be +ve) and/or wrong coefficient of t in $a(t)$] B1 $\sqrt$ 2
- [Accept 'acceleration is 1.25 times greater']
- (iv) B 's velocity is a maximum when $0.06 - 0.00024t = 0$ B1 $\sqrt$
- [$\sqrt$ wrong coefficient of t in $a(t)$]
- 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) A1
- For using the idea that s_B is obtained from integration M1
- $0.03t^2 - 0.00004t^3$ A1
- Required distance is 155 m A1 $\sqrt$ 6
- ($\sqrt$ dependent on both M marks)