CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 2003

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/04

MATHEMATICS
Paper 4 (Mechanics 1)

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

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 √	
		Resistance is 270 N	A1	3
2	(i)	Speed is 20 ms^{-1}	B1	1
	(ii)	For using $s = \frac{1}{2} gt^2$ $\quad 45 = \frac{1}{2} 10t^2$	M1	
		Time taken is 3 s	A1	2
	(iii)	For using $v^2 = u^2 + 2gs$ $\quad (40^2 = 30^2 + 2 \times 10s)$	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	
		$N + 25\sin 15^\circ = 3 \times 10$ (√ cos instead of sin following sin instead of cos in (i))	A1 √	
		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

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	
		For using $v = at$	M1	
		Speed = 1.2 ms^{-1}	A1	3
6	(i)	$T_{BM} = T_{AM}$ or $T_{BM}\cos 30^\circ = T_{AM}\cos 30^\circ$	B1	
		For resolving forces at M horizontally $(2T\sin 30^0 = 5)$ 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 $(N = T\sin 30^0)$ 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	
		$0.2 \times 10 + F = T\cos 30^0$ or $(0.2g + F) \div \sin 120^\circ = T \div \sin 90^\circ$	A1	
		For using $F = \mu R$ $(2.33 = 2.5\mu)$	M1	
		Coefficient is 0.932	A1	5
	(iii)	$(0.2 + m)g - 2.33 = 5\cos 30^0$ or $mg = 2(2.33)$	B1 √	
		$m = 0.466$	B1	2
7	(i)	For using the idea that area represents the distance travelled.	M1	
		For any two of ½ $\times 100 \times 4.8$, ½ $\times 200(4.8 + 7.2)$, ½ $\times 200 \times 7.2$ (240, 1200, 720)	A1	
		Distance is 2160 m	A1	3

(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} [√ for 0.06 – ans(ii) (must be +ve) and/or wrong coefficient of t in $a(t)$] [Accept 'acceleration is 1.25 times greater']	B1 √	2
(iv)	B's velocity is a maximum when $0.06 - 0.00024t = 0$ [√ wrong coefficient of t in $a(t)$]	B1 √	
	For the method of finding the area representing $s_A(250)$	M1	
	$240 + ½ (4.8 + 6.6)150$ or $240 + (4.8 \times 150 + ½\ 0.012 \times 150^2)$ (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 (√ dependent on both M marks)	A1√	6