CAMBRIDGE
INTERNATIONAL EXAMINATIONS

NOVEMBER 2001

ADVANCED SUBSIDIARY LEVEL

MARK SCHEME

MAXIMUM MARK : 50

SYLLABUS/COMPONENT : 8709/4

MATHEMATICS

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

1			M1		For using WD = $Fd\cos\alpha$
		WD = 30x80 cos 10°	A1		
		Answer: 2360J	A1	3	
2	**(i)**	$\frac{9500-1500}{440-120}$	M1		For attempting to find the gradient of the relevant section
		Answer: 25ms^{-1}	A1	2	
	(ii)		M1		For drawing 3 connected straight line segments with, in order, +ve, zero and –ve slopes
		Any two of the following three features:	A1		
		Graph starts at the origin and terminates on the t-axis			
		The acceleration stage is less steep than the deceleration stage			
		25ms^{-1} (f.t. for ans (i)) is correctly shown			
		All three of the above features	A1	3	
3		$R = mg\cos 30°$	B1		
		$F = 0.4\,mg\cos 30°$	M1		For using $F = \mu R$
			M1		For resolving forces along the plane
		Component of the weight down the plane = $mg\sin 30°$	B1ft		f.t. for cos instead of sin, following earlier cos/sin mix
		$0.4\,mg\cos 30° + P = mg\sin 30°$	A1ft		Depends on both M marks; f.t. for wrong *F* or wrong weight component
		Answer: $P = 0.768$	A1	6	
4	**(i)**		M1		For using $s(t) = \int v\,dt$ and attempting to integrate
		$s = 2t^2 - 0.01t^4$	A1		
		$2t^2 - 0.01t^4 = 100$	B1ft		f.t. for wrong *s*(*t*)
			M1		For identifying the equation as a quadratic in t^2 and attempting to solve
		Answer: $t = 10$	A1	5	
	(ii)		M1		For using *a* = d*v*/d*t* and attempting to differentiate
		$4 - 0.12t^2$	A1		
		Answer: -ve when $t = 10$ ➔ slowing down	A1	3	
	Alternative for the above 3 marks:				
	$v(10) = 0$ ➔ slowing down		B3		

5	(i)	$T_{AR} = T_{BR}$	B1	1	
	(ii)	$T \cos RAB = T \cos RBA$ → angle RAB = angle RBA	B1	1	
	(iii)	$2T \cos 60^\circ = 0.5g$	M1		For resolving forces on R vertically
		$T = 0.5g$	A1		May be implied
		$R = 0.3g + T \sin 30^\circ$	M1		For resolving the forces on B vertically (3 terms required)
		Answer: 5.5N	A1ft		f.t. for 3 + ½ T
	Alternative for the above 4 marks:				
	For using $R_B = R_A + 0.3g$	B1			
	For resolving forces vertically on the whole system ($R_B + R_A = (0.5 + 0.3)g$) or for $R_A = ½ (0.5g)$ and eliminating R_A	M1			
	Answer: 5.5 N	A1			
	$T = 0.5g$	B1			
		$F = T \cos 30^\circ$	M1		For resolving the forces on B horizontally
		Answer: 4.33N	A1	6	
6	(i)		M1		For applying N2 to one particle, or for using $(m_1 + m_2)a = (m_1 - m_2)g$
		$0.5a = 0.5g - T$ or $0.4a = T - 0.4g$ or $0.9a = 0.1g$	A1		
			M1		For applying N2 to the other particle (if necessary) and solving for a
		Answer: 1.11ms^{-2}	A1	4	
	(ii)	$v^2 = 2(g/9)4.5$	M1		For using $v^2 = 2as$
		$0 = g^{1/2} - gt$	M1		For using $0 = u + at$
		Answer: 0.316s	A1	3	
	(iii)		M1		For using distance is $2s$ and obtaining s from $(u + 0)/2 = s/t$, $0 = u^2 + 2as$ or $s = ut + ½ at^2$
		Answer: 1m	A1	2	

7	(i)	1200g(500 sin6°) seen or implied	B1		Can be scored in 1st or 2nd part
			M1		For using WD by driving force = PE gain + WD against resistance, or for using WD against resistance = (1800 – component of weight) × 500
		1800 x 500 = 1200g(500 sin6°) + WD against resistance, or WD against resistance = (1800 – 1200*g*sin6°) × 500	A1ft		f.t. for wrong PE gain or equivalent
		Answer: 273 000J	A1	4	
	(ii)		M1		For using KE gain = ½ $m(v^2 - u^2)$
		½ 1200($20^2 - 8^2$)	A1		
		WD = 201 600 + 627 170 + 700 x 500	M1		For using WD by driving force = KE gain + PE gain + WD against resistance
		Answer: 1 180 000 J	A1	4	
	SR (For candidates who assume, implicitly or otherwise, that the acceleration is constant) (max 2 out of 4)				
	For finding the acceleration (0.336) using $v^2 = u^2 + 2as$, applying Newton's 2nd law to find the force of *D*'s engine (2360) and multiplying by 500 to find the WD. M1				
	Answer: 1 180 000 J A1				
	(iii)		M1		For using $\frac{P_{top}}{P_{bottom}} = \frac{F_{top}}{F_{bottom}} \times \frac{v_{top}}{v_{bottom}}$
		Ratio = 4 x 20/8	A1		
		Answer: 10	A1	3	
	SR (max 1 out of 3)				
	For using calculated values of *F* in the ratio 4:1 (e.g. 2360 × 4 and 2360), and obtaining the answer 10:1 for required ratio. B1				