CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 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

Page 1	Mark Scheme	Syllabus	Paper
	A AND AS LEVEL – JUNE 2003	9709	4

Mechanics 1

1	**(i)**	Tension is 8000 N or 800*g* Accept 7840 N (from 9.8) or 7850 (from 9.81)	B1	1
	(ii)	For using $P = \frac{\Delta W}{\Delta t}$ or $P = Tv$	M1	
		$\Delta W = 8000 \times 20$ or $v = \frac{20}{50}$	A1 ft	
		Power applied is 3200 W Accept 3140 W (from 9.8 or 9.81)	A1	3
		SR (for candidates who omit *g*) (Max 2 out of 3) P = $800 \times 20 \div 50$ B1 Power applied is 320 W B1		
2	**(i) (a)**	For resolving in the direction *PQ*	M1	
		Component is 2 x 10cos30° – 6cos60° or 14.3 N or $10\sqrt{3} - 3$ N	A1	2
	(b)	Component is $\pm$6cos30° – 6cos60° or $\pm$5.20 N or $\pm 3\sqrt{3}$ N	B1	1
		SR (for candidates who resolve parallel to and perpendicular to the force of magnitude 6 N) (Max 2 out of 3) For resolving in both directions M1 For *X* = 6 – 10cos 30° or –2.66 N and *Y* = 10 + 10sin 30° or 15 N A1 **SR** (for candidates who give a combined answer for **(a)** and **(b)**) (Max 2 out of 3) For resolving in both directions M1 For (6cos30°)**i** + (2 x10cos30° – 6cos60°)**j** or any vector equivalent A1		
	(ii)	For using Magnitude = $\sqrt{ans(i)^2 + ans(ii)^2}$	M1	
		Magnitude is 15.2 N ft only following sin/cos mix and for answer 5.66 N	A1 ft	2
3	**(i)**	Region under $v = 2t$ from $t = 0$ to $t = T$ indicated	B1	1
	(ii)	For attempting to set up and solve an equation using area Δ = 16 or for using $s = \frac{1}{2} 2t^2$	M1	
		For $16 = \frac{1}{2} 2T^2$	A1	
		$T = 4$	A1	3
		SR (for candidates who find the height of the Δ but do not score M1) (Max 1 out of 3) For $h/T = 2$ or $h = 2T$ or $v = 8$ B1		

	(iii)	For using distance = 10 × ans **(ii)** or for using the idea that the distance is represented by the area of the relevant parallelogram or by the area of the trapezium (with parallel sides 9 and 4 and height 10) minus the area of the triangle (with base 5 and height 10)	M1	
		Distance is 40m	A1 ft	2
4	**(i)**	For differentiating *x*	M1	
		$\dot{x} = t + \frac{1}{10}t^2$	A1	
		Speed is 20 ms^{-1}	A1	3
	(ii)	$\ddot{x} = 1 + \frac{1}{5}t$	B1 ft	
		For attempting to solve $\ddot{x}(t) = 2\ddot{x}(0)$ $(1 + \frac{1}{5}t = 2)$	M1	
		$t = 5$	A1	3
5	**(i)**	For resolving forces on any two of *A*, or *B*, or *A* and *B* combined ($T_1 = W_A + T_2, T_2 = W_B, T_1 = W_A + W_B$)	M1	
		Tension in S_1 is 4 N or Tension in S_2 is 2 N Accept 0.4*g* or 3.92 (from 9.8 or 9.81) for T_1 Tension in S_2 is 2 N or Tension in S_1 is 4 N Accept 0.2*g* or 1.96 (from 9.8 or 9.81) for T_2 **SR** (for candidates who omit g) (Max 1 out of 3) $T_1 = 0.4$ and $T_2 = 0.2$ B1	B1 A1	3
	(ii)	For applying Newton's second law to *A*, or to *B*, or to *A* and *B* combined	M1	
		For any one of the equations $T + 2 - 0.4 = 0.2a$, $2 - T - 0.2 = 0.2a$, $4 - 0.4 - 0.2 = 0.4a$	A1	
		For a second of the above equations	A1	
		For solving the simultaneous equations for *a* and *T*	M1	
		Acceleration is 8.5 ms^{-2}, tension is 0.1 N Accept 8.3 from 9.8 or 8.31 from 9.81 **SR** (for candidates who obtain only the 'combined' equation) (Max 3 out of 5) For applying Newton's second law to *A* and *B* combined M1 For $4 - 0.4 - 0.2 = 0.4a$ A1 Acceleration is 8.5 ms^{-2} A1	A1	5

6	**(i)**	For using $F = \mu R$ and $R = mg$ $(F = 0.025 \times 0.15 \times 10)$	M1	
		Frictional force is 0.0375 N or 3/80 N Accept 0.0368 from 9.8 or 9.81	A1	2
	(ii)	For using $F = ma$ (-0.0375 = 0.15a) or $d = \mu g$	M1	
		Deceleration is 0.25 ms^{-2} (or a = - 0.25) A.G.	A1	2
	(iii)	For using $s = ut + \frac{1}{2}at^2$ $(s = 5.5 \times 4 + \frac{1}{2}(-0.25)16)$	M1	
		Distance *AB* is 20m	A1	2
	(iv)	For using $v^2 = u^2 + 2as$ $(v^2 = 3.5^2 - 2 \times 0.25 \times 20)$	M1	
		Speed is 1.5 ms^{-1} (ft $\sqrt{(24.5 - (iii))/2}$)	A1 ft	2
	(v)	Return dist. = $\frac{3.5^2}{2 \times 0.25}$ or distance beyond *A* = $\frac{(iv)^2}{2 \times 0.25}$	M1	
		Total distance is 44.5 m (ft 24.5 + **(iii)** or 2(**(iv)**^{2} + **(iii)**)	A1 ft	2
7	**(i)**	PE gain = $mg(2.5\sin 60^o)$	B1	
		For using KE = ½ mv^2	M1	
		For using the principle of conservation of energy (½ $m8^2$ - ½ mv^2 = $mg(2.5\sin 60^o)$)	M1	
		Alternative for the above 3 marks: For using Newton's Second Law or stating $a = -g\sin 60^0$ a = -8.66 (may be implied) For using $v^2 = u^2 + 2as$ $(v^2 = 64 - 2 \times 8.66 \times 2.5)$	 M1* A1 M1dep*	
		Speed is 4.55 ms^{-1} Accept 4.64 from 9.8 or 9.81	A1	4
	(ii)	For using ½ mu^2 (>) mgh_{max} (½ 8^2 > $10h_{max}$)	M1	
		For obtaining 3.2m A.G.	A1	2
	(iii)	Energy is conserved or absence of friction or curve *BC* is smooth (or equivalent) and *B* and *C* are at the same height or the PE is the same at *A* and *B* (or equivalent)	B1	1

	(iv)	WD against friction is 1.4×5.2	B1	
		For WD = KE loss (or equivalent) used	M1	
		$1.4 \times 5.2 = \frac{1}{2} 0.4(8^2 - v^2)$ or $1.4 \times 5.2 = \frac{1}{2} 0.4((i)^2 - v^2) + 0.4 \times 10(2.5 \sin 60^\circ)$ (12.8 or 4.14 + 8.66)	A1	
		Alternative for the above 3 marks: For using Newton's Second Law $0.4g(2.5 \sin 60^o \div 5.2) - 1.4 = 0.4a$ (a = 0.6636) For using $v^2 = u^2 + 2as$ with u ≠ 0 $(v^2 = 4.55^2 + 2 \times 0.6636 \times 5.2)$	M1* A1 M1dep*	
		Speed is 5.25 ms^{-1}	A1	4