

Mark Scheme 4728
June 2005

1	(i)	<i>R</i> is smooth	B1	1	
	(ii)	$T + T\cos 60^\circ = 1.6\cos 45^\circ$ Tension is 0.754 N AG	M1 A1 A1	3	For resolving forces horizontally to obtain an equation in <i>T</i> (requires 3 relevant terms and at least one force resolved)
	(iii)	$mg = T\sin 60^\circ + 1.6\sin 45^\circ$ $m = 0.182$	M1 A1 ft A1	3	For resolving forces vertically to obtain an equation for <i>m</i> (requires 3 relevant terms with both <i>T</i> and the 1.6 N force resolved) ft sin/cos mix from (ii)
					SR $m = T\sin 60^\circ + 1.6\sin 45^\circ$ M1 $m = 1.78$ B1
2	(i)	$0.2g + T - 0.4 = 0.2a$ $0.3g - T - 0.25 = 0.3a$	M1 A1 A1 A1	4	For applying $F = ma$ (requires at least <i>ma</i> , <i>T</i> and air resistance in linear combination in at least one equation). At least one equation with not more than one error. SR $0.2g - T - 0.4 = 0.2a$ and $0.3g + T - 0.25 = 0.3a$ B1
	(ii)	$0.5g - 0.65 = 0.5a$ or $5T - 0.7 = 0$ $a = 8.5$ and $T = 0.14$ (positive only)	M1 A1 ft A1	3	For obtaining an equation in <i>T</i> or <i>a</i> only, either by eliminating <i>a</i> or <i>T</i> from the equations in (i) or by applying $F = ma$ to the complete system For a correct equation in <i>a</i> only or <i>T</i> only ft opposite direction of <i>T</i> only

3	(i)	<p>Momentum before = $0.1 \times 4 - 0.2 \times 3$</p> <p>Momentum after =</p> <p>$-0.1u + 0.2(3.5 - u)$</p> <p>$0.1 \times 4 - 0.2 \times 3 = -0.1u + 0.2(3.5 - u)$</p> <p>$u = 3$ (positive value only)</p>	<p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>4</p>	<p>or Loss by $P = 0.1 \times 4 + 0.1u$</p> <p>or Gain by $Q = 0.2(3.5 - u) + 0.2 \times 3$</p> <p>For using the principle of conservation of momentum</p>
	(ii)	<p>$0 = 3^2 - 10s_1$ and $0 = 0.5^2 - 10s_2$</p> <p>$0.9 + 0.025$</p> <p>Distance is 0.925 m cao</p>	<p>M1</p> <p>A1 ft</p> <p>M1</p> <p>A1</p> <p>4</p>	<p>SR If mgv used for momentum instead of mv, then</p> <p>$u = 3$ B1</p> <p>For using $v^2 = u^2 + 2as$ with $v = 0$ (either case) or equivalent equations</p> <p>ft value of u from (i)</p> <p>For using $PQ = s_1 + s_2$</p>

4	(i) α	<p>$2 = 0.8u + \frac{1}{2} a(0.8)^2$</p> <p>$8 = 2u + \frac{1}{2} a2^2$ or</p> <p>$6 = 1.2(u + 0.8a) + \frac{1}{2} a(1.2)^2$ or</p> <p>$6 = 1.2(2 \times 2 \div 0.8 - u) + \frac{1}{2} a(1.2)^2$</p> <p>$u = 1.5$</p> <p>Acceleration is 2.5 ms^{-2}</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>7</p>	<p>For using $s = ut + \frac{1}{2} at^2$ for the first stage</p> <p>For obtaining another equation in u and a with relevant values of velocity, displacement and time</p> <p>For eliminating a or u</p>
	(i) β	<p>$2 = 0.8v - \frac{1}{2} a(0.8)^2$</p> <p>$6 = 1.2v + \frac{1}{2} a(1.2)^2$</p> <p>Acceleration is 2.5 ms^{-2} ($v = 3.5$)</p> <p>$u = 1.5$</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>7</p>	<p>For using $s = vt - \frac{1}{2} at^2$ for the first stage</p> <p>For using $s = ut + \frac{1}{2} at^2$ for the second stage</p> <p>For obtaining values of a and v and using $v = u + at$ for first stage to find u</p>
	(i) γ	<p>$2 \div 0.8 \text{ ms}^{-1}$ and $6 \div 1.2 \text{ ms}^{-1}$</p> <p>$= 2.5 \text{ ms}^{-1}$ and 5 ms^{-1}</p> <p>$t_1 = 0.4$ and $t_2 = (0.8 +) 0.6$</p> <p>$5 = 2.5 + a(1.4 - 0.4)$</p> <p>Acceleration is 2.5 ms^{-2}</p>	<p>M1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1</p>	<p>For finding average speeds in both intervals</p> <p>For finding mid-interval times</p> <p>For using $v = u + at$ between the mid-interval times</p>

		$2.5 = u + 2.5 \times 0.4$ or $5 = u + 2.5 \times 1.4$ $u = 1.5$	M1 A1	7	For using $v = u + at$ between $t = 0$ and one of the mid-interval times
	(ii)	$2.5 = 9.8 \sin \alpha$ $\alpha = 14.8^\circ$	M1 A1ft	2	For using $(m)a = (m)g \sin \alpha$ ft value of acceleration

5	(i)	$F = 2 + 7 \cos \alpha$ $F = 3.96$ (may be implied) $N = 7 \sin \alpha$ $N = 6.72$ (may be implied) $3.96 = \mu \cdot 6.72$ Coefficient is 0.589 or 33/56 cao	M1 A1 A1 M1 A1 M1 A1	7	For resolving forces on A vertically (3 terms) For resolving forces on A horizontally (2 terms) For using $F = \mu N$
	(ii)	$T \cos \beta = 7 \cos \alpha$ $T \cos \beta = 7 \times 0.28$ (= 1.96 AG)	M1 A1	2	For resolving forces at P vertically (2 terms)
	(iii)	$T \cos \beta - mg = 0$ Mass is 0.2 kg	M1 A1 A1	3	For resolving forces on B vertically (2 terms)

6	(i)(a)	$V = P \cos 20^\circ - 0.04g$ $P = 0.417$	B1 M1 A1	3	For setting $V = 0$
	(i)(b)	$R = P \sin 20^\circ$ Magnitude is 0.143 N	M1 A1ft	2	For using $R =$ horizontal component of P ft value of P
	(i)(c)	$0.143 = 0.04a$ Acceleration is 3.57 ms^{-2}	M1 A1ft	2	For using Newton's second law ft magnitude of the resultant
	(ii)	$R^2 = 0.08^2 + (0.04g)^2$ Magnitude is 0.400 N (or 0.40 or 0.4) $\tan \theta = +/-0.04g/0.08$ or $\tan(90^\circ - \theta) = +/-0.08/0.04g$ Angle made with horizontal is 78.5° or 1.37 radians, or angle made with vertical is 11.5° or 0.201 radians Downwards or below horizontal	M1 A1 M1 A1 B1	5	For using $R^2 = P^2 + W^2$ For using $\tan \theta = Y/X$ or $\tan(90^\circ - \theta) = X/Y$ Direction may alternatively be shown clearly on a diagram or given as a bearing

7	(i)	$\frac{1}{2} 200 \times 16 + 300 \times \frac{1}{2} (16 + 25)$ + $\frac{1}{2} 100 \times 25 (=1600 + 6150 + 1250)$ Distance is 9000m	M1 A1 A1	3	For using the idea that the area of the quadrilateral represents distance
	(ii)	$a = (0 - 25)/(600 - 500)$ Deceleration is 0.25 ms^{-2}	M1 A1	2	For using the idea that gradient (= vel \div time) represents acceleration Or for using $v = u + at$ Allow acceleration = -0.25 ms^{-2}
	(iii)	Acceleration is $(1200t - 3t^2) \times 10^{-6}$	M1 A1	2	For using $a(t) = \dot{v}(t)$
	(iv)	$0.25 - 0.2475$ Amount is $\pm 0.0025 \text{ ms}^{-2}$	M1 A1ft	2	For using 'ans(ii) - $ a_Q(550) $ ' ft ans(ii) only
	(v)	$1200t - 3t^2 = 0$ $t = (0 \text{ or } 400)$ AG	M1 A1	2	For solving $a_Q(t) = 0$ or for finding $a_Q(400)$ Or for obtaining $a_Q(400) = 0$
	(vi)	$\frac{1}{2} 200 \times 16 + 200 \times \frac{1}{2} (16 + 22)$ $s_Q(t) = (200t^3 - t^4/4) \times 10^{-6} (+C)$ $6400 - 5400$ Distance is 1000 m	M1 A1 M1 A1 M1 A1	6	For correct method for $s_P(400)$ For using $s_Q(t) = \int v_Q dt$ For using correct limits and finding $ s_Q(400) - s_P(400) $