

Mark Scheme 4728

January 2006

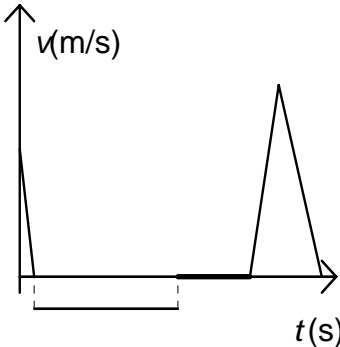
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1	(i)	0.3g – T = 0.3a and T – 0.4g = 0.4a	M1 A1	[4]	For using Newton’s second law (either particle) condone 0.3ga, 0.4ga and !(LHS) Both correct. SR Accept $T - 0.3g = 0.3a$ etc as correct only if consistent with a shown as upwards for P on c 's diagram Eliminating T AG		
		-0.1g = 0.7a a = -1.4 <u>See appendix for substituting a = -1.4</u>	M1 A1				
		(ii)	0 = 2.8t – ½ 1.4t ² 0 = t(2.8 – 0.7t) Time taken is 4 s OR (0.3 + 0.4)a = (0.3 – 0.4)g			M1 M1 A1 M2 A1	[3]
	(i)	a = -1.4 0 = 2.8 + -1.4t t = 2.8/1.4 Time taken is 4 s	A1 M1 M1 A1	[4]		For using $(m_1 + m_2)a = (m_1 - m_2)g$ No application of SR shown above AG	
	(ii)			[3]		For using $v = u + at$ with $v = 0$ Solve for t , and double <u>or any other complete method</u> for return time	
2	(i)	Tsin α = 0.08 x 1.25 = 0.1	M1 A1	[2]	Newton’s second law condone cos, and 0.08g for mass but not part of force		
	(ii)	Tcos α = 0.08g T ² = 0.1 ² + 0.784 ² or α = 7.3° T = 0.79	M1 A1 M1 A1 A1			[5]	Resolving forces vertically, condone sin May be implied by $T^2 = 0.1^2 + 0.784^2$ For eliminating α or T $\alpha = 7.3^\circ$ or better Accept anything rounding to 0.79
3	(i)	a = 7.2 – 0.9t T = 8 <u>See also special case in appendix.</u>	M1 A1 M1 A1	[4]	For using $a = dv/dt$ For attempting to solve $a(t) = 0$		
	(ii)	v(T) = 28.8 <u>See also special case in appendix.</u>	B1			[1]	AG (From $7.2 \times 8 - 0.45 \times 8^2$)
	(iii)	s = 3.6t ² – 0.15t ³ (+C) s = 153.6 (+C) s at constant speed = 662.4 Displacement is 816 m	M1 A1 DM1 A1 B1ft A1ft			[6]	For using $s = \int vdt$ For finding $s(T$ or 31) or using limits (0) to T or (0) to 31 (dep on integration) Condone +C For using $(31 - cv T) \times 28.8$ $cv 153.6 + cv 662.4$ (non-zero numerical)

4	(i)	$F = 12\cos 15^\circ$ Frictional component is 11.6 N	M1 A1 [2]	Resolve horizontally (condone sin) Accept $12\cos 15^\circ$
	(ii)	$N + 12\sin 15^\circ = 2g$ Normal component is 16.5 N	M1 A1 [2]	Resolve vert 3 forces (accept cos) AG
	(iii)	$11.591\dots = \mu 16.494\dots$ Coefficient is 0.7(0)	M1 A1ft [2]	For using cv $F = \mu cv N$ Ft cv F to 2 sf. $\mu = 0.7027\dots$
	(iv)	$N = 2g$ $F = 19.6 \times 0.7027\dots$ $20 - 13.773\dots = 2a$ Acceleration is 3.11 ms^{-2} MISREAD (omits "horizontal") $N = 2g - 20\sin 15$ $F = 0.7027 \times 14.4$ $20\cos 15 - 10.14 = 2a$ Acceleration is 4.59 ms^{-2}	B1 M1 M1 A1ft A1 [5] MR-1 B1ft M1 M1 A1ft A1ft [4]	For using Newton's second law cv Tractive - cv Friction (e.g. from (i)) Accept either 3.11 or 3.12 only All A and B marks now ft. Subtract "MR-1" from initial B1 or final A1 (not A1ft in main scheme). Equals 14.42... Equals 10.1... For using Newton's second law cv Tractive - cv Friction Accept 4.59, 4.6(0)

5	(i)	 <p>Graph with 5 straight line segments and with v single valued.</p> <p>Line segment for car stage Line segment for walk stage Line segment for wait stage 2 line segments for motor-cycle stage</p>	B1 B1 B1 B1 B1 B1 [5]	'Wait' line segment may not be distinguishable from part of the t axis. Attempt at all lines segments fully straight. Mainly straight, ends on t -axis. Horizontal below t -axis. Ignore linking to axis. Can be implied by gap between walk and motor-cycle stages Inverted V not U, mainly straight. Condone vertex below x intercept.
	(ii)	$d = 12/8$ Deceleration is 1.5 ms^{-2}	M1 A1 [2]	Using gradient represents accn Or $a = -1.5 \text{ ms}^{-2}$
	(iii)	$t_{\text{walk}} = 420/0.7$ $t_{\text{motorcycle}} = 42$ $T = 8 + 600 + 250 + 42 = 900$	M1 B1 B1 A1 [4]	Using area represents displacement. Accept 600 Ignore method

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6	(i)	$T_A \cos \alpha - T_B \cos \beta = W$ $T_A = T_B (= T)$ $\cos \alpha > \cos \beta \rightarrow \alpha < \beta$	M1 B1 A1 [3]	For resolving 3 forces vertically, condone Wg , sin May be implied or shown in diagram AG
	(ii)(a)	$T \sin \alpha + T \sin \beta = 14$ $\sin \alpha = 0.6$ and $\sin \beta = 0.8$ Tension is 10 N	M1 DM1 A1 [3]	Resolve 3 forces horiz accept cos
	(ii)(b)	$10 \cos \alpha - 10 \cos \beta = W$ $\alpha = 36.9^\circ$, $\beta = 53.1^\circ$ $W = 2$ <u>See appendix for solution based on resolving along RA and RB.</u>	M1 DM1 A1 ft [3]	Must use cv T, and W (not Wg) Or $\cos \alpha = 0.8$ and $\cos \beta = 0.6$ SR -1 for assuming $\alpha + \beta = 90^\circ$ ft for $T/5$ (accept 1.99)
	(iii)	R is below B Tension is 1 N	B1 B1 ft [2]	Accept R more than 0.5 m below A ft for $W/2$ accept $W/2$

<p>7</p>	<p>(i)</p>	<p>Initial momentum $= 0.15 \times 8 + 0.5 \times 2$ Final momentum = $0.5v$ $0.15 \times 8 + 0.5 \times 2 = 0.5v$ (or $0.15 \times 8 = 0.5 \times (v - 2)$) $v = 4.4$ $(m)g \sin \alpha = (\pm)(m)a$ $a = (\pm)4.9$ EITHER (see also part (ii)) $0 = 4.4^2 - 2 \times 4.9s$ $s = 1.97$ or 1.98 m OR $v^2 = 4.4^2 - 2 \times 4.9 \times 2$ $v^2 = -0.24$ OR (see also part (ii)) $t = 4.4/4.9 (=0.898)$ with either $s = 4.4 \times 0.898 - 0.5 \times 4.9 \times 0.898^2$ or $s = (4.4 + 0)/2 \times 0.898$ $s = 1.97$ or 1.98 m</p>	<p>B1 B1 M1 A1 [4] M1 A1 M1 A1ft M1 A1ft M1 A1ft [4]</p>	<p>(or loss in A's momentum = 0.15×8 B1 and gain in B's momentum = $0.5(v - 2)$ B1) For using the principle of conservation of momentum condone inclusion of g in all terms SR Awarded even if g in all terms Condone \cos For using $v^2 = u^2 + 2as$ with $v = 0$ Accept $s < 2$ iff $s = 4.4^2 / (2 \times 4.9)$ For using $v^2 = u^2 + 2as$ with $s = 2$ Accept $v^2 < 0$ Both parts of method needed Accept $s < 2$</p>
<p></p>	<p>(ii)</p>	<p>$2 = \frac{1}{2} 4.9 t_A^2$ $t_A = 0.904$ EITHER $2 = (-4.4)t_B + \frac{1}{2} 4.9 t_B^2$ $t_B = (4.4 \pm \sqrt{4.4^2 + 4 \times 2.45 \times 2}) / 4.9$ $t_B = 2.17$ $t_B - t_A = (2.17 - 0.9) = 1.27$ s OR $t_{\text{up}} = 4.4/4.9 (=0.898)$ $(2 + 1.98) = 0.5 \times 4.9 \times t_{\text{down}}^2$ $t_{\text{down}} = 1.27$ $t_B - t_A = (0.9 + 1.27 - 0.9) = 1.27$ s OR $0 = 4.4t - \frac{1}{2} 4.9t^2$ (i.e. approx 1.8 s to return to start) $2 = 4.4t + 4.9t^2$ $t = 0.376$ $t_B - t_A = 1.796 + 0.376 - 0.9 = 1.27$ s</p>	<p>M1 A1 M1 M1 A1 A1 M1 M1 A1 A1 M1 M1 A1 A1 [5]</p>	<p>cv for acceleration Accept $0.903 \leq \text{time} \leq 0.904$ Appropriate use of $s = ut + \frac{1}{2} at^2$ Correct method for solving QE 2.171... Or using s_{up} to find t_{up} $s = ut + \frac{1}{2} at^2$ with cv s in part (i) <u>Not the final answer</u> $s = ut + \frac{1}{2} at^2$ with $s = 0 = 1.796$</p>