Mark Scheme 4728
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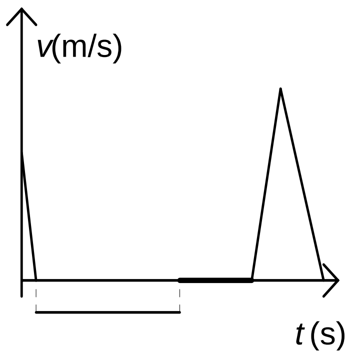
1	**(i)**	0.3g – *T* = 0.3a and T – 0.4g = 0.4a -0.1g = 0.7a a = –1.4 <u>See appendix for substituting a = -1.4</u>	M1 A1 M1 A1	 [4]	For using Newton's second law (either particle) condone 0.3ga,0.4ga and !(LHS) Both correct. ***SR*** Accept *T* -0.3*g* = 0.3a etc as correct only if consistent with *a* shown as upwards for *P* on c's diagram Eliminating *T* AG
	(ii)	$0 = 2.8t – ½ 1.4t^2$ 0 = t(2.8 - 0.7t) Time taken is 4 s	M1 M1 A1	 [3]	For using $s = ut + ½ at^2$ with s = 0 Solving QE From correct equation only
		OR			
	(i)	(0.3 + 0.4)a = (0.3 – 0.4)g a = –1.4	M2 A1 A1	 [4]	For using $(m_1 + m_2)a = (m_1 – m_2)g$ No application of *SR* shown above AG
	(ii)	0 = 2.8 + -1.4t t = 2.8/1.4 Time taken is 4 s	M1 M1 A1	 [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)**	T sin α = 0.08 x 1.25 = 0.1	M1 A1	 [2]	Newton's second law condone cos, and 0.08*g* for mass but not part of force
	(ii)	T cos 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 α = 7.3° or better Accept anything rounding to 0.79

3	**(i)**	 *a* = 7.2 – 0.9*t* *T* = 8 <u>See also special case in appendix.</u>	M1 A1 M1 A1	 [4]	For using *a* = d*v*/d*t* For attempting to solve *a*(*t*) = 0
	(ii)	*v*(*T*) = 28.8 <u>See also special case in appendix.</u>	B1	 [1]	AG (From $7.2\times8 – 0.45\times8^2$)
	(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*) ×28.8 cv 153.6 + cv 662.4 (non-zero numerical)

4	**(i)**	$F = 12\cos15^o$ Frictional component is 11.6 N	M1 A1 [2]	Resolve horizontally (condone sin) Accept 12cos 15^o
	(ii)	$N + 12\sin15^o = 2g$ Normal component is 16.5 N	M1 A1 [2]	Resolve vert 3 forces (accept cos) AG
	(iii)	$11.591\ldots = \mu\, 16.494\ldots$ Coefficient is 0.7(0)	M1 A1ft [2]	For using cv $F = \mu$ cv N Ft cv F to 2 sf. $\mu = 0.7027....$
	(iv)	$N = 2g$ $F = 19.6 \times 0.7027\ldots$ $20 - 13.773\ldots = 2a$ Acceleration is 3.11 ms^{-2} ***MISREAD*** (omits "horizontal") $N = 2g - 20\sin15$ $F = 0.7027 \times 14.4$ $20\cos15 - 10.14 = 2a$ 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)**		Graph with 5 straight line segments and with v single valued. Line segment for car stage Line segment for walk stage Line segment for wait stage 2 line segments for motor-cycle stage	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 ms^{-2}
	(iii)	 $t_{walk} = 420/0.7$ $t_{motorcycle} = 42$ $T = 8 + 600 + 250 + 42 = 900$		M1 B1 B1 A1 [4]	Using area represents displacement. Accept 600 Ignore method

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)	$10\cos\alpha - 10\cos\beta = W$ $\alpha = 36.9^o$, $\beta = 53.1^o$ $W = 2$ See appendix for solution based on resolving along *RA* and *RB.*	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 $\alpha + \beta = 90^o$ 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

7	**(i)**	Initial momentum = 0.15×8 + 0.5×2	B1	(or loss in A's momentum = 0.15×8 B1
		Final momentum = 0.5v	B1	and gain in B's momentum = 0.5(v – 2) B1)
		0.15×8 + 0.5×2 = 0.5v (or 0.15×8 = 0.5×(v - 2))	M1	For using the principle of conservation of momentum
		v = 4.4	A1 [4]	condone inclusion of g in all terms
		(m)$g$sinα =(±)(m)a	M1	***SR*** Awarded even if g in all terms
		a = (±)4.9	A1	Condone cos
		EITHER (see also part (ii)) 0 = 4.4^2 – 2×4.9s	M1	For using $v^2 = u^2 + 2as$ with v = 0
		s = 1.97 or 1.98 m	A1ft	Accept s < 2 iff s = 4.4^2 /(2×4.9)
		OR v^2 = 4.4^2 – 2×4.9×2	M1	For using $v^2 = u^2 + 2as$ with s = 2
		v^2 = -0.24	A1ft	Accept v^2 < 0
		OR (see also part (ii)) t = 4.4/4.9 (=0.898) with either s = 4.4 ×0.898-0.5 ×4.9 × 0.898^2 or s = (4.4 + 0)/2 × 0.898	M1	Both parts of method needed
		s = 1.97 or 1.98 m	A1ft [4]	Accept s < 2
	(ii)	2 = ½4.9 t_A^2	M1	cv for acceleration
		t_A = 0.904	A1	Accept 0.903=<time=<0.904
		EITHER 2 = (-4.4)t_B + ½ 4.9t_B^2	M1	Appropriate use of $s = ut + ½ at^2$
		t_B = (4.4!⊕(4.4^2 +4×2.45× 2))/4.9	M1	Correct method for solving QE
		t_B = 2.17	A1	2.171...
		$t_{B\,-}\,t_A$ = (2.17 - 0.9) = 1.27 s	A1	
		OR t_{up} = 4.4/4.9 (=0.898)	M1	Or using s_{up} to find t_{up}
		(2 + 1.98) = 0.5× 4.9 × t_{down}^2	M1	$s = ut + ½ at^2$ with cv s in part (i)
		t_{down} = 1.27	A1	Not the final answer
		$t_{B\,-}\,t_A$ =(0.9 + 1.27 - 0.9) =1.27s	A1	
		OR 0 = 4.4t - ½ 4.9t^2 (i.e. approx 1.8 s to return to start)	M1	$s = ut + ½ at^2$ with s = 0 = 1.796
		2 = 4.4t + 4.9t^2	M1	
		t = 0.376	A1	
		$t_{B\,-}\,t_A$ = 1.796+0.376-0.9 = 1.27s	A1 [5]	