Question	Answer	Marks	Guidance
1	[$T\sin70 + T\sin45 = 0.2\,g$]	**M1**	Resolving vertically
	$T = 1.21$ N (1.21447…)	**A1**	
	[$P + T\cos70 = T\cos45$]	**M1**	Resolving horizontally
	$P = 0.443$ (0.443389…)	**A1**	
		4	

Question	Answer	Marks	Guidance
2	$R = mg + 50\sin20$	**B1**	
	[$F = 0.3(mg + 50\sin20)$]	**M1**	Use of $F = \mu R$
		M1	Resolving horizontally
	$50\cos20 – 0.3(mg + 50\sin20) = 0$	**A1ft**	ft R (R containing term in m)
	$m = 14.0$kg (13.9514…)	**A1**	
		5	

Question	Answer	Marks	Guidance
3(i)	$[\frac{1}{2} \times 1.2 \times 7.5^2 - \frac{1}{2} \times 1.2 \times v^2 = 25]$	**M1**	For use of KE and 25 in a 3 term equation
	$v = 3.82$ m s^{-1} (3.81881…)	**A1**	
		[2]	
3(ii)	$1.2gd\sin 30$	**B1**	Correct expression for PE
	$[\frac{1}{2} \times 1.2 \times 7.5^2 - 25 + 1.2gd\sin 30 = \frac{1}{2} \times 1.2 \times 9^2]$	**M1**	For 4 term work / energy equation
	$d = 6.64$ m (6.64166…)	**A1**	
		3	

Question	Answer	Marks	Guidance
4(i)		**B1**	Three correct straight lines
	$v = 6$ m s^{-1}, $t = 5$ s and $t = 17$ s	**B1**	Correct trapezium with key values
	$[\frac{1}{2} \times 6 \times (12 + 20)]$ or $[\frac{1}{2} \times 5 \times 6 + 12 \times 6 + \frac{1}{2} \times 3 \times 6]$	**M1**	Use of trapezium area or use of suvat formulae
	Total distance = 96 m	**A1**	**AG**
		4	

Question	Answer	Marks	Guidance
4(ii)	[½ × 20 × v = 96]	**M1**	Uses area of triangle = 96 or uses $s = ut + ½ at^2$ to form equation in a
	v = 9.6 m s^{-1} or 48 = ½ a (10)^2	**A1**	
	Acceleration = 9.6 / 10 = 0.96 m s^{-2}	**A1**	
		3	

Question	Answer	Marks	Guidance
5(i)	[T – 0.3g = 0.3a or 0.5g – T = 0.5a]	**M1**	Use of Newton's second law for P or Q or use of $a = (m_Q – m_P)g / (m_P + m_Q)$
	T – 0.3g = 0.3a and 0.5g – T = 0.5a or a = (0.5g – 0.3g) / (0.5 + 0.3)	**A1**	
	[0.5g – 0.3g = 0.8a]	**M1**	Solve for a
	a = 2.5	**A1**	
	[h = 0 + ½ × 2.5 × 0.6^2]	**M1**	For use of $s = ut + ½at^2$
	h = 0.45	**A1**	
		6	

Question	Answer	Marks	Guidance
5(ii)	Velocity of P when Q reaches floor = $0 + 0.6 \times 2.5 = 1.5\ \text{m s}^{-1}$	**B1ft**	ft a from **(i)** × 0.6
	[$0 = 1.5 - gt \rightarrow t = \ldots$] ($t = 0.15$)	**M1**	Use of *suvat* to find time to highest point
	Total time = $2 \times 0.15 + 0.6 = 0.9$ s	**A1**	
		3	

Question	Answer	Marks	Guidance
6(i)	Driving force = 36000 / 20	**B1**	For use of power = Fv
	[$36000 / 20 - R = 3200 \times 0.2$]	**M1**	Use of Newton's Second Law
	$R = 1160$ N	**A1**	
		[3]	
6(ii)	Driving force $F = 3200g\sin 1.5 + 1160$	**M1**	Resolving along plane
	[Power = $(3200g\sin 1.5 + 1160) \times 30$]	**M1**	Use of $P = Fv$
	Power = 59900 W (59929.87…)	**A1**	
		3	

Question	Answer	Marks	Guidance
6(iii)	[– (3200*g*sin1.5 + 1160) = 3200*a*]	**M1**	Use of Newton's Second Law
	(*a* = –0.62426…)	**A1**	
	[$0^2 = 30^2 + 2as$]	**M1**	Use of $v^2 = u^2 + 2as$ to find *s*
	Distance *s* = 721 m (720.84…)	**A1**	
		4	
	OR:		
6(iii)	[3200*g*sin1.5*s*] or [½ × 3200 × 900]	**M1**	For PE gain or KE loss
	3200*g*sin1.5*s* and ½ × 3200 × 900	**A1**	For PE gain and KE loss
	[½ × 3200 × 900 = 1160*s* + 3200*g*sin1.5*s*]	**M1**	For work / energy equation
	Distance *s* = 721 m (720.84…)	**A1**	
		4	

Question	Answer	Marks	Guidance
7(i)	Acceleration = 0 when *t* = 5 from $25 - t^2 = 0$	**B1**	
	[$v = 25t - \frac{1}{3}t^3$]	**M1**	Use of integration
	[Max speed = 25 × 5 – ⅓× 5^3]	**M1**	Substitution for *t*
	Max speed = 83⅓ m s^{-1}	**A1**	
		4	

Question	Answer	Marks	Guidance
7(ii)	$[s = 12½t^2 - {}^1/_{12}t^4]$	**M1**	Use of integration
	Distance = 260 m (260.4166…)	**A1**	
		2	
7(iii)	At $t = 9$, $v = 25 \times 9 - ⅓ \times 9^3 = -18$	**B1ft**	ft v from **(i)**
	$[s = \int_9^{25} \left(-3t^{-\frac{1}{2}}\right) dt = \left[-6t^{\frac{1}{2}}\right]]$	**M1**	Use of integration
	[Change in velocity from $t = 9$ to $t = 25 = \left[-6t^{\frac{1}{2}}\right] = -6 \times 5 + 6 \times 3 = -12$]	**M1**	Substituting limits
	Velocity at $t = 25$ is $-18 - 12 = -30$ m s^{-1}	**A1**	
		4	
	OR:		
7(iii)	At $t = 9$, $v = 25 \times 9 - {}^1/_3 \times 9^3 = -18$	**B1ft**	ft v from **(i)**
	$[s = \int -3t^{-½}\, dt = -6t^{½}\ (+ C)]$	**M1**	Use of integration
	$[t = 9, v = -18 \rightarrow C = 0, t = 25, v = -6 \times 25^{½}]$	**M1**	Finds C and substitutes $t = 25$
	Velocity at $t = 25$ is -30 m s^{-1}	**A1**	
		4	