Qu	Answer	Part Marks	Marks	Notes
1 (i)	[PE gain = $8g \times 20\sin 30^\circ$]	M1		For using PE gain = mgh
	Change in PE is 800 J	A1	2	
(ii)	[$8g$ x $20\sin 30^\circ + 20F$ = 1146]	M1		For using PE gain + WD against friction = 1146
	Frictional force is 17.3 N	A1	2	
2 (i)	$s_B = \frac{1}{2} \times 1.2 \times 5^2$ Distance travelled is 15 m	B1		
	$v_B = 1.2 \times 5$ Speed is 6 ms^{-1}	B1	2	
(ii)	[$4T = 15 + 6(T - 10)$] or [$4(T + 5) = 15 + 6(T - 5)$] or [$4(T + 10) = 15 + 6T$]	M1		For using $s_A = s_B$ after T seconds or after $T + 5$ seconds or after $T + 10$ seconds
	$T = 22.5$or $T = 17.5$or $T = 12.5$	A1		
	Distance OP = $4 \times 22.5 = 90$ m	B1	3	
3		M1		For resolving forces horizontally and/or vertically
	$12\cos 75^\circ + P\cos\theta^\circ = 18\cos 65^\circ$	A1		
	$18\sin 65^\circ + 12\sin 75^\circ = 15 + P\sin\theta^\circ$	A1		
	[$P^2 = (18\sin 65^\circ + 12\sin 75^\circ - 15)^2 + (18\cos 65^\circ - 12\cos 75^\circ)^2$] or [$\theta = \tan^{-1}(18\sin 65^\circ + 12\sin 75^\circ - 15)/(18\cos 65^\circ - 12\cos 75^\circ)$]	M1		For eliminating either θ or P from the simultaneous equations
	$P = 13.7$ or $\theta = 70.8$	A1		
	$\theta = 70.8$ or $P = 13.7$	B1	6	

Qu	Answer	Part Marks	Marks	Notes
4	$R = 15g\cos 20^o$	**B1**		140.95
	$F = \mu R = 0.2 \times 15g\cos 20^o$	**B1**		28.19
		M1		For resolving parallel to the plane (F acting up plane)
	$X + 0.2 \times 15g\cos 20^o = 15g\sin 20^o$	**A1**		
	Least value of X is 23.1	**A1**		AG
	$[X = 15g\sin 20^o + 0.2 \times 15g\cos 20^o]$	**M1**		For resolving parallel to the plane (F acting down plane)
	Greatest value of X is 79.5	**A1**	7	
5 (i)				For using DF = P/v and for resolving forces along the direction of motion
	$[20000/v = 650]$	**M1**		
	Speed is 30.8 ms^{-1}	**A1**	2	
(ii)				For resolving forces along the direction of motion
	$[DF = 650 + 1400g \times {}^1/_7]$	**M1**		
	$P/10 = 650 + 1400g \times {}^1/_7$	**M1**		For using DF = P/v
	Power is 26500 W	**A1**	3	
(iii)	$P = 0.8 \times 26500(21200)$	**B1**√		ft $0.8 \times P$ from (ii)
	$[21200/20 + 1400g \times {}^1/_7 - 650 = 1400a]$	**M1**		For using Newton's Second Law
	Acceleration is 1.72 ms^{-2}	**A1**	3	
6 (i) (a)				For applying Newton's Second Law to one particle or for using $m_1g - m_2g = (m_1 + m_2)a$
		M1		
	$1.3g - T = 1.3a$ and $T - 0.7g = 0.7a$ or $1.3g - 0.7g = (1.3 + 0.7)a$ and either $1.3g - T = 1.3a$ or $T - 0.7g = 0.7a$	**A1**		
	Tension is 9.1 N	**B1**		

Qu	Answer	Part Marks	Marks	Notes
(b)	Acceleration is 3 ms^{-2}	**B1**		
	$[2 = ½ \times 3 \times t^2]$	**M1**		For using $s = ½ at^2$
	Time taken is 1.15 seconds	**A1**	6	
(ii)	$[v^2 = 2 \times 3 \times 2]$	**M1**		For using $v^2 = u^2 + 2as$ to find the speed on reaching plane
	$v = \sqrt{12}(3.464)$	**A1**√		ft√(4a)orat from (i)
	$[0 = 12 – 2gs \rightarrow s = ...]$	**M1**		For using $v^2 = u^2 + 2as$ to find the distance 0.7 kg particle continues upwards
	Greatest height is 4.6 m	**A1**	4	
	Alternative			
(ii)	$[1.3g \times 2 = ½ (1.3)v^2 + 9.1 \times 2]$ or $[9.1 \times 2 = ½ (0.7)v^2 + 0.7g \times 2]$	**M1**		For using PE loss = KE gain + WD_T for 1.3 kg or for using WD_T = KE gain + PE gain for 0.7 kg
	$v = \sqrt{12}(3.464)$	**A1**√		ft√(4a) or at from (i)
	$[½ \times 0.7v^2 = 0.7gs \rightarrow s = ...]$	**M1**		For using KE loss = PE gain
	Greatest height is 4.6 m	**A1**	4	
7 (i)	$[6t – 2 < 0 \rightarrow t < .....]$	**M1**		For solving $a(t) < 0$
	$0 < t < 1/3$	**A1**	2	
(ii)	$[v = 3t^2 – 2t + c]$	**M1**		For using $v(t) = \int a(t)dt$
	$s = t^3 – t^2 + ct + d$	**M1**		For using $s(t) = \int v(t)dt$
	$[c + d = 7$ $3c + d = 11 \rightarrow c = ... , d = ...]$	**A1**		For using t=1, s=7 and t=3, s=29 to form and solve simultaneous equations
	$s = t^3 – t^2 + 2t + 5$	**M1**	5	
(iii)	$[3t^2 – 2t + 2 = 10]$	**A1**		For using $v(t) = 10$
	$t = 2$	**DM1**	3	For solving 3 term quadratic $v(t) = 10$