Question	Answer	Marks	Guidance
1	(X=) 20 cos 60 + 30 cos 60 – F	**B1**	
	[F = 20 cos 60 + 30 cos 60]	**M1**	Use of horizontal component of resultant = 0
	F = 25	**A1**	
		3	

Question	Answer	Marks	Guidance
2(i)	[F = 1480 + 7850g sin 3] (= 5588)	**M1**	
	[$\frac{P}{10}$ = 1480 + 7850g sin 3] →P = …	**M1**	Using $P = Fv$ and solving for P
	Power = 55 900 W	**A1**	
		3	
2(ii)	[F + 7850g sin 3 – 1480 = 7850 × 0.8] (F = 3652)	**M1**	Use of Newton's Second Law
	[$\frac{P}{15}$ + 7850g sin 3 – 1480 = 7850 × 0.8] →P = …	**M1**	Using $P = Fv$ and solving for P
	Power = 54800 W	**A1**	
		3	

Question	Answer	Marks	Guidance
3(i)	$R = mg$ cos 25	**B1**	
	[F = 0.4mg cos 25]	**M1**	Using $F = \mu R$
	[mg sin 25 – 0.4mg cos 25 = ma]	**M1**	Use of Newton's Second Law
	a = 0.601 ms^{-2}	**A1**	
		4	
3(ii)	[s = ½ × 0.601 × 3^2]	**M1**	Use of $s = ut + \frac{1}{2}at^2$
	Distance = 2.70 m	**A1 FT**	FT 4.5 × a from **(i)**
		2	

Question	Answer	Marks	Guidance
4(i)	*EITHER:* [$T - 0.35g = 0.35a$ or $0.45g - T = 0.45a$ or $0.45g - 0.35g = 0.8a$]	**(M1**	Applies Newton's Second Law to one of the particles or forms system equation in a ($m_Bg - m_Ag = (m_A + m_B)a$)
	[$0.45g - T = 0.45a$ or $T - 0.35g = 0.35a$] $\rightarrow a = \ldots$	**M1**	Applies Newton's Second Law to form second equation in T and a and solves for a or solves system equation for a
	$a = 1.25$ m s^{-2}	**A1**	
	[$v^2 = 2 \times 1.25 \times 0.64$] (= 1.6)	**M1**	Using $v^2 = u^2 + 2as$
	Velocity = 1.26 ms^{-1}	**A1)**	
	OR: [PE loss = $0.45g \times 0.64 - 0.35g \times 0.64$]	**(M1**	Attempts PE loss
	[KE gain = ½ $(0.35 + 0.45)$ v^2]	**M1**	Attempts KE gain
	PE loss = $0.45g \times 0.64 - 0.35g \times 0.64$ and KE gain = ½ $(0.35 + 0.45)$ v^2	**A1**	
	[½ (0.8) $v^2 = 0.1g \times 0.64$] ($v^2 = 1.6$)	**M1**	Using PE loss = KE gain
	Velocity = 1.26 ms^{-1}	**A1)**	
		5	
4(ii)	*EITHER:* [$0 = 1.6 - 2gs$] ($s = 0.08$)	**(M1**	Using $v^2 = u^2 + 2as$
	Distance = 0.16 m	**A1)**	
	OR: [$0.35gh$ = ½ $(0.35) \times 1.6$] ($h = 0.08$)	**(M1**	Using PE gain = KE loss for particle A
	Distance = 0.16 m	**A1)**	
		2	

Question	Answer	Marks	Guidance
5(i)	$v = \int k(3t^2 - 12t + 2)\,\mathrm{d}t$ $= k(3t^3/3 - 12t^2/2 + 2t) + C$	***M1**	Use of $v = \int a\,\mathrm{d}t$
	$v = k\left(t^3 - 6t^2 + 2t\right) + C$	**A1**	Condone C missing
	$C = 0.4$	**B1**	
	$0.1 = k(1 - 6 + 2) + 0.4$ $[-0.3 = -3k]$	**DM1**	Substitutes $t = 1$, $v = 0.1$
	$k = 0.1$	**A1**	AG
		5	
5(ii)	$[s = \int 0.1(t^3 - 6t^2 + 2t) + 0.4\,\mathrm{d}t$ $= 0.1(t^4/4 - 6t^3/3 + 2t^2/2) + 0.4t + C]$	**M1**	Use of $s = \int v\,\mathrm{d}t$
	$s = 0.025t^4 - 0.2t^3 + 0.1t^2 + 0.4t$	**A1**	$C = 0$ seen or implied
		2	
5(iii)	Substitutes $t = 2$ to show $s = 0$	**B1**	AG
		1	

Question	Answer	Marks	Guidance
6(i)	[Area = ½ (10 + 4) × 6 = 42 m] Displacement = 42 m	**B1**	
		1	
6(ii)	$\frac{v}{2} = \frac{6}{4}$ or [gradient =1.5, $v = 6 + 1.5 \times 6$]	**M1**	Using similar triangles or using acceleration = gradient and $v = u + at$
	$v = 3\ \mathrm{ms}^{-1}$	**A1**	
		2	
6(iii)	Total distance travelled $= 42 + ½\,(T - 10) \times 3$	**B1 FT**	Area found with FT distance from **(i)** and FT speed from **(ii)**
	$[42 + ½\,(T - 10) \times 3 = 49.5] \rightarrow T =$ …	**M1**	For equation and solving for T
	$T = 15$ s	**A1**	
		3	

Question	Answer	Marks	Guidance
6(iv)	$V = 1.75 \times 4 = 7$ ms^{-1}	**B1**	
	Q travels [½ (13 + 6) × 7 = 66.5 m] Distance apart = [66.5 + 42 – 7.5]	**M1**	Finding area for Q and interpreting total distance between particles
	Distance between P and Q = 101 m	**A1**	
		3	

Question	Answer	Marks	Guidance
7(i)	$R = 0.2g \cos 30 - T \sin 15$	**B1**	
	$[F = 0.3 \times (0.2g \cos 30 - T \sin 15)]$	**M1**	Use of $F = \mu R$
		M1	For resolving along the plane
	$T \cos 15 + 0.3 \times (0.2g \cos 30 - T \sin 15)$ $= 0.2g \sin 30$	**A1**	
		M1	For solving a 4 term equation for T
	$T = 0.541$	**A1**	
		6	
7(ii)	$0.3 \times 0.2g \cos 30 \times 3$ [= 1.5588 J]	**B1**	WD against F = friction × distance
	WD = 0.25×3 [= 0.75 J]	**B1**	WD against 0.25 force
	$0.2g \times 3 \sin 30$ [= 3 J]	**B1**	PE loss = mgh
	$[\frac{1}{2} (0.2) v^2 = 3 - 1.5588 - 0.75]$	**M1**	Work/Energy equation
	Speed = 2.63 ms^{-1}	**A1**	
		5	