Question	Answer	Marks	Guidance
1(i)	0.4 (m s^{-2})	B1	
	Total:	1	
1(ii)	$[9040 = \frac{1}{2}(600 + T) \times 16]$	M1	Equating area of the trapezium to the total distance or using $s = ½ (u + v)t$ or equivalent
	Time is 530 (s)	A1	
	Total:	2	
1(iii)	$[s = \frac{1}{2} \times (600 - 530 - 40) \times 16]$	M1	Use of triangular area, or equivalent
	Distance is 240 (m)	A1	
	Total:	2	

Question	Answer	Marks	Guidance
2	$[V^2 = 5^2 + 2 \times g \times 7.2]$	M1	Use of *uvast* to find V
	$V = 13$	A1	
	$[13 = 5 + gt \quad t = \ldots..]$ 0.8 (s)	M1	Use of *uvast* to find time for A to reach ground
	$[0 = 6.5 - gt \quad t = \ldots..]$ 0.65 (s)	M1	Use of *uvast* to find time from ground to B
	Total time is 1.45 (s)	A1	
	Total:	**5**	

Question	Answer	Marks	Guidance
3		M1	For resolving forces in any one direction
	E.g. $X = 18 + 12\sin 60° - 8\sin 30°$ $14 + 6\sqrt{3}$	A1	One correct equation or expression
	E.g. $Y = 8\cos 30° + 12\cos 60°$ $6 + 4\sqrt{3}$	A1	Second correct equation or expression (X and Y may denote components of resultant of given 3 forces or may be components of the fourth force that would produce equilibrium)
	$[(14 + 6\sqrt{3})^2 + (6 + 4\sqrt{3})^2]$ or $[\tan^{-1}(6 + 4\sqrt{3})/(14 + 6\sqrt{3})]$	M1	Use of Pythagoras or appropriate trig to find magnitude or angle
	Magnitude is 27.6 (N)	A1	Not for resultant
	Direction is 27.9° below 'negative x-axis'	A1	Not for 27.9° only; direction must be clearly specified
	Total:	**6**	

Question	Answer	Marks	Guidance
4	$[\frac{1}{2} \times 0.8 \times v^2]$ or $[\frac{1}{2} \times 1.6 \times v^2]$	**M1**	For KE of either particle
	Gain in KE $= \frac{1}{2}\times 0.8\times v^2 + \frac{1}{2}\times 1.6\times v^2$	**A1**	Total KE
	[Gain in $PE_A = 0.8g \times 0.5 \times \sin\theta$] or [Loss in $PE_B = 1.6g \times 0.5$]	**M1**	For PE change of either particle (irrespective of sign)
	Loss in PE $= 1.6g \times 0.5 - 0.8g \times 0.5 \times 0.6$	**A1**	Change of PE
	$[1.2v^2 = 8 - 2.4]$	**M1**	Energy equation originating from 4 terms
	Speed is 2.16 (m s^{-1})	**A1**	
	Total:	**6**	
			SC for using Newton II equations and $v^2 = u^2 + 2as$ (**max 2/6**) $[16 - T = 1.6a$ and $T - 8\sin\theta = 0.8a] \rightarrow a = 4.67$ (ms^{-2}) **B1** $[v^2 = 2 \times \frac{14}{3} \times 0.5] \rightarrow$ speed is 2.16 (ms^{-1}) **B1**
	Alternative method 1 for Question 4		
	$[\frac{1}{2} \times 0.8 \times v^2]$ or $[0.8g \times 0.5 \times \sin\theta]$	**M1**	For KE gain or PE gain of particle *A*
	$\frac{1}{2} \times 0.8 \times v^2 + 0.8g \times 0.5 \times 0.6$	**A1**	Total energy gain for particle *A*
	$[16 - T = 1.6a$ and $T - 8\sin\theta = 0.8a \rightarrow T = ...]$ 8.53	**M1**	Forms and solves Newton II equations to find tension T
	$WD_T = \frac{128}{15} \times 0.5$	**A1**	Finds $WD_{Tension}$
	$[\frac{1}{2} \times 0.8 \times v^2 + 0.8g \times 0.5 \times 0.6 = \frac{128}{15} \times 0.5]$	**M1**	Energy equation (3 terms)

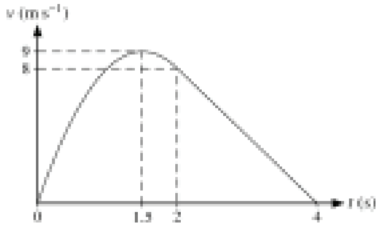
Question	Answer	Marks	Guidance
4	Speed is 2.16 (m s^{-1})	**A1**	
	Total:	**6**	
	Alternative method 2 for Question 4		
	$[\frac{1}{2} \times 1.6 \times v^2]$ or $[1.6\,g \times 0.5]$	**M1**	For KE gain or PE loss of particle B
	$1.6\,g \times 0.5 - \frac{1}{2} \times 1.6 \times v^2$	**A1**	Energy change for particle B
	$[16 - T = 1.6a$ and $T - 8\sin\theta = 0.8a \rightarrow T = ...]$ 8.53	**M1**	Forms and solves Newton II equations to find tension T
	$WD_T = \frac{128}{15} \times 0.5$	**A1**	Finds $WD_{Tension}$
	$1.6\,g \times 0.5 - \frac{1}{2} \times 1.6 \times v^2 = \frac{128}{15} \times 0.5]$	**M1**	Energy equation (3 terms)
	Speed is 2.16 (m s^{-1})	**A1**	
	Total:	**6**	

Question	Answer	Marks	Guidance
5	$R = 3g\cos 20°$	**B1**	Correct normal reaction stated or used
	$[\ F = 0.35 \times 3g\cos 20°\ ]$	**M1**	For use of $F = \mu R$
	$[\ P_1 + F = 3g\sin 20°\ ]$	**M1**	Attempted resolving equation for minimum case
	$P_1 = 0.394$ **(AG)**	**A1**	Correct given answer from correct work
	$[\ P_2 = F + 3g\sin 20°\ ]$	**M1**	Attempted resolving equation for maximum case
	$P_2 = 20.1\,(\text{N})$	**A1**	
	Total:	**6**	

Question	Answer	Marks	Guidance
6(i)	$[\ \frac{P}{56} = 40 \times 56\ ]$	**M1**	For equating $\frac{\text{Power}}{\text{Velocity}}$ to Resistance, or equivalent
	Power is 125 (kW)	**A1**	
	Total:	**2**	
6(ii)	Driving force is $\frac{125\,440}{32}$	**B1ft**	Follow through their power from **(i)**
	$[\ \frac{125\,440}{32} - 40 \times 32 = 1400a\ ]$	**M1**	For 3-term Newton II equation
	$a = 1.89\,(\text{m s}^{-2})$	**A1**	
	Total:	**3**	

Question	Answer	Marks	Guidance
6(iii)	[$\frac{60\,000}{50} + 1400g\sin\theta - 40 \times 50 = 0$]	M1	For 3-term Newton II equation
		A1	Correct equation
	[$\sin\theta° = \frac{800}{14\,000}$]	M1	
	$\theta = 3.3$	A1	
	Total:	**4**	

Question	Answer	Marks	Guidance
7(i)	[$\frac{dv}{dt} = 12 - 8t$] or e.g. [$-4[(t-1.5)^2 - 2.25]$]	M1	For attempted differentiation of $12t - 4t^2$ (or for alternative e.g. completing the square)
	[Maximum v when $t = 1.5 \Rightarrow v = 12 \times 1.5 - 4 \times 1.5^2$]	M1	For finding and using t
	Maximum velocity is 9 (m s^{-1})	A1	
	Total:	**3**	
7(ii)	[$\frac{dv}{dt} = 12 - 8t = -4$]	M1	Finding acceleration for $0 \leqslant t \leqslant 2$ when t = 2
	Acceleration for $2 \leqslant t \leqslant 4$ is –4 No instantaneous change	A1	Both values correct, with correct statement
	Total:	**2**	

Question	Answer	Marks	Guidance
7(iii)		B1	Quadratic shape (with max) for $0 \leqslant t \leqslant 2$
		B1	Line with negative gradient from (2, …) to (4,0)
		B1	All correct, smooth join and key values indicated
	Total:	**3**	
7(iv)	Area of triangle is 8	B1	(May be obtained by integrating $16 - 4t$ or use of *uvast*)
	$[\int (12t - 4t^2)\,dt = 6t^2 - \frac{4}{3}t^3]$	M1	Integration attempt for $0 \leqslant t \leqslant 2$
	$[6 \times 2^2 - \frac{4}{3} \times 2^3 - 6 \times 0^2 + \frac{4}{3} \times 0^3]$	DM1	Use of limits 0 and 2; condone absence of zero terms
	Area under curve is $\frac{40}{3}$ or 13.3	A1	
	Distance travelled is $\frac{64}{3}$ (m) or 21.3 (m)	A1	
	Total:	**5**	