Question			Answer	Marks	AO	Guidance
13	(a)		Newton's second law for the train $5 - 2 \times 0.8 = (0.5 + 0.4)a$	M1	3.1b	N2L for whole train with correct mass and all forces present
			Alternative $5 - 0.8 - T = 0.5a$ $T - 0.8 = 0.4a$			Also allow for 2 equations where both have correct mass and all forces present in each
			giving $a = \frac{34}{9} = 3.78 \text{ m s}^{-2}$.	A1	1.1b	
			Using $v = u + at$ with $u = 0, t = 1.5$	M1	3.1b	using *suvat* equation(s) with $u = 0$ and their $a \neq g$ leading to a value for v
			$v = \frac{34}{9} \times 1.5 = \frac{17}{3} = 5.67 \text{ m s}^{-1}$ (3sf)	A1	1.1b	FT their *a*. Any form
				[4]		
13	(b)			B1	1.1b	weights and normal reactions (must be distinct and not vertical) Allow if both components of weight given instead. Allow in addition to weight only if clear they are for working purposes only
				B1	1.1b	tensions in string and coupling parallel to inclined plane
				B1	1.1b	*R* marked for both parts of the train. No additional forces Allow if distinct if it is clear they are equal in later work
				[3]		
13	(c)		Newton's second law $P - 2R - 0.9g \sin 20° = 0.9a$	M1	1.1b	Newton's law with $m = 0.9$. Allow for incorrect weight term(s) or R used instead of 2R
				A1	3.3	Fully correct Any form
				[2]		
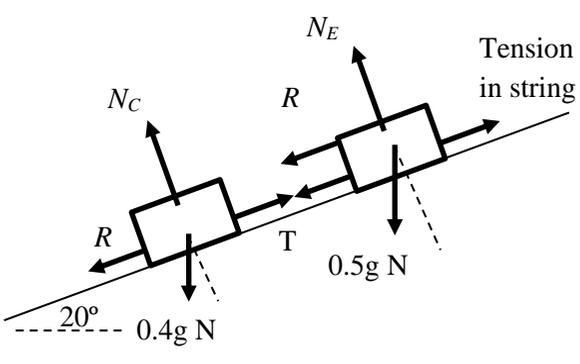
Question			Answer	Marks	AO	Guidance
13	**(d)**		When $P = 5$ the equation gives $5 - 2R - 0.9g\sin 20° = 0.9a$	**M1**	**3.1b**	establishes one equation linking R and a. FT their (c)
			When $P = 5.5$ the equation gives $5.5 - 2R - 0.9g\sin 20° = 0.9 \times 2a$	**M1**	**3.1b**	establishes another equation linking R and a. Consistent with their first equation
			Solve simultaneously giving $R = 0.742$ $\left[a = \frac{5}{9}\right]$	**A1**	**1.1b**	method need not be seen BC correct value for R (a is not required)
			Alternative method When $P = 5$ $a = \dfrac{5 - 2R - 0.9g\sin 20°}{0.9}$ When $P = 5.5$ $a_1 = \dfrac{5.5 - 2R - 0.9g\sin 20°}{0.9}$ So	**M1**		Finds expression for a when $P = 5$ or $P = 5.5$ Soi
			$\dfrac{5.5 - 2R - 0.9g\sin 20°}{0.9} = 2\left(\dfrac{5 - 2R - 0.9g\sin 20°}{0.9}\right)$	**M1**		Links corresponding acceleration for the other value of P Do not allow factor of 2 on the wrong side
			giving $R = 0.742$ $\left[a = \frac{5}{9}\right]$	**A1**		correct value for R (a is not required)
				[3]		