Question		Answer	Marks	AO	Guidance	
SEE APPENDIX AT THE END OF THE MS FOR IMPORTANT INFORMATION REGARDING THIS PART						
13	**(a)**		**M1***	**2.1**	Applying N2L parallel to the plane for P – correct number of terms and weight component resolved – allow sign errors and sin/cos confusion. Allow g missing but **M0** if $4ga$ in N2L	**For the first five marks condone**: μ used as the coefficient of friction for both P and B, or implying that $\mu_B = 2\mu_P$ rather than the correct $\mu_P = 2\mu_B$
		$4g\sin 60 - F_P - T = 4a$	**A1**	**1.1**	NB $T + F_P - 4g\sin 60 = 4a$ is **A1** (taking up the plane as +ve dir.)	Where F_P is the frictional force for P
		$R_P = 4g\cos 60$	**B1**	**3.3**	Resolving **correctly** perpendicular to the plane for P	Where R_P is the normal contact force for P
		$4g\sin 60 - \mu_P(4g\cos 60) - T = 4a$ $\Rightarrow 2\sqrt{3}g - 2\mu_P g - T = 4a$	**M1dep***	**3.4**	Use of $F = \mu R$ in the attempt at N2L for P with their R which must be a component of $4g$ only	Where μ_P is the coefficient of friction between P and the plane
		$T - \mu_B(2g) = 2a$	**M1**	**3.3**	Applying N2L parallel to the surface for B – correct number of terms – allow sign errors but note that $\mu_B(2g) - T = 2a$ is consistent with $T + F_P - 4g\sin 60 = 4a$ and therefore gives the correct answer (and is not incorrect working)	Where μ_B is the coefficient of friction between B and the plane Allow g missing but **M0** if $2ga$ in N2L or for $T - F_B = 2a$ **only**
		$2\sqrt{3}g - 2\mu_P g - T = 4a$ and $2T - 4\mu_B g = 4a$ with $\mu_P = 2\mu_B$ gives $2\sqrt{3}g - T = 2T$	**A1**	**3.3**	Solving simultaneously with $\mu_P = 2\mu_B$ (soi) to obtain a correct equation in T only	

Question		Answer	Marks	AO	Guidance	
		$2\sqrt{3}g - T = 2T \Rightarrow T = \frac{2\sqrt{3}}{3}g$	**A1**	**2.2a**	Must be seen in terms of g	Accept awrt $1.15g$
			[7]			

Question		Answer	Marks	AO	Guidance	
13(b)		$1.9 = 2(0.5) + \frac{1}{2}a_P(0.5)^2$	**B1**	**3.4**	Applying $s = ut + \frac{1}{2}at^2$ correctly to find a_P	
		$a_P = 7.2$	**B1**	**1.1**		
		$4g\sin 60 - \mu_P(4g\cos 60) = 4a_P$	**M1**	**3.1b**	Set $T = 0$ (or apply N2L) to obtain an expression for the acceleration of P when the string breaks	Correct number of terms, dimensionally correct (so g not missing), must be using the correct mass of 4 – **allow sin/cos mix and sign errors only**
		$\mu_P = 0.26266... \Rightarrow \mu_B = 0.13(1...)$	**A1**	**3.4**	Using their acceleration of P to correctly calculate the coefficient of friction for B. Can be implied from a correct deceleration of B. Accept 0.13 (so **2** sf) or better	For reference: exact value is $\frac{-72+49\sqrt{3}}{98}$ (which scores **A1**)
		$a_B = -\mu_B g \Rightarrow$ deceleration is 1.29 (m s^{-2})	**A1**	**3.2a**	Accept awrt 1.29 or -1.29	1.28704895… or, for reference, exact value is $\frac{-72+49\sqrt{3}}{10}$ (which scores **A1**)
			[5]			

APPENDIX (To assist with 13a)

Exemplar responses for Q13(a) – see main MS for Guidance for the requirements/conditions to award each of these marks

Response	**Max. Mark**
Case 1: candidates who immediately set μ as the coefficient of friction for *B* and 2μ as the coefficient of friction for *P* (correct) $4g\sin 60 - F_P - T = 4a$ **M1 A1** $R_P = 4g\cos 60$ **B1** $4g\sin 60 - 2\mu(4g\cos 60) - T = 4a$ **M1** $T - \mu(2g) = 2a$ **M1** $2\sqrt{3}g - T = 2T$ **A1** $T = \frac{2\sqrt{3}}{3}g$ **A1** Or equivalent e.g. replace 2μ above with μ **and** μ above with 0.5μ	**7**
Case 2: candidates who immediately set 2μ as the coefficient of friction for *B* and μ as the coefficient of friction for *P* **or** set both coefficients of frictions equal to μ (both of these are incorrect) $4g\sin 60 - F_P - T = 4a$ **M1 A1** $R_P = 4g\cos 60$ **B1** $4g\sin 60 - \mu(4g\cos 60) - T = 4a$ **M1** $T - 2\mu(2g) = 2a$ **M1** $4g\sin 60 - 4g\mu\cos 60 - T = 2T - 8\mu g$ **A0 A0** $4g\sin 60 - F_P - T = 4a$ **M1 A1** $R_P = 4g\cos 60$ **B1** $4g\sin 60 - \mu(4g\cos 60) - T = 4a$ **M1** $T - \mu(2g) = 2a$ **M1** $4g\sin 60 - 4g\mu\cos 60 - T = 2T - 4\mu g$ **A0 A0**	**5**
Case 3: assuming that as $\mu_P = 2\mu_B$ then this implies that $F_P = 2F_B$ without justification (e.g. no calculation of the normal contact forces for *P* and *B* considered – so while it turns out to be correct in this case it is not true in general) – if this is assumed then $4g\sin 60 - 2F - T = 4a$ **M1 A1** $T - F = 2a$ **M1** (so now allow this M mark even though in the main MS this would have been **M0**) leading to $2g\sqrt{3} - 2(T - 2a) - T = 4a$ and therefore $T = \frac{2\sqrt{3}}{3}g$ no further marks (3 marks max. also if assuming that $2F_P = F_B$)	**3**

Case 4: if assuming that $a = 0$ or g or any other value then they can score the **B** mark only for $R_P = 4g\cos 60$	**1**