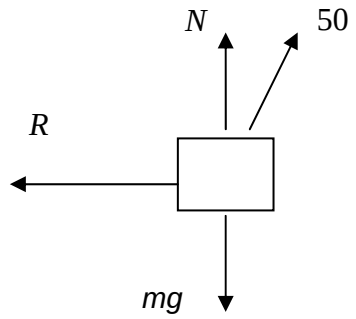
Question			Answer	Marks	Guidance
1	(i)			B2 [2]	Subtract one mark for each error, omission or addition down to a minimum of zero. Each force must have a label and an arrow. Accept *T* for 50 N. Units not required. If a candidate gives the tension in components: Accept if the components are a replacement for the tension Treat as an error if the components duplicate the tension However, accept dotted lines for the components as not being duplication
	(ii)		Horizontal equilibrium : $R = 50\sin 30° = 25$	M1 A1 [2]	May be implied. Allow sin-cos interchange for this mark only Award both marks for a correct answer after a mistake in part (i) (eg omission of *R*)
	(iii)		Vertical equilibrium $N + 50\cos 30° = 10g$ $N = 54.7$ to 3 s.f.	 M1 A1 [2]	 Relationship must be seen and involve all 3 elements. No credit given in the case of sin-cos interchange Cao
	(iv)		Resultant $= \sqrt{25^2 + 54.7^2}$ Resultant is 60.1 N	M1 A1 [2]	Use of Pythagoras. Components must be correct but allow ft from both (ii) and (iii) for mark only Cao

2		mark	notes
(i)	25 N	B1 1	Condone no units. Do not accept -25 N.
(ii)	50 cos25 = 45.31538… so 45.3 N (3 s. f.)	M1 A1 2	Attempt to resolve 50 N. Accept s ↔ c . No extra forces. cao but accept – 45.3.
(iii)	Resolving vertically $R + 50 \sin 25 - 8 \times 9.8 = 0$ R = 57.26908… so 57.3 N (3 s. f.)	M1 A1 A1 3	All relevant forces with resolution of 50 N. No extras. Accept s ↔ c . All correct.
(iv)	Newton's 2nd Law in direction DC $50\cos 25 - 20 = 18a$ a = 1.4064105… so 1.41 m s^{-2} (3 s. f.)	M1 A1 A1 3	Newton's 2nd Law with m = 18. Accept $F = mga$. Attempt at resolving 50 N. Allow 20 N omitted and s ↔ c . No extra forces. Allow only sign error and s ↔ c . cao
2 (v)	continued Resolution of weight down the slope	B1	$mg\sin 5°$ where m = 8 or 10 or 18, wherever first seen
	either Newton's 2nd Law down slope overall $18 \times 9.8 \times \sin 5 - 20 = 18a$ a = – 0.2569… Newton's 2nd Law down slope. Force in rod can be taken as tension or thrust. Taking it as tension T gives For D: $10 \times 9.8 \times \sin 5 - 15 - T = 10a$ (For C: $8 \times 9.8 \times \sin 5 - 5 + T = 8a$) T = – 3.888… = - 3.89 N (3 s. f.) The force is a thrust	M1 A1 M1 F1 A1 A1	$F = ma$. Must have 20 N and m = 18. Allow weight not resolved and use of mass. Accept s ↔ c and sign errors (including inconsistency between the 15 N and the 5 N). cao $F = ma$. Must consider the motion of either C or D and include: component of weight, resistance and T. No extra forces. Condone sign errors and s ↔ c . Do not condone inconsistent value of mass. FT only applies to a, and only if direction is consistent. '+T' if T taken as a thrust '-T' if T taken as a thrust If T taken as thrust, then T = +3.89. Dependent on T correct

	or Newton's 2nd Law down slope. Force in rod can be taken as tension or thrust. Taking it as tension T gives For C: $8\times 9.8\times \sin 5 - 5 + T = 8a$ For D: $10\times 9.8\times \sin 5 - 15 - T = 10a$ a = – 0.2569… T = – 3.888… = - 3.89 N (3s.f.) The force is a thrust	M1 M1 A1 A1 F1 A1	$F = ma$. Must consider the motion of C and include: component of weight, resistance and T. No extra forces. Condone sign errors and s ↔ c. Do not condone inconsistent value of mass. $F = ma$. Must consider the motion of D and include: component of weight, resistance and T. No extra forces. Condone sign errors and s ↔ c. Do not condone inconsistent value of mass. Award for either the equation for C or the equation for D correct. '-T' if T taken as a thrust '+T' if T taken as a thrust First of a and T found is correct. If T taken as thrust, then T = +3.89. The second of a and T found is FT Dependent on T correct
	then After 2 s: $v = 3 + 2 \times a$ v = 2.4860303.. so 2.49 m s^{-1} (3 s. f.) 9	M1 F1	Allow sign of a not followed. FT their value of a. Allow change to correct sign of a at this stage. FT from magnitude of **their** a but must be consistent with its direction.
		18	

3		mark	notes
(i)	Resolving	M1	Resolving in at least 1 of horiz or vert. Accept $\sin \leftrightarrow \cos$. No extra terms.
	$\leftarrow \ 250\sin 70 = 234.92...$ so 235 N (3 s. f.)	A1	Either both expressions correct (neglect direction) or one correct in correct direction
	$\uparrow \ 250\cos 70 = 85.5050...$ so 85.5 N (3 s. f.)	A1 3	cao Both evaluated and directions correct
(ii)	$250 \div 2 = 125$ N	**B1** 1	Accep $125g$ only if tension taken to be $250g$ in (i)
		4	

4		mark	notes
(i)	Diagram for P or Q Other diagram	B1 B1 2	Must be properly labelled with arrows Must be properly labelled with arrows consistent with 1st diagram Accept single diagram if clear.
(ii)	Let tension in rope be T N and accn $\uparrow$ a m s^{-2} For box P: N2L $\uparrow$ $1030 - 75g - T = 75a$ For box Q: N2L $\uparrow$ $T - 25g = 25a$	M1 A1 A1 3	N2L applied correctly to either part. Allow $F = mga$ and sign errors. Do not condone missing or extra forces. Direction of a consistent with equation for P. [Condone taking + ve downwards in either equation. +ve direction must be consistent in both equations to receive both A1s]
(iii)	 tension is 257.5 N	M1 A1 2	Solving for T **their** simultaneous equations with 2 variables. cao CWO
		7	

5		mark	notes
(i)	L **i** direction $150 = 250a$ $a = 0.6$ so 0.6 m s^{-2}	 M1 A1 2	 Use of N2L. Allow $F = mga$. Accept no reference to direction
(ii)	0 N – **i** direction	B1 B1 2	 Allow correct description or arrow [Accept '– 150 in **i** direction' for B1 B1]
(iii)	For force only in direction perp to **i** $300\sin 40 = 450\sin\theta$ $\theta = 25.37300\ldots$ so 25.4° (3 s. f.) In **i** direction $300\cos 40 + 150 + 450\cos\theta$ 786.4017… so 786**i** N (3 s. f.)	 M1 B1 A1 **M1** A1 A1 6	 Resolution of both terms attempted. Allow sin ↔ cos if in both terms. Allow 250 or 250g present. 300sin40 or 450sinθ Accept ± . Accept answer rounding to 25.5. Allow SC1 if seen in this part. Prope resolution attempted of 450 **and** 300. Allow sin ↔ cos if in both terms Accept use of **their** θ or just θ. Either resolution correct. Accept **their** θ or just θ. Accept sin/cos consistent with use for cpt perpendicular to **i.** Accept no reference to direction cao. Allow SC1 WW
(iv)	Using $s = ut + 0.5at^2$ $1 = 0.5a \times 2^2$ $a = 0.5$ Using N2L in **i** direction 786.4017… $– F = 250 \times 0.5$ 661.4017… so 661 N (3 s. f.)	 M1 A1 M1 A1 E1 5	 Appropriate (sequence of) *suvat* [WW M0 A0] Use of $F = ma$ with **their** 786.4 and **their** a. No extra forces. Allow sign errors. All correct using **their** 786.4 and a Use of N2L clearly shown. (Accept 0.5 used WW)
(v)	Usi g N2L in **i** direction **either** $125 - 200 = 250a_1$ **or** (starting again) 786.4017… – (200 + 661.4017…) = 250 a_1 so $a_1 = – 0.3$ Using $v^2 = u^2 + 2\ a_1$s $v^2 = 1.8^2 + 2 \times (– 0.3) \times 1.65$ $v = 1.5$ so 1.5 m s^{-1}	 M1 F1 M1 F1 A1 5	 Use of $F = ma$ with **their** values. Allow 1 force missing FT only **their** 786… and **their** 661 Appropriate (sequence of) *suvat* with $u \neq 0$. Must be 'new' a obtained by using N2L. Only FT use of ± **their** a_1 cao
		20	

6		mark	comment	sub
(i)				
	Up the plane $T - 4g\sin 25 = 0$	M1	Resolving parallel to the plane. If any other direction used, all forces must be present. Accept $s \leftrightarrow c$. Allow use of *m*. No extra forces.	
	T = 16.5666… so 16.6 N (3 s. f.)	A1		
				2
(ii)				
	Down the plane, $(4+m)g\sin 25 - 50 = 0$	M1	No extra forces. Must attempt resolution in at least 1 term. Accept $s \leftrightarrow c$. Accept *Mg*sin25. Accept use of mass.	
		A1	Accept *Mg*sin25	
	m = 8.0724… so 8.07 (3 s. f.)	A1		
				3
(iii)				
	Diagram		Any 3 of weight, friction normal reaction and *P* present	

		B1	in approx correct directions with arrows. All forces present with suitable directions, labels and arrows. Accept *W*, *mg*, 4*g* and 39.2.	2
(iv)				
	Resolving up the plane	M1	Resolving parallel to the plane or All forces must be present . Accept $s \leftrightarrow c$. Allow use of *m*. At least one resolution attempted and accept wrong angles. Allow sign errors.	
		B1	$P\cos 15$ term correct. Allow sign error.	
	$P\cos 15 - 20 - 4g\sin 25 = 0$	B1	Both resolutions correct. Weight used. Allow sign errors. FT use of *P*sin 15.	
		A1	All correct but FT use of *P*sin 15.	
	P = 37.8565…. so 37.9 N (3 s. f.)	A1		
				5
(v)				
	Resolving perpendicular to the plane	M1	May use other directions. All forces present. No extras. Allow $s \leftrightarrow c$. Weight not mass used. Both resolutions attempted. Allow sign errors.	
	$R + P\sin 15 - 4g\cos 25 = 0$	B1	Both resolutions correct. Allow sign errors. Allow use of *P*cos15 if *P*sin15 used in (iv).	
		F1	All correct. Only FT **their** *P* and their use of *P*cos15.	
	R = 25.729… so 25.7 N	A1	cao	
				4
		16		