Newton's Laws of Motion 1 MS

Q1.

7	**(i)**		M1		For resolving forces on Q vertically
		$R + 3.2\sin30° = 0.5g$	A1		
			M1		For resolving forces on Q horizontally and using $T = W_P$
		$F + 0.2g = 3.2\cos30°$	A1		
		$[\mu = (3.2\cos30° - 2)/(5 - 3.2\sin30°)]$	M1		For using $F = \mu R$
		Coefficient is 0.227	A1	[6]	
	(ii)	$2 - T = 0.2a$	B1		
		$T - 0.227 \times 5 = 0.5a$	B1ft		
					Allow B1ft for $2 - 0.227 \times 5 = (0.2 + 0.5)a$ instead of *one* of the above equations
			M1		For solving for a or T
		Acceleration is 1.24 ms^{-2} and tension is 1.75 N	A1	[4]	Allow a = 1.25

Q2.

2	**(i)**	$F = 0.2 \times 6g\cos8$	B1		
		$[6g\sin8 - F = 6a]$	M1		For use of Newton's second law
		Deceleration is 0.589 ms^{-2}	A1	3	Accept a = –0.589
	(ii)		M1		For use of $0 = u^2 + 2as$
		Distance is 7.64 m	A1	2	

Q3.

3			M1		For using Newton's second law
	$0.9g - 7.2 = 0.9a$	$(a = 2)$	A1		
	$[v^2 = 2 \times (0.9g - 7.2)/0.9 \times 2]$	$(v = \sqrt{8})$	M1		For using $v^2 = (0^2) + 2ah$
	$u_{slack} = v_{taut} = 2\sqrt{g - 8}$		B1ft		ft incorrect equation for a
	[distance = 4 – 32/g]		M1		For using $(0^2) = u^2 - 2gh$ and distance = 2h
	Distance is 0.8 m		A1	6	

Newton's Laws of Motion 1 MS

Q4.

5	**(i)**	Tension in S_1 is 30 N	B1		
		Tension in S_2 is 50 N	B1	[2]	
	(ii)		M1		For applying Newton's second law to A or to B
		$3g - T - 1.6 = 3a$ (or $2g + T - 4 = 2a$)	A1		
		$2g + T - 4 = 2a$ (or $3g - T - 1.6 = 3a$) or $(3g + 2g) - (1.6 + 4) = (3 + 2)a$	B1		
		Acceleration is 8.88 ms^{-2}	B1		
		Tension is 1.76 N	A1	[5]	

SR (max. 1 / 2) for candidates who do not give numerical answers in (i).

Allow B1 for Tension in S_1 is 3g and Tension in S_2 is 5g

Q5.

2	**(i)**	$[0.6 = 0 + 0.3a]$	M1		For using $v = 0 + at$
		Acceleration is 2 ms^{-2}	A1	2	
	(ii)	$[mg - T = 2m, T - (1 - m)g = 2(1 - m)]$	M1		For applying Newton's 2nd law to A or to B
		$[m = T/8 \rightarrow T - (10 - 1.25T) = 2 - 0.25T$ or $T = 8m \rightarrow 8m - (10 - 10m) = 2 - 2m]$	M1		For eliminating or evaluating m
		$T + 1.25T + 0.25T = 10 + 2$ or $m = 0.6$ and $T = 8m$	A1		
		$m = 0.6$ and tension is 4.8 N	A1	4	
		Alternative for part **(ii)**			
		$[\{m + (1 - m)\} \times 2 = \{m - (1 - m)\} \times g]$	M1		For using $(m_A + m_B)a = (m_A - m_B)g$
		$m = 0.6$	A1		
		$[mg - T = 2m$ or $T - (1 - m)g = 2(1 - m)]$	M1		For applying Newton's 2nd law to A or to B, substituting for m and solving for T
		Tension is 4.8 N	A1		

Newton's Laws of Motion 1 MS

Q6.

5	$[P - 8g\sin5^\circ - F = 8a]$	M1		For using Newton's 2nd law (either case)
	$7X - 8g\sin5^\circ - F = 8 \times 0.15$ **and** $8X - 8g\sin5^\circ - F = 8 \times 1.15$	A1		
	$X = 8$	A1		
		M1		For obtaining a numerical expression for F
	$F = 56 - 8g\sin5^\circ - 8 \times 0.15$ **or** $F = 64 - 8g\sin5^\circ - 8 \times 1.15$ **or** $F = 56 \times 1.15 - 64 \times 0.15 - 8g\sin5^\circ$ **or** $F = 47.8(275...)$	A1✓		ft X either from error for one term in X/F equation or from error in solution of correct X/F equations
	$R = 8g\cos5^\circ$ (= 79.695...)	B1		
	$[\mu = 47.8 \div 79.7]$	M1		For using $\mu = \frac{F}{R}$
	Coefficient is 0.600 (accept 0.6)	A1	8	

Q7.

6 (i)		M1		For using the gradient property for acceleration
	Acceleration is 4 ms^{-2}	A1		
		M1		For applying Newton's 2nd law to both particles or using the formula $(M + m)a = (M - m)g$ and for using $m + M = 1$
	For $T - mg = 4m$ **and** $(1 - m)g - T = 4(1 - m)$ **or** $4 = (1 - m - m)g$	A1		
	P has mass 0.3 kg and Q has mass 0.7 kg	A1	5	
(ii)	For using the area property of the graph or $h = ½ at^2$ to obtain $h = 2$	B1	1	
(iii)	Distance travelled upwards by $P = ½ 1.4 \times 4$	B1		
	Height is 4.8 m	B1	2	

Newton's Laws of Motion 1 MS

Q8.

6 **(i)**		M1		For resolving forces down the plane
	$20 + 5g\sin10° - F = 0$	A1		
	$R = 5g\cos10°$	B1		
	$[\mu = (20 + 8.6824) \div 49.24]$	M1		For using $\mu = F \div R$
	Coefficient of friction is 0.582	A1	5	
(ii)		M1		For using Newton's 2nd law
	$5g\sin10° - 0.582 \times 49.24 = 5a$	A1√		ft μ from **(i)** ($\mu > 0$)
	$\left[0 = 2.5^2 - 2 \times 4s\right]$	M1		For using $v^2 = u^2 + 2as$
	Distance is 0.781 m	A1	4	

Alternative Method for part (ii)				
(ii)	PE loss = $5gd\sin10^\circ$	B1		
		M1		For using KE loss + PE loss = WD against friction
	$\frac{1}{2} \times 5 \times 2.5^2 + 5gd\sin10^\circ = 0.582 \times 5gd\cos10^\circ$	A1√		ft μ ($\mu > 0$)
	Distance is 0.781 m	A1	4	

Newton's Laws of Motion 1 MS

Q9.

5 (i)				
		M1		For applying Newton 2nd law to P **or** to Q **or** for applying N2 to the system
	$0.5g \times \frac{7}{25} - T = 0.5a$ $T - 0.1g = 0.1a$ $1.4 - 1 = 0.6a$	**A1**		Any two correct Allow sin 16.3 for 7/25
	For eliminating T and obtaining $a = \frac{2}{3}$ ms^{-2}	**B1**		
		M1		For substituting for a to find T
	Tension is 1.07 N	**A1**	5	Allow $T = 16/15$ N
(ii)	$[v^2 = 2 \times \left(\frac{2}{3}\right) \times 0.7]$	**M1**		For using $v^2 = u^2 + 2as$ to find the speed of the particles immediately before the string breaks
	$[2^2 = 2 \times \frac{2}{3} \times 0.7 + 2 \times 0.28g \times s]$	**M1**		For applying $v^2 = u^2 + 2as$ for the motion of P when the string is slack and s is the distance travelled by P after the break until it reaches the floor
	Length of string $= 2.5 - s = 1.95$ m	**A1**	3	Allow length $= 41/21$ m