1	**(i)**		M1		For using the gradient property for acceleration or v = u + at
		Acceleration is 0.02 ms^{-2}	A1		
		Acceleration is – 0.21 ms^{-2}	A1	3	
	(ii)	[½ (1.5 + 2.1) ×30 + ½ 2.1 × 10 – ½ 2.2 × 20]	M1		For using the area property for displacement
		Distance AB is 42.5 m	A1	2	
	(iii)	Total distance walked is 86.5 m	B1ft	1	ft error in '64.5'or '22.0' or both
2			M1		For resolving in **i** and **j** directions.
	X = 31 + 26cosα, Y = 58 – 26sinα		A1		
	X = 55, Y = 48		A1		May be implied
			dM1		For using R = $(X^2 + Y^2)^{½}$ or tan θ = Y/X
	Resultant is 73N or Direction is at 41.1º to **i** direction		A1		
	Direction is at 41.1º to **i** direction or Resultant is 73N		B1	6	
Alternative solution for Q2					
	[tan θ_{12} = 58/31, R_{12}^2= 31^2 + 58^2]		M1		For finding an angle and the hypotenuse of a right angled Δ whose other sides are 31 & 58
	θ_{12} = 61.9º and R_{12} = 65.76		A1		
	[Incl. angle = (180 – θ_{12}– α)º, $R^2 = 26^2 + R_{12}^2 – 2 \times 26R_{12}$cos (incl. angle)]		M1		For finding the included angle between sides R_{12} and 26 and using the cosine rule to find R
	Incl. angle = 95.5º, Resultant is 73 N		A1		
	[sin β = 26sin95.5/73; θ = 61.9 – β]		M1		For using the sine rule in the triangle to find the angle opposite 26 and subtracting this from θ_{12}
	Direction is at 41.1º to **i** direction		A1		
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	

4	**(i)**	$0.8g \times 4$	B1		For finding PE at A For using $\frac{1}{2} mv_C^2 = PE_A$ or
		$[\frac{1}{2} 0.8v^2 = 32]$	M1		$\frac{1}{2} mv_B^2 = PE_A$ and $v_C = v_B$
		Speed at C = 8.94 ms^{-1}	A1	3	
	(ii)	[Either F = 0.3(0.8g) and – 2.4 = 0.8a or F = 0.3(0.8g) and WD = 2.4 × 5]	M1		For using F = μ mg and either Newton's 2nd law to find a or WD = F × BC
		$[v^2 = ans\textbf{(i)}^2 - 2 \times 3 \times 5$ or $\frac{1}{2} 0.8v^2 = 32 - 12]$	M1		For using either $v^2 = u^2 + 2as$ or $\frac{1}{2} mv^2$ = PE loss – WD by F
		Speed at C = 7.07 ms^{-1}	A1	3	
5	**(i)**		M1		For using s = $\int v dt$
		Displacement is $2t^3 - kt^4/4$	A1	2	
	(ii)	t = 6/k	B1	1	
	(iii)	$[2 \times 216/k^3 - k \times 1296/4k^4 = 108$ $\rightarrow 2 \times 216 - 1296/4 = 108k^3]$	dM1		For substituting for t in displacement and equating to 108
		k = 1	A1	2	
	(iv)	$dv/dt = 12t - 3kt^2$	B1		
		= 0 when t = (0), 4	B1		
		maximum value is 32	B1	3	
6			M1		For resolving forces horizontally
		R = Tcos30	A1		
			M1		For resolving forces vertically (either case)
		F = Tsin30 – 2g	A1		(preventing upwards motion)
		– F = Tsin30 – 2g	A1		(preventing downwards motion)
			M1		For using F = μR (either case) and attempting to solve for T
		T = 2g/(sin30 ± 0.24cos30) either case	A1		
		T = 28.3 and T = 68.5	A1	8	

7	**(i)**	DF = 30000/v or			
		WD by DF = 30000 × 100	B1		
		DF = R = 750 (v = 40) or WD by DF = WD by R = 750 × AB	B1		
		Distance AB is 4000 m	B1	3	
	(ii)	–750 = 600 a (a = – 1.25)	B1		
		$20^2 = 40^2 + 2(-1.25)BC$	M1		For using $v^2 = u^2 + 2as$
		Distance BC = 480 m	A1	3	
	Alternative for **(ii)**				
			M1		For using 'Loss of energy = WD against resistance'
		½ 600(40^2– 20^2) = 750(BC)	A1		
		Distance BC = 480 m	A1		
	(iii)	WD by engine = 30000 × 14	B1		
		Gain in KE = ½ 600 (30^2 – 20^2)	B1		
		[750 × CD = 420 000 – 150 000]	M1		For using 750 × CD = WD by engine – gain in KE
		Distance CD is 360 m	A1	4	