1 (i)	Less than	B1		
	F = 1.25W so W< F	B1	[2]	
(ii)	[P – 60 × 1.25 = 6 × 4]	M1		For applying Newton's second law.
	P = 99	A1	[2]	
2	Increase in PE = 1250 × 10 × 600 sin2.5°	B1		
	Decrease in KE = ½ 1250(30^2 – v_{top}^2)	B1		
	WD against resistance = 400 × 600	B1		
	[562500 – 625v_{top}^2 = 327145 + 240000 – 450000]	M1		For using WD by DF = Increase in PE – decrease in KE + WD against resistance
	Speed is 26.7 ms^{-1}	A1	[5]	
Special Ruling for candidates who assume, without justification, that the driving force (DF) is constant (maximum mark 4).				
	[DF – Weight component – Resistance = Mass × Accel'n]	M1		For applying Newton's second law.
	750 – 545 – 400 = 1250a	A1		
	$v^2 = 30^2 + 2 \times (-0.156) \times 600$	B1ft		ft value of a
	Speed is 26.7 ms^{-1}	B1	[4]	
3 (i)		M1		For using $0 = u^2 - 2gs$
	$u^2 = 2 \times 10 \times 45$; speed is 30$ms^{-1}$	A1	[2]	
(ii)	[$40 = 30t - 5t^2$ ➔ t = 2, 4]			For using s = ut – ½ gt^2 with s = 40, u = 30 and T = $t_2 - t_1$ or s = ut + ½ gt^2 s = 5, u = 0 and T = 2t
	[5 = ½ $10t^2$ ➔ t = 1]	M1		
	Time above the ground is 2 s	A1ft	[2]	
Special Ruling for candidates who assume, without justification, that the length of time required is that of the upward movement only. (maximum mark 1).				
(ii)	5 = ½ $10t^2$ ➔ t = 1, the length of time required is 1 s	B1	B1	
(iii)	Max. height above top of cliff = ½ g(17 ÷ 4) (= 21.25)	B1		
	[$0 = V^2 - 2g(40 + 21.25)$]	M1		For using $0 = u^2 - 2gs$
	Speed is 35 ms^{-1}	A1	[3]	

Alternative Marking Scheme for (iii)

	(iii)		M1		For using $40 = Vt - 5t^2$ ➔ $t_2 - t_1 = \frac{1}{2}(V/5 + \sqrt{(V^2/25 - 32)}) - \frac{1}{2}(V/5 - \sqrt{(V^2/25 - 32)})$
		$17 = V^2/25 - 32$	A1		
		Speed is 35 ms^{-1}	A1	[3]	
4	**(i)**	DF = 1500 000/37.5 (= 40 000)	B1		
		[DF – R = ma]	M1		For using Newton's second law
		DF – 30 000 = 400 000a	A1		
		Acceleration is 0.025 ms^{-2}	A1	[4]	
	(ii)	[1500 000/v – 30 000 = 0]	M1		For using Newton's 2nd law with a = 0
		Steady speed is 50 ms^{-1}	A1	[2]	
5	**(i)**	R = 2.6 × (12 ÷ 13) (= 2.4)	B1		
		[F = 0.2 × 2.4]	M1		For using F = μR
		[T – 2.6(5 ÷ 13) – F = 0.26a, 5.4 – T = 0.54a]	M1		For applying Newton's 2nd law to A or to B.
		For any two of T – 1 – 0.48 = 0.26a, 5.4 – T = 0.54a or (5.4 – 1 – 0.48) = (0.54 + 0.26)a	A1		
		Acceleration is 4.9 ms^{-2}	B1		
		Tension is 2.75 N (2.754 exact)	A1	[6]	
	(ii)	[s = ½ 4.9 × 0.4^2]	M1		For using s = ½ at^2
		Distance is 0.392 m	A1	[2]	
6	**(i)**		M1		For resolving forces in the *x* and *y* directions (or for sketching a marked triangle of forces)
		Fcosθ = 2.5 × 24 ÷ 25 + 2.6 × 5 ÷ 13	A1		(= 3.4)
		Fsinθ = 2.6 × 12 ÷ 13 – 2.5 × 7 ÷ 25	A1		(= 1.7)
			M1		For using $F^2 = (F\cos\theta)^2 + (F\sin\theta)^2$ to find F or tanθ = Fsinθ ÷ Fcosθ to find θ
		For F = 3.80 N or tanθ = 0.5	A1		
		For tanθ = 0.5 or F = 3.80 N	B1	[6]	

(ii)	[3.80 = 0.5a]	M1		For using Newton's 2nd law with the magnitude of the resultant force equal to the value of F found.
	Acceleration is 7.60 ms^{-2}	A1ft		ft value of F found in (i)
	Direction is 26.6° clockwise from +ve *x*-axis.	B1ft	[3]	ft value of tanθ found in (i)
7 (i)	$[0.0000117(1200t^2 - 12t^3) = 0]$	M1		For differentiating and solving ds/dt = 0
	$1200t^2 = 12t^3$ ➔ t = 0, 100	A1		Accept just t = 100, if it is used to find distance AB.
	Distance AB = 1170 m	A1	[3]	
(ii)		M1		For differentiating again and solving $d^2s/dt^2 = 0$
	$2400t - 36t^2 = 0$ ➔ t = 0, 200/3	A1		Accept just t = 200/3, if it is used to find v_{max}.
	$[v_{max} = 0.0000117\{1200(200/3)^2 - 12(200/3)^3\}]$	M1		For substituting into v(t)
	Maximum speed is 20.8 ms^{-1}	A1	[4]	
(iii)	At A a(t) = 0	B1		
	At B a(t) = $0.0000117(2400 \times 100 - 36 \times 100^2) = -1.40$ ms^{-2} (–1.404 exact)	B1	[2]	
(iv)	Sketch has v increasing			
	from 0 to maximum and decreasing to 0, with maximum closer to t = 100 than t = 0.	B1		
	Sketch has zero gradient at t = 0 and inflexion closer to t = 0 than t = 100.	B1	[2]	