1 **(i)**	$[-(1 \div 3)(W\cos\alpha) - W\sin\alpha = (W/g)a]$	M1		For using Newton's 2nd law and $F = \mu R$
	$(-0.32 - 0.28)g = a$	A1		
	$a = -6$.	A1	3	AG
(ii)	$[0 = 5.4^2 + 2(-6)s]$ or $[mgs(0.28) = \frac{1}{2}\, m(5.4)^2 - mgs(0.96)/3]$	M1		For using $0 = u^2 + 2as$ or for using PE gain = KE loss – WD against friction
	Distance is 2.43 m	A1	2	
2		M1		For using $a = (M - m)g/(M+m)$ or for applying Newton's 2nd law to A and to B and solving for a.
	$a = 5$	A1		
	When B reaches the floor $v^2 = 2 \times 5 \times 1.6$; speed is 4ms^{-1}	B1ft		ft a $a \neq g$ $v = \sqrt{(3.2a)}$
		M1		For using $0 = u^2 - 2gs$ or for using PE gain = KE loss
	$0 = 16 - 20s$ $(s = 0.8)$	A1ft		ft speed
	$h + 1.6 + 0.8 = 3 \rightarrow h = 0.6$	B1	6	
3		M1		For resolving forces on P vertically
	$T_A(1/2.6) + T_B(1/1.25) = 10.5$	A1		
		M1		For resolving forces on P horizontally
	$T_A(2.4/2.6) = T_B(0.75/1.25)$	A1		
		M1		For solving for T_A and T_B
	Tension in AP is 6.5 N and tension in BP is 10 N.	A1	6	

	First Alternative			
		M1		For finding two angles in the triangle of forces
	$75.7(5)^o$ opposite to 10.5 N $36.8(7)^o$ opposite to T_A $67.3(8)^o$ opposite to T_B	A1		
		M1		For using the sine rule to find equations for T_A and T_B
	$T_A \div \sin 36.8(7) = 10.5 \div \sin 75.7(5)$ and $T_B \div \sin 67.3(8) = 10.5 \div \sin 75.7(5)$	A1		
		M1		For solving for T_A and T_B
	Tension in AP is 6.5 N and tension in BP is 10 N.	A1	6	
	Second Alternative			
		M1		For finding angles at P in the space diagram.
	$104.2(5)^o$ opposite to 10.5 N $143.1(3)^o$ opposite to T_A $112.6(2)^o$ opposite to T_B	A1		
		M1		For using Lami's rule to find equations for T_A and T_B
	$T_A \div \sin 143.1(3) = 10.5 \div \sin 104.2(5)$& $T_B \div \sin 112.6(2) = 10.5 \div \sin 104.2(5)$	A1		
		M1		For solving for T_A and T_B
	Tension in AP is 6.5 N and tension in BP is 10 N.	A1	6	
4	**(i)** $[W\sin\alpha + F = 40]$	M1		For resolving forces parallel to the plane
	$F = 40 - 300 \times 0.1$ (= 10)	A1		
	$R = 300\sqrt{(1 - 0.1^2)}$ (= 298.496..)	B1		
		M1		For using $\mu = F/R$
	Coefficient is 0.0335	A1	5	

(ii)	[The component of weight (30 N) is greater than the frictional force (10 N)]	M1		For comparing the weight component parallel to the plane and the frictional force or for using Newton's Second Law and finding the acceleration
	Box does not remain in equilibrium	A1	2	
5 (i)		B1		The sketch requires three straight line segments with +ve, zero and –ve slopes in order, which together with a segment of the t axis form a trapezium.
		M1		For using $v = at$ for T_1 or $u = -at$ for T_3
	$T_1 = V \div 0.3$, $T_3 = V$	A1	3	
(ii)	[$S = \frac{1}{2} T_1V + T_2V + \frac{1}{2} T_3V$]	M1		For using the area property for the distance travelled
		M1		For substituting for T_1, T_2 and T_3 in terms of V
	$S = 552V - V\{0.5(T_1 + T_3)\}$ $= 552V - 13V^2/6$	A1		
	$13V^2 - 3312V + 72000 = 0$	B1		AG
	$V = 24$	B1	5	
6 (i)	[$144000/v - 4800 = 12500a$]	M1		For using DF = P/v and Newton's 2nd law at A or at B
	Acceleration at A is 0.336 ms^{-2}	A1		
	The speed at B 24 ms^{-1}	A1	3	AG
(ii)	WD by DF = 5800 × 500 &			
	WD against res'ce = 4800 × 500	B1		
	Loss in KE = $\frac{1}{2}12500(24^2 - 16^2)$	B1		
		M1		For using WD by DF = PE gain – KE loss + WD against res'ce
	$5800 \times 500 = 12500gh - \frac{1}{2}12500(24^2 - 16^2) + 4800 \times 500$	A1		
	Height of C is 20 m	A1	5	

	(ii) Alternative			
	$[16^2 = 24^2 + 2 \times 500a]$	M1		For using $v^2 = u^2 + 2as$
	$a = -0.32$ ms^{-2}	A1		
		M1		For using Newton's second law
	$5800 - 4800 - 12500g \times (h \div 500)$ $= 12500(-0.32)$	A1		
	Height of C is 20 m	A1	5	
7 (i)	$[s = k_1t^2/2 - 0.005t^3/3 + (C)]$	M1		For using $s = \int v dt$
	$[k_1(60^2/2) - 0.005(60^3/3) = 540]$	DM1		For using limits 0 and 60 and equating to 540
	$k_1 = 0.5$	A1		
	$0.5 \times 60 - 0.005 \times 60^2 = k_2 \div \sqrt{60}$	M1		For using $v_1(60) = v_2(60)$
	$k_2 = 12\sqrt{60}$	A1	5	AG
(ii)		M1		For using $s = 540 + 12\sqrt{60}\int_{60}^{t} (t^{-1/2})dt$
	$[s = 540 + 12\sqrt{60}(2\sqrt{t} - 2\sqrt{60}) =]$ $24\sqrt{(60t)} - 900$	A1	2	Accept any other correct form for s if it is used in **(iii)**
(iii)	$[24\sqrt{(60t)} - 900 = 1260]$	M1		For solving $s(t) = 1260$ for t
	$t = 135$	A1		
	$v = 12\sqrt{60} \div \sqrt{135} \rightarrow$ speed is 8 ms^{-1}	B1	3	