1	$a = g\sin30^o$	B1		
	[**(i)** $v_1^2 = 2(g\sin30^o)0.9$ or ½ $mv_1^2 = mg(0.9\sin30^o)$ or **(ii)** $v_2 = (g\sin30^o)0.8$]	M1		For using $v^2 = 2as$ or $1/2\ mv^2 = mgh$ or $v = at$
	(i) Speed is 3 ms^{-1} or **(ii)** Speed is 4ms^{-1}	A1		
	(ii) Speed is 4ms^{-1} or **(i)** Speed is 3 ms^{-1}	B1	**[4]**	
2	**(i)** [½ $v^2 = 10x1.8$] Speed is 6 ms^{-1}	M1 A1	**[2]**	For using ½ $mv^2 = mgh$
	(ii) [WD = ½x0.5$(6^2 – 5^2)$ or 0.5x10x1.8 = ½x0.5x5^2] Work done is 2.75 J	M1 A1	**[2]**	For using WD = loss of KE or $KE_A + PE_A – WD = KE_C + PE_C$
3	**(i)** [$2T\cos30^o = 3\sqrt{3}$ or $T/\sin30^o = 3\sqrt{3}/\sin120^o$ or $T^2 = T^2 + (3\sqrt{3})^2 – 2T(3\sqrt{3})\cos30^o$ or $\sqrt{\{(T\cos30^o)^2 + (T + T\cos60^o)^2\}} = 3\sqrt{3}$] Tension is 3 N	M1 A1	**[2]**	For expressing resultant in terms of T and equating with value or for using sine rule or for using cosine rule or for finding Rx and Ry and equating resultant to $3\sqrt{3}$ AG
	(ii) [T = F + mg sin30] R = mg cos30 3 = 0.75(10cos30°)m + 10 m sin 30° Mass is 0.261 kg	M1 B1 M1 A1 A1	**[5]**	For resolving forces on Q parallel to AC For using F = μ R
4	**(i)** v(4) = 0.75x4 v(54) = v(4) and v(60) = v(54) – 0.5(60 – 54) Velocity is 3 ms^{-1} when t = 4 and 0 when t = 60 2nd segment has zero slope; end points of segments are seen to be correct {(0,0), (4,3), (54,3), (60,0)}	B1 B1 B1 M1 A1ft	**[5]**	 Graph consists of 3 straight line segments with 1st and 3rd having +ve and –ve slopes respectively; v is single valued and continuous throughout, and v(0) = 0. ft incorrect value(s) for v(4) and v(60)
	(ii) [XY = ½ (60 + 50)x3 or XY = ½ x0.75x4^2 + 3x50 – ½ x0.5x6^2] Distance is 165 m	M1 A1	**[2]**	For using area property for distance or $s_1 = ½\ a_1t_1^2$, $s_2 = u_2t_2$, $s_3 = ½\ a_3t_3^2$ and $XY = s_1 + s_2 – s_3$

5	**(i)**	$[F^2 = 27.5^2 + (-24)^2]$	M1		For using $F^2 = X^2 + Y^2$ (may be scored in **(ii)**)
		$F = 36.5$	A1		
		$[\tan\alpha^o = -(-24/27.5)]$	M1		For using $\tan\alpha^o = -Y/X$
		$\alpha = 41.1$	A1	**[4]**	
	(ii)	$R = 94.9$	B1		
		$[\alpha^o + \theta^o = \tan^{-1}(87.6/36.5)$; or $(\alpha^o + \theta^o) = \cos^{-1}(36.5/94.9)$ or $\theta^o = \tan^{-1}(87.6\sin 48.9^o - 24)/(27.5 + 87.6\cos 48.9^o)]$	M1		For using $\tan(\alpha^o + \theta^o) = 87.6/F$ or $\cos(\alpha^o + \theta^o) = F/R$ or $\tan\theta^o = Y/X$
		$\theta = 26.3$	A1ft	**[3]**	ft 67.4 – incorrect α
6	**(i)**		M1		For using $a(t) = \dot{v}(t)$
		$a_1(t) = 1.44t - 0.288t^2$, $a_2(t) = 2.4 - 0.48t$	A1		
		$[a_1 = 1.44x5 - 0.288x25$, $a_2 = 2.4 - 0.48x5]$	M1		For evaluating $a_1(5)$ and $a_2(5)$
		$a_1 = a_2 (= 0)$ ➔ no instantaneous change	A1	**[4]**	
	(ii)		M1		For using $s = \int v dt$
		$s_1 = 0.24t^3 - 0.024t^4$, $s_2 = 1.2t^2 - 0.08t^3$	A1		
		$[\{(0.24x5^3 - 0.024x5^4) - (0 - 0)\} + \{(1.2x10^2 - 0.08x10^3) - (1.2x5^2 - 0.08x5^3)\}]$	M1		For using limits 0 to 5 and 5 to 10 or equivalent
		Distance is 35 m	A1	**[4]**	
7	**(i)**	$DF = 24000/20$	B1		
		$[DF - R = 1250x0.32]$	M1		For using Newton's second law (3 terms)
		$R = 800$	A1	**[3]**	
	(ii)	$24000/29.9 - 800 = 1250a$	B1		
		Acceleration is $0.002\,ms^{-2}$	B1	**[2]**	
	(iii)	$[a = (24000/30 - 800)/1250$ $24000/v - 800 > 0$ ➔ $v < 30]$	M1		For finding a when $v = 30$ or for using $a > 0$ to obtain an inequality for v
		Car not accelerating when $v = 30$ or Speed cannot reach $30\,ms^{-1}$	A1	**[2]**	AG
	(iv)	$29.9 \le v < 30$ ➔ speed approximately constant	B1	**[1]**	
	(v)	$30\,ms^{-1}$ (max error 0.1) or $29.95\,ms^{-1}$ (max error 0.05) or $29.9\,ms^{-1}$ (max error 0.1)	B1	**[1]**	
	(vi)	**(a)** $[24 = 1200/T]$	M1		For using $P = \Delta WD/\Delta t$
		Time taken is 50 s	A1		
		(b) $[s = 30x50$ or $29.95x50$ or $29.9x50]$	M1		For using $s = vt$
		Distance BC is 1500 m or 1500 m or 1495 m	A1	**[4]**	

ALTERNATIVE FOR PART **(vi)**

(b)	[1200 000 = 800d]	M1	For using 'no change in KE' ➔ WD by car's engine = WD against resistance' (may be implied)
	Distance BC is 1500 m	A1	
(a)	[t = 1500/30 or 1500/29.95 or 1500/29.9]	M1	For using t = s/v
	Time taken is 50 s or 50.1 s or 50.2 s	A1	