1	d = 2 × 8		B1		
	[25 × 16cos20]		M1		For using WD = Fdcosα
	Work done is 376 J		A1	3	
2			M1		For applying Newton's second law to either particle (3 terms)
	0.65g – T = 0.65a and T – 0.35g = 0.35a		A1		Accept (0.65 – 0.35)g = (0.65 + 0.35)a as an alternative to one of these equations
			M1		For solving for T
	Tension in the string is 4.55 N		A1		
	Magnitude of resultant is 9.1 N		B1ft	5	
3	**(i)**	**(a)** [2 × 12cos40 – 15cos50]	M1		For resolving in direction *AB*
		Component is 8.74 N	A1		
		(b) Component is 11.5 N	B1	3	
	(ii)	Magnitude is 14.4 N or direction is 52.7° (or 0.920^c) anticlockwise from **i** dir'n	M1		For using $R^2 = X^2 + Y^2$ or $\tan\theta = Y/X$
			A1		
		Direction is 52.7° (or 0.920^c) anticlockwise from **i** dir'n or magnitude is 14.4 N	B1	3	
4	**(i)**	$1.76 = 0.8u + 0.32a$	M1		For using $s = ut + \frac{1}{2}at^2$ for *AB*
			A1		
		$[1.76 + 2.16 = (0.8 + 0.6)u + \frac{1}{2}(0.8 + 0.6)^2a$ or $2.16 = (u + 0.8a)0.6 + \frac{1}{2}0.6^2a]$	M1		For using $s = ut + \frac{1}{2}at^2$ for *AC* or $v = u + at$ for *AB* and $s = ut + \frac{1}{2}at^2$ for *BC*
		$3.92 = 1.4u + 0.98a$ or $2.16 = 0.6u + 0.66a$	A1		
		$u = 1.4$ and $a = 2$	M1		For solving for *u* and *a*
			A1	6	
	(ii)	$[2 = 10\sin\theta]$	M1		For using $a = g\sin\theta$
		$\theta = 11.5$	A1	2	
5	**(i)**	$F = 12\cos\alpha$	B1		
			M1		For resolving forces vertically
		$R_1 = 2g + 12\sin\alpha$	A1		
		$[12 \times 0.8 \leq \mu(2g + 12 \times 0.6)]$	M1		For using $F_1 \leq \mu R$
		$\mu \geq 9.6/27.2 = 6/17$	A1	5	AG

	(ii)	$12\cos\alpha > \mu R_2$	B1		
		$R_2 = 2g - 12 \times 0.6$	B1		
		$\mu < 9.6/12.8 = 3/4$	B1	3	
6	**(i)**	PE gain = $1200g \times 45$	B1		
		WD = $1200g \times 45 + 360\,000$	M1		For WD by car's engine = PE gain + WD against resistance
		Work done is 900 000 J or 900 kJ	A1	3	
	(ii)	WD against resistance = $360 \times \sin5/\sin1$ (kJ) or $\{360000 \div (45/\sin5^o)\} \times (45/\sin1^o)$ (J) or 697.24... × 2578.44... (J) or 1798 (kJ)	B1		
		KE gain = 1660 + 540 – 1798	B1ft		Accept 1660 + 540 – 1800
		$[402000 = \tfrac{1}{2}1200(v^2 - 225)]$	M1		For using KE gain = $\tfrac{1}{2}$ m$(v^2 - 15^2)$
		Speed is 29.9 ms^{-1}	A1	4	AG
	(iii)	$\frac{P_B}{P_C} = \left(\frac{DF_B}{DF_C}\right) \times \frac{v_B}{v_C} = 1.5 \times 15/29.9$	M1		For using P = Fv
			A1		
		Ratio is 0.75	A1	3	
7	**(i)**	$v(100) = 0.16 \times 1000 - 0.016 \times 10000 = 0$	B1	1	AG
	(ii)	$a = 1.5 \times 0.16t^{\frac{1}{2}} - 0.032t$	M1		For using $a = dv/dt$
			A1		
		$[t^{\frac{2}{3}} = 0.24/0.032 \rightarrow t = 56.25 \rightarrow v_{max} = 0.16 \times 421.875 - 0.016 \times 3164.0625]$	M1		For solving a = 0 and subst into $v(t)$
		Maximum speed is 16.9 ms^{-1} (or $16\frac{7}{8}$ ms^{-1})	A1	4	
	(iii)	$s = 2/5 \times 0.16t^{\frac{5}{2}} - 0.016t^3/3$	M1		For using $s = \int v\,dt$
			A1		
		Distance is 1070 m	A1	3	
	(iv)	$\frac{1}{3}t^{\frac{1}{2}}(0.192 - 0.016\sqrt{t}) = 0$	M1		For attempting to solve $s(t) = 0$
		Value of t is 144	A1	2	