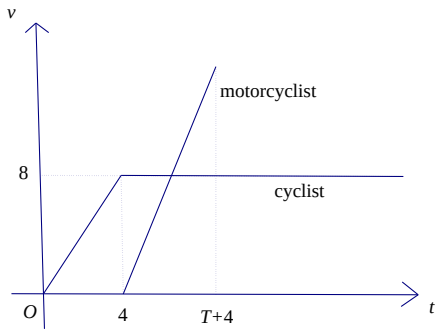
Mark Scheme (Results)

Summer 2018

Pearson Edexcel International A Level
in Mechanics M1 (WME01/01)
Paper 01

Question Number	Scheme	Marks	Notes
	Mark parts (i) and (ii) together		For marking:1st equation M1A1 2nd equation M1A1 1st value A1, 2nd value A1
2a i	Moments equation	M1	Use moments to form an equation in R_C and/or R_D All terms required. Dimensionally correct. Condone sign errors.
	$M(D)$: $(60g \text{ x } 0.6) + (20g \text{ x } 1.6) = R_C \text{ x } 2$ $M(C)$: $(60g \text{ x } 1.4) + (20g \text{ x } 0.4) = R_D \text{ x } 2$ *M(A)*: $2\times 20g + 3\times 60g = 1.6R_C + 3.6R_D$ *M(B)*: $0.4R_D + 2.4R_C = 60g\times 1 + 20g\times 2$	A1	Correct unsimplified equation
	$R_C = 34g$	A1	333 (333.2) is an accuracy error
ii	Resolve vertically	M1	Or form a moments equation in R_D
	$(\uparrow)\ R_C + R_D = 80g$	A1	Correct unsimplified equation
	$R_D = 46g$	A1	451 (450.8) is an accuracy error (penalise once only if *g* substituted in both answers and correct versions not seen)
		(6)	
2b	Set $R_D = 0$ and use moments to form equation in a relevant distance (One unknown only)	M1	Complete method for a relevant distance Dimensionally correct equation. Using their answers from (a) is M0
	$M(C)$, $(20g\times 0.4) = (60g\times x)$ where *x* = distance from C when beam tilts	A1	Correct unsimplified equation for a relevant distance
	$\left(x = \frac{2}{15}\right)$		
	Use their distance to find the distance walked	DM1	Dependent on the previous M1
	Distance $= 1.4 + \frac{2}{15} = \frac{23}{15} = 1.53$ m	A1	
		(4)	
		[10]	

Question Number	Scheme	Marks	Notes
3a		B1 shape B1 figs B1 shape B1 figs (4)	Correct shape graph for cyclist 4 marked Motorcyclist graph in relatively correct position Must start at $t = 4$ and must continue beyond point of intersection of the graphs $T + 4$ marked Treat two separate graphs as two attempts and award the marks for the better attempt
3b	$\frac{1}{2}T.4T = \left(\frac{T+T+4}{2}\right)8$	M1	Equate distances to form equation in T
		A1	One distance correct
		A1	Both distances correct
	$T^2 - 4T - 8 = 0$	A1	Simplify to 3 term quadratic
	$T = 2 \pm \sqrt{12}$	M1	Solve a 3 term quadratic for T
	$T = 5.5$	A1	Q asks for answer to 1 dp. Must reject negative solution if seen.
		(6)	
		[10]	
			See over

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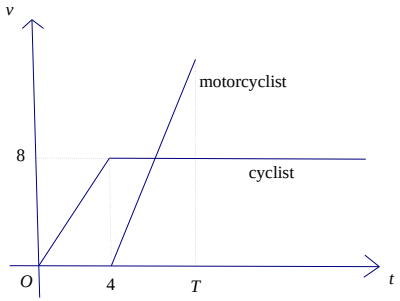
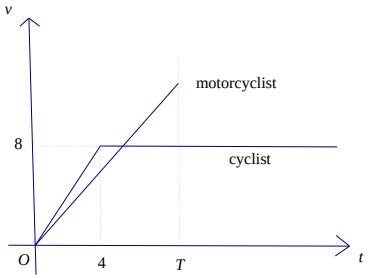
SC1			B1B1 B1B0 $16+8(T-4)=\frac{1}{2}\times 4(T-4)^2$ M1A1A1 $T^2-12T+24=0$ (or equivalent) A1 $T=6+2\sqrt{3}=9.5$ M1A0 (marking the T as a misread)
SC2			B1B1 B0B0 $16+8(T-4)=\frac{1}{2}\times 4T^2$ M1A1A1 $2T^2-8T+16=0$ A0M0A0 (completely changed the question but some evidence of correct thinking)

Question Number	Scheme	Marks	Notes
4a	Resolve perpendicular to the surface	M1	Condone sin/cos confusion
	$R = 2g\cos\alpha$ (15.68)	A1	Correct resolution
	$F = \frac{1}{4}R = \frac{2g}{5} = 3.9$ N or 3.92 N	A1	Max 3 sf for decimal answer
		(3)	
4b	$-2g\sin\alpha - F = 2a$	M1	Equation of motion parallel to the plane. Require all terms and dimensionally correct. Condone sign errors and sin/cos confusion
		A1ft	Correct unsimplified equation in F (or their F)
	$\frac{-4g}{5} = a$	A1	Or $-7.84\,(\text{m s}^{-2})$ Accept +/-
	$0^2 = 6^2 - \frac{8g}{5}s$	DM1	Complete method using *suvat* and $a \neq g$ to find s Dependent on the previous M1
	$s = \frac{45}{2g} = 2.3$ m or 2.30 m	A1	Max 3 sf
		(5)	
4c	$2g\sin\alpha - F = 2a'$	M1	Equation for motion down the plane to find new acceleration. Require all terms and dimensionally correct. Condone sign errors and sin/cos confusion
		A1ft	Correct unsimplified equation in F (or their F)
	$\frac{2g}{5} = a'$	A1	Or $3.92\,(\text{m s}^{-2})$
	$v^2 = \frac{4g}{5}\frac{45}{2g} = 18 \Rightarrow$	DM1	Complete method using *suvat* , $a' \neq g$ and $a' \neq a$, to find v Dependent on the previous M1
	$v = \sqrt{18} = 4.2$ m s^{-1}(or better)	A1	g cancels Condone 4.25 (from using rounded values).
		(5)	
		[13]	

Question Number	Scheme	Marks	Notes
5a	Correct equation for $\mathbf{v}_P$ or find displacement	M1	Use of $\mathbf{r}_P = \mathbf{r}_0 + \mathbf{v}_P t$ to find $\mathbf{v}$. Allow for $\lambda(-\mathbf{i}-5\mathbf{j})$
	$\mathbf{v}_P = 3(6\mathbf{i}-(7\mathbf{i}+5\mathbf{j})) = -3\mathbf{i}-15\mathbf{j}$	A1	
	$\sqrt{(-3)^2+(-15)^2}$	M1	Use of Pythagoras to find magnitude of their $\mathbf{v}$
	$= \sqrt{234} = 15.3 \left(\text{km h}^{-1}\right)$ (or better)	A1	CSO $\left(3\sqrt{26}\right)$ A0 if it comes from $3\mathbf{i}+15\mathbf{j}$
			NB Could score the M marks in reverse order - find displacement in 20 minutes and then multiply by 3
		(4)	
5b	Use of $\mathbf{r}_P = \mathbf{r}_0 + \mathbf{v}_P t$: $\mathbf{r}_P = 7\mathbf{i}+5\mathbf{j}+t(-3\mathbf{i}-15\mathbf{j})$	M1	For their $\mathbf{v}_P$
	$\Rightarrow \mathbf{r}_P = (7-3t)\mathbf{i}+(5-15t)\mathbf{j}$	A1	Obtain **given answer** from correct working
		(2)	
5c	$\dfrac{(7-3t)}{(5-15t)} = \dfrac{16}{5}$	M1	Use given answer and direction to form equation in t
		A1	Correct unsimplified equation
	$35-15t = 80-240t$	DM1	Solve for t. Dependent on the previous M1
	$t = 0.2$	A1	
		(4)	
5d	P and Q in the same place at the same time	M1	Equate **i** or **j** components of position vectors and solve for t
	$\Rightarrow\ 7-3t = 5+2t$ or $5-15t = -3+5t$	A1	Either
	$t = 0.4$	A1	
	Check that the same value of t gives equal values for the other component	DM1	Dependent on the previous M mark
	$\mathbf{r} = (5.8\mathbf{i}-\mathbf{j})$ km	A1	Must be a vector
		(5)	
		[15]	

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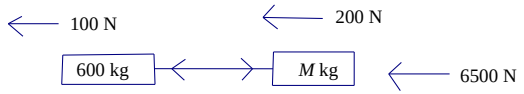
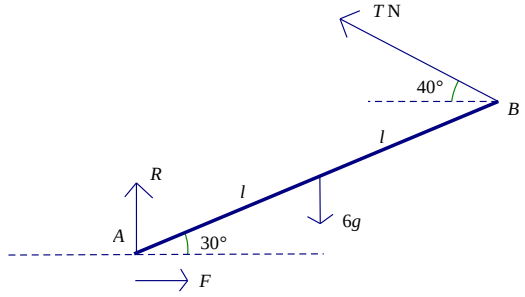
			
6a	For the trailer:	M1	Complete method to form an equation in T. e.g. equation of motion for the trailer. Need all 3 terms. Condone sign errors.
	$-100-T=600\times(-4)$	A1	Correct unsimplified equation. Allow with $\pm T$
	$T=2300$ N	A1	Must be positive
		(3)	
6b	For the car and trailer:	M1	Complete method to solve for M. Equation of motion for the car + trailer. Need all terms. Condone sign errors.
	$6500+100+200=4(M+600)$	A1	Correct unsimplified equation
	$M=1100$	A1	
			Allow M1A1 if a correct equation is seen in (a) and used in (b)
6balt	For the car:	M1	Equation of motion for the car. Need all terms. Condone sign errors.
	$6500+200-T=4M$	A1	Correct unsimplified equation in T or their T
	$M=1100$	A1	
		(3)	
6c	$s=vt-\frac{1}{2}at^2$	M1	Complete method using s*uvat* to find t Clear use of $s=ut+\frac{1}{2}at^2$ with $u=0, a=4$ is M0. e.g. $40.5=-2t^2$ from no working is M0A0
	$40.5=\frac{1}{2}.4.t^2$	A1	Correct unsimplified equation
	$t=4.5$ s	A1	
		(3)	
		[9]	

Question Number	Scheme	Marks	Notes
7a	$\sin\alpha = \frac{3}{5}$ or $\cos\alpha = \frac{4}{5}$	B1	Correct trig ratios for α seen or implied Watch out - it could be up beside the diagram
	At B, $(\uparrow)$	M1	Complete method to form equation in T_{AB}
	$\Rightarrow \quad T_{AB}\sin\alpha = 3g$	A1	Correct unsimplified equation
	$T_{AB} = 5g = 49$ N	A1	
		(4)	
7b	At B, $(\rightarrow)$	M1	Complete method to form equation in T_{BC}
	$\Rightarrow \quad T_{AB}\cos\alpha = T_{BC}$	A1	Correct unsimplified equation. Allow with their T_{AB}
	$T_{BC} = 4g = 39$ or 39.2 N	A1	
		(3)	
7c	Resolve at C:	M1	Resolve to form equation in T_{CD} There is a lot of confusion over the labelling of the tensions. Allow if a value is used correctly, whatever it is called.
	At C, $(\rightarrow)$ $T_{CD}\cos\beta = T_{BC}$	A1	One correct equation in T_{CD} Could be whole system equations e.g. $T_{AB}\cos\alpha = T_{CD}\cos\beta$ $T_{AB}\sin\alpha + T_{CD}\sin\beta = (3+M)g$
	At C, $(\uparrow)$ $T_{CD}\sin\beta = Mg$	A1	Two correct equations in T_{CD} (=101.92)
	$\tan\beta = \dfrac{Mg}{T_{BC}}$	DM1	Dependent on previous M1. Use $\tan\beta$ and solve for M
	$Mg = 4g \times \frac{12}{5} \Rightarrow M = 9.6$	A1	
		(5)	
		[12]	

Mark Scheme (Results)

Summer 2018

Pearson Edexcel International Advanced Level
In Mechanics M2 (WME02/01)

Question Number	Scheme	Marks
2a		
	Moments about A: $T \times 1.6\sin 70^o = 6g \times 0.8\cos 30^o$	M1A2
	$T = 27.1$ **Given Answer**	A1
		(4)
2b	Resolve $\leftrightarrow$: $F = T\cos 40$	B1
	Resolve $\updownarrow$: $R + T\cos 50 = 6g$	M1A1
	Use of $F \le \mu R$ and solve for μ : $\mu \ge \dfrac{20.76}{41.38} = 0.50$ (0.502)	**DM1**A1
		(5)
		[9]
	Notes for Qu2	
	2(a) M1 for a complete method to obtain an equation in T only, with usual rules (applied to all equations if more than one is used) **N.B.** Treat wrong angle(s) as A error(s) A2 for a correct equation (or equations) A1A0 if one error (Allow use of a and $2a$ for lengths) A1 for 27.1 correctly obtained (and no incorrect work seen) **N.B.** GIVEN ANSWER Other equations: $\nearrow\swarrow$: $R\cos 60 + F\cos 30 = 6g\cos 60 + T\cos 70$ $\nwarrow\searrow$: $R\sin 60 + T\sin 70 = F\sin 30 + 6g\sin 60$ $M(B): 6gl\cos 30 + F2l\sin 30 = R2l\cos 30$ $M(G): Fl\sin 30 + Tl\sin 70 = Rl\cos 30$	
	2(b) B1 for $F = T\cos 40$ seen First M1 for a complete method, with usual rules applied to all equations used, to find R **N.B.** Treat wrong angle(s) as A error(s) First A1 for a correct equation Second **DM**1, dependent on first M1, for use of $F \le \mu R$, and solve for μ (Allow this M if they use $F = \mu R$ or $F < \mu R$ but final A1 not then available but M0 if they use $F \ge \mu R$ or $F > \mu R$) Second A1 for either $\mu \ge 0.5(0)$ or $\mu \ge 0.502$ A0 if they also give an upper bound for μ	

Question Number	Scheme	Marks
5a	Differentiate **v**: $\mathbf{a}=(6t-4)\mathbf{i}+(6t-8)\mathbf{j}$	M1A1
	$\mathbf{F}=m\mathbf{a}$ when $t=4$: $\mathbf{F}=0.3(20\mathbf{i}+16\mathbf{j})=6\mathbf{i}+4.8\mathbf{j}$	M1
		(3)
5b	Motion parallel to **i**: $3t^2-8t+4=0=(3t-2)(t-2)$	M1
	$t=\frac{2}{3}$ or $t=2$	A1
	Integrate **v**: $\mathbf{r}=(t^3-2t^2(+p))\mathbf{i}+(t^3-4t^2+4t(+q))\mathbf{j}$	M1A1
	Use limits: $\mathbf{r}_2=(8-8(+p))\mathbf{i}+(8-16+8(+q))\mathbf{j}$	M1A1
	$\mathbf{r}_{\frac{2}{3}}=\left(\frac{8}{27}-\frac{8}{9}(+p)\right)\mathbf{i}+\left(\frac{8}{27}-\frac{16}{9}+\frac{8}{3}(+q)\right)\mathbf{j}$	A1
	$\overrightarrow{AB}=\pm\left(\frac{16}{27}\mathbf{i}-\frac{32}{27}\mathbf{j}\right)$	
	Pythagoras' theorem: $\left\lvert\overrightarrow{AB}\right\rvert=\frac{16}{27}\sqrt{5}=1.3$ (or better) (m)	**DM**1A1
		(9)
		[12]
	Notes for Qu5	
	Accept column vectors throughout	
	5(a) First M1 for attempt to differentiate **v,** at least two powers of t decreasing by one. A1 for a correct expression. (A0 if **i** or **j** omitted) Second M1 for multiplying their **a** by 0.3, substituting $t = 4$ and collecting **i**'s and **j**'s. Isw if they find the magnitude.	
	5(b) First M1 for $3t^2-8t+4=0$ and attempting to solve. This M mark can be implied by two correct answers but if answer(s) are incorrect , we need to see an explicit attempt at factorising, using the formula or completing the square. First A1 for two correct answers, allow 0.67 or better. Second M1 for attempt to integrate **v**, to produce a vector, with at least two powers of t increasing by 1. Second A1 for a correct **r** (constant not needed). Third M1for substituting both their values of t (which must have come from using a <u>velocity</u> vector) into their **r.** Third A1 for correct unsimplified $\mathbf{r}_2$ (constant not needed) Allow a point. Fourth A1 for correct unsimplified $\mathbf{r}_{\frac{2}{3}}$ (constant not needed).Allow a point. Fourth **DM**1, dependent on previous M mark, for subtracting their <u>velocity</u> vectors (or points) either way and using Pythagoras to find the length. Fifth A1 for correct surd answer oe or 1.3 or better.	