Mark Scheme (Results)
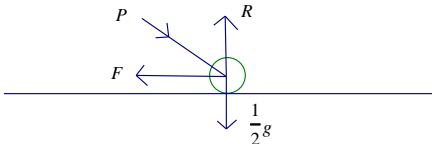
Summer 2019

Pearson Edexcel IAL In Mechanics 1
Paper WME01/01
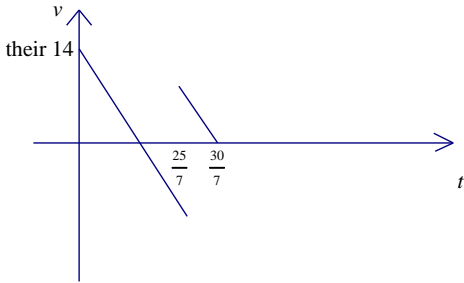
Question Number	Scheme	Marks	Notes
1(a)	Use of CLM	M1	All four terms and dimensionally correct.
	$6mu - 8mu = -3mu + 2mv$	A1	Correct unsimplified
	$v = \frac{1}{2}u$	A1	Must be positive
		(3)	
(b)	$I = 3m(u - -2u)$ or $I = 2m(\frac{1}{2}u - -4u)$	M1	Impulse momentum equation for either particle. Accept +/- Correct process seen or implied. Dimensionally correct. Must link correct masses with the respective speeds
	$I = 9mu$	A1	Must be positive
		(2)	
		(5)	

Question Number	Scheme	Marks	Notes
2.			Condone if P acting in the wrong direction but see SC below
	$F = \frac{1}{4}R$	B1	Use of $F = \mu R$ with $\mu = \frac{1}{4}$ seen or implied
	$P\cos 40 = F$	B1	Resolve horizontally. Accept $F\cos 40° = F_{max}$. Not $F\cos 40° = F$
	Resolve vertically	M1	All terms required, and dimensionally correct. $P \neq R$ Condone sign errors and sin/cos confusion
	$P\sin 40 + 0.5g = R$	A1	Correct unsimplified equation
	$P(4\cos 40 - \sin 40) = 0.5g$	DM1	Substitute for R and solve for P. Requires zero acceleration. Dependent on previous M1
	$P = 2.0$ (N) or 2.02 (N)	A1	2 or 3 sf only
		(6)	SC if F opposes their P, 6/6 available If P and F inconsistent max score available B1B0 M1A1follow their diagram DM1A0

Question Number	Scheme	Marks	Notes
3(a)	moments equation	M1	All terms required. Dimensionally correct Condone sign errors
	$M(C)$, $Mg \times 1.5 + 100g \times 3.5 = 637 \times 7$ $M(A)$: $2Mg + 400g = \frac{1}{2}T + 7.5 \times 637$ $M(P)$: $1.5T + 100g \times 2 = 637 \times 5.5$	A1	Correct unsimplified equation
	Resolve vertically or a second moments equation	M1	All terms required. Dimensionally correct Condone sign errors
	$(\uparrow)$, $T + 637 = Mg + 100g$	A1ft	Correct unsimplified equation in M or their M, T or their T
	(i) $M = 70$	A1	$69.99... = 70$ is A0 (from 9.81)
	(ii) $T = 1000N$ or 1030 N	A1	Not 1029, not $105g$
			They need to form two independent equations. M1A1 for first equation seen M1A1ft for the second equation (ft on any result from the first eqn) A1 for M, A1 for T.
		(6)	
(b)	Assumed that the beam remains straight	B1	Not flexible B1,Does not bend B1, Extra irrelevant (e.g. centre of mass at midpoint) B0
		(1)	
(c)	$T + T = 60g + 100g + 48g$	M1	Resolve vertically. Need all terms. Equal Ts. Condone sign errors
	$(T = 104g$ or $1019.2N)$	A1	Correct unsimplified equation
	Moments equation	M1	All terms required. Dimensionally correct. Not using T from (a) Condone sign errors
	$M(C)$, $60g \times 1.5 + 100g \times 3.5 + 48g \times (x - 0.5) = T \times 7$ $M(A)$: $60g \times 2 + 100g \times 4 + 48gx = 0.5T + 7.5T$ $M(B)$: $0.5T + 7.5T = 48g(8 - x) + 4 \times 100g + 6 \times 60g$ $M(D)$: $100g \times 3.5 + 48g(7.5 - x) + 60g \times 5.5 - 7T = 0$	A1	Correct unsimplified equation
	Solve for x	DM1	Solve for our x. Dependent on both preceding M marks
	$x = 6.5$ (m)	A1	
	Watch out for "correct" answer from working that ignores the $100g$	(6) (13)	As above, M1A1 for two independent equations, then DM1A1 for solving

Question Number	Scheme	Marks	Notes
4(i)	Equation of motion for the system	M1	All terms required. Dimensionally correct. Condone sign errors and sin/cos confusion
	$3050 - 300 - 2500g \sin \theta = 2500a$	A1 A1	Unsimplified equation with at most one error. Correct unsimplified equation NB A sign error on the 300 or a sign error on $2500g \sin \theta$ counts as 2 errors (to be consistent with the penalty if they did this in 2 separate equations).
	$a = 0.4 \ (\text{m s}^{-2})$	A1	Not $\frac{2}{5}$ (follows 9.8)
		(4)	
(ii)	Equation of motion for the truck	M1	All terms required. Dimensionally correct. Condone sign errors and sin/cos confusion
	$T - 100 - 500g \sin q = 500a$	A1 A1	Unsimplified equation with at most one error. Condone negative T Consistent sign for T. Correct unsimplified equation (in a or their a)
	$T = 650 \ (\text{N})$		
	$T = 650 \ (\text{N})$	A1	Must be positive
		(4)	
(ii) alt	Equation of motion for the engine	M1	All terms required. Dimensionally correct. Condone sign errors and sin/cos confusion
	$3050 - 200 - 2000g \sin q - T = 2000a$	A1 A1	Unsimplified equation with at most one error. Condone negative T Correct unsimplified equation
	$T = 650 \ (\text{N})$		
	$T = 650 \ (\text{N})$	A1	Must be positive
		(4)	
			(i) and (ii) can be solved together by forming the two separate equations of motion and solving using simultaneous equations. M1A1A1 **for each equation** and A1A1 as above.
			If the 100 N and the 200 N are associated with the wrong vehicles, treat this as a MR. This error gives them $T = 750$
		(8)	

Question Number	Scheme	Marks	Notes
5(a)	$\tan \theta = \frac{2}{3}$	M1	Use trig to find a relevant angle $\left(56.3°, \quad 33.7°\right)$
	Angle is $\theta + 90° = 123.69°..$	A1	124° or better (2.16 radians)
		(2)	
(b)	$\mathbf{F}_1 + \mathbf{F}_2 = (a\mathbf{i} + 3\mathbf{j}) + (-4\mathbf{i} + b\mathbf{j})\left(= k(3\mathbf{i} - 2\mathbf{j})\right)$	M1	Resultant force seen or implied: must be the sum, NOT the difference As a column vector or in $\mathbf{i}$ / $\mathbf{j}$ form
	Use direction to form equation in a and b	M1	From ratio of scalars or 2 separate equations involving $k \neq 1$
	$\dfrac{a-4}{3+b} = \dfrac{3}{-2}$	A1	Correct unsimplified equation
	$0 = 2a + 3b + 1$ Given answer	A1	Obtain **given answer** from correct working- need to see evidence
		(4)	
		(6)	

Question Number	Scheme	Marks	Notes
6(a)	$s = ut + \frac{1}{2}at^2$	M1	Complete method using *suvat* to **form** equation in U only
	$-12\frac{1}{2} = \frac{25}{7}U - 4.9(\frac{25}{7})^2$	A1	Correct unsimplified equation Allow $12\frac{1}{2} = \frac{25}{7}U + 4.9(\frac{25}{7})^2$ even if it is not clear that they know why it is true
	$U = 14$	A1	Must be positive
		(3)	
(b)	$s = vt - \frac{1}{2}at^2$	M1	Complete method using *suvat* to **form** equation in s only
	$s = 0 - \frac{1}{2}(-9.8)(\frac{5}{7})^2$	A1	Correct unsimplified equation
	$= 2\frac{1}{2}$ (m)	A1	
		(3)	
(b) alt	$0 = u - g(\frac{5}{7})$ $u = 7$ $s = ut + \frac{1}{2}at^2$	M1	Complete method using *suvat* to **form** equation in s
	$s = 7(\frac{5}{7}) - \frac{1}{2}9.8(\frac{5}{7})^2$	A1	Correct unsimplified equation
	$= 2\frac{1}{2}$ (m)	A1	
		(3)	
(c).		B1	1st line (existing for both +ve and –ve v) ignore figures
		B1	2nd line correct and stopping on the t axis. no other lines. Ignore figures. Parallel to upward portion of their first line if seen.
		B1 ft	Figs. In the right places. Allow U for their 14
		(3)	
			Accept mirror image in the t axis
		(9)	

Question Number	Scheme	Marks		Notes
7(a)	Use of $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t$	M1		At least once. Must be adding, not subtracting
	$\mathbf{r}_A = (8\mathbf{i} + 7\mathbf{j}) + t(2\mathbf{i} - 14\mathbf{j})$	A1	$\mathbf{r}_A$ correct $\begin{pmatrix} 8 + 2t \\ 7 - 14t \end{pmatrix}$	
	$\mathbf{r}_B = (\mathbf{i} + 2\mathbf{j}) + t(12\mathbf{i} - 4\mathbf{j})$	A1	$\mathbf{r}_B$ correct $\begin{pmatrix} 1 + 12t \\ 2 - 4t \end{pmatrix}$	
	$\overrightarrow{BA} = (8\mathbf{i} + 7\mathbf{j}) + t(2\mathbf{i} - 14\mathbf{j}) - \left[(\mathbf{i} + 2\mathbf{j}) + t(12\mathbf{i} - 4\mathbf{j}) \right]$	M1		Need to see an indication of method as leading to a given answer
	$= (7 - 10t)\mathbf{i} + (5 - 10t)\mathbf{j}$	A1		Obtain **given answer** from correct working
		(5)		
(b)	Use of Pythagoras to equate distance to 2 km	M1		
	$(7 - 10t)^2 + (5 - 10t)^2 = 2^2$	A1		Correct unsimplified equation in t
	$20t^2 - 24t + 7 = 0$	M1		Form 3 term quadratic in t
	$(10t - 7)(2t - 1) = 0$	DM1		Solve for t. Dependent on the preceding M1. Must see working if using an incorrect quadratic
	$t = \frac{7}{10}$ or $\frac{1}{2}$	A1		
	Time $= \frac{7}{10} - \frac{1}{2}$	DM1		Correct method to find the time interval. Dependent on the preceding M1
	$= \frac{2}{10}$ h (12 min)	A1		
		(7)		
		(12)		

Question Number	Scheme	Marks	Notes
8(a)	Equation of motion for P or for Q&R.	M1	All terms required and dimensionally correct. Condone sign errors. If m missing throughout, mark as a misread
	$5mg - T = 5ma$ or $T - 4mg = 4ma$	A1	One correct unsimplified equation
	Second equation of motion.	M1	Condone if second equation is for the **whole system**
	$5mg - T = 5ma$ $T - 4mg = 4ma$	A1	A second correct unsimplified equation
	Solve for a and T	DM1	Dependent on the first M mark
	$a = \dfrac{g}{9}$	A1	1.09 or 1.1 not $\dfrac{49}{45}$
	$T = \dfrac{40mg}{9}$	A1	43.6m, 44m
		(7)	SC A whole system alone leading to correct a scores M0A0M1A1M0A1A0
(b)	All particles have acceleration of the same magnitude	B1 (1)	Particles all start to move at the same time B1 Extra irrelevant comments B0
(c)	$v^2 = \dfrac{2gd}{9}$	M1	Complete method to find v or v^2 at the instant of separation
	Two independent equations of motion	M1	Dimensionally correct and contain correct terms
	$3mg - T' = 3ma'$ $T' - 4mg = 4ma'$	A1 A1	A1 for each correct equation. Accept the combined eqn. for A2
	$a' = -\dfrac{g}{7}$	A1	Accept +/-
	Use of *suvat* to find distance	DM1	With $a \neq$ their $\dfrac{g}{9}$ or g Dependent on the two preceding M marks
	$0 = \dfrac{2gd}{9} - 2\dfrac{g}{7}s$	A1ft	Correct unsimplified equation. Follow their $a \neq$ their $\dfrac{g}{9}$
	$s = \dfrac{7d}{9}$	A1	0.78d, 0.778d or better. Must be positive. Do not ISW
		(8)	
		(16)	