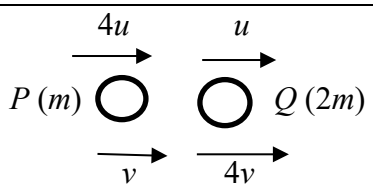
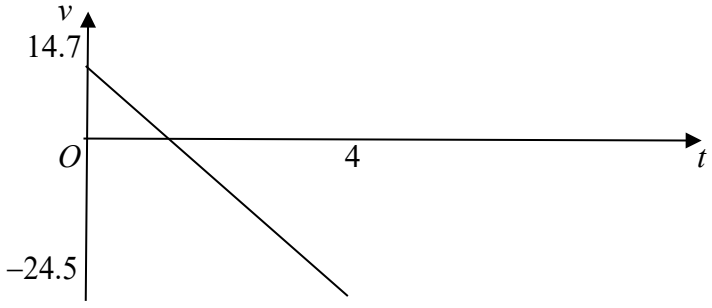
Mark Scheme (Results)

October 2020

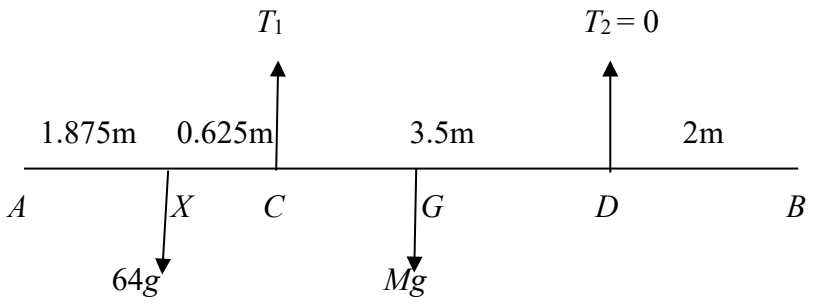
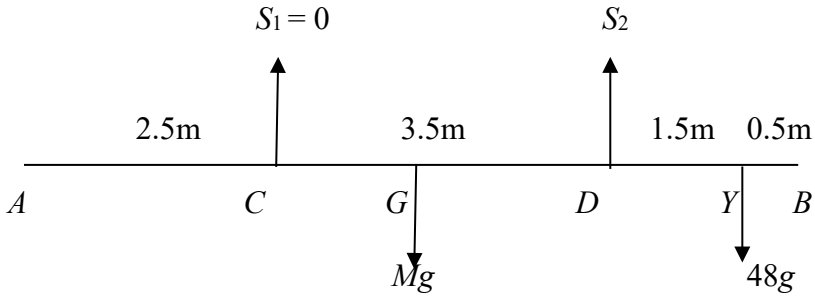
Pearson Edexcel IAL In Mechanics 1
Paper WME01/01

Question Number	Scheme	Marks
1(a)		
	CLM: $4mu + 2mu = mv + 2m \times 4v$	M1 A1
	$4v = \frac{8u}{3}$ (2.7u or better)	A1
		(3)
(b)	$\pm m(v - 4u)$ **OR** $\pm 2m(4v - u)$	M1 A1**ft**
	$\frac{10mu}{3}$ (3.3mu or better)	A1
		(3)
(c)	Opposite to the direction of motion	B1
		(1)
		(7)
	Notes for Question 1	
1(a)	M1 Correct number of terms, dimensionally correct, condone sign errors Allow even if they assume that both are moving with the same speed after the collision.	
	A1 Correct equation, allow cancelled m's or consistent extra g's	
	A1 Correct answer (must be positive as it's a speed) and a single term.	
1(b)	M1 Dimensionally correct imp-momentum equation (M0 if g is included), with correct terms, condone sign errors, but must be a difference of momenta and must be using EITHER m and $4u$ and their v_P OR $2m$ and u and their v_Q	
	A1**ft** Correct expression, in terms of m and u, follow their v_P or v_Q A0ft if they assume that both move with the same speed after the collision	
	A1 cao Must be positive as it's a magnitude	
1(c)	B1 Any clear equivalent	

Question Number	Scheme	Marks
2(a)	Complete method to find the total time: e.g. $-19.6 = 14.7t + \frac{1}{2}(-9.8)t^2$ using one equation **OR:** $0 = 14.7 - 9.8t_1 \Rightarrow t_1 = 1.5$ $s_1 = 14.7 \times 1.5 - \frac{1}{2} \times 9.8 \times 1.5^2 = 11.025$ using four equations $30.625 = \frac{1}{2} \times 9.8 \times t_2^{\ 2} \Rightarrow t_2 = 2.5$ $t = t_1 + t_2 = 4$ (s) and many other methods	M1
	There are two A marks for all the equations they use, -1 each error	A1
		M(A)1
	$t = 4$ (s) only	A1
		(4)
(b)	$v^2 = 14.7^2 + 2(-9.8)(-19.6)$ **OR** $v = 14.7 + (-9.8) \times 4$	M1 A1
	Speed = 24.5 or 25 (m s^{-1})	A1
		(3)
(c)	e.g $0^2 = 14.7^2 + 2(-9.8)s$ or $24.5^2 = 2$ x $9.8s$	M1
	$s = 11.025$ (11 or better) $s = 30.625$	A1
	Total distance = $2 \times 11.025 + 19.6$ Total distance = 2 x 30.625 – 19.6	M1
	= 41.7 (3 sf) or 42 (2 sf) (m)	A1
		(4)
(d)		B1 line B1 start pt (0,14.7) **OR** on axes B1**ft** end pt (4,-24.5) **OR** on axes
		(3)
		(14)

	Notes for Question 2	
2(a)	M1 **Complete** method to find the total time	
	A1 M(A)1 There are now two A marks for the equation(s) that they use, -1 for each error.	
	A1 Correct answer **N.B**. If using a quadratic, ignore the other solution, even if it's incorrect. If they combine the 2 solutions in some way, A0	
2(b)	M1 Complete method to find the speed	
	A1 Correct equation(s)	
	A1 Correct answer must be positive	
2(c)	M1 Method to find a relevant distance	
	A1 A correct relevant distance	
	M1 Method to find the total distance	
	A1 Correct answer	
2(d)	B1 Straight line starting on the v-axis and crossing the t-axis (line may be reflected in the t-axis) (B0 if solid vertical line at $t = 4$)	
	B1 Correct appropriate coordinates (start point) Allow these to be marked on the axes.	
	B1**ft** Correct appropriate coordinates (end point) ft on their answers to (a) and (b) Allow these to be marked on the axes.	

Question Number	Scheme	Marks
3(a)	$R = 10g\cos\alpha$	M1
	$= 78.4$ or 78 (N)	A1
		(2)
(b)	$F = 0.5R$	B1
	$P = 10g\sin\alpha + F$	M1A1
	$= 98$	A1
		(4)
(c)	$P = 10g\sin\alpha - F$	M1
	$= 19.6$ or 20	A1
		(2)
		(8)
	Notes for Question 3	
3(a)	M1 Allow sin/cos confusion	
	A1 Correct answer. Allow $8g$.	
3(b)	B1 $F = 0.5R$ seen anywhere	
	M1 Correct number of terms, with $10g$ resolved	
	A1 Correct equation or inequality	
	A1 Correct answer. Allow $10g$.	
	For any inequality which never becomes an equation, usual rules: Max M1A1A0 for $P \leq 10g\sin\alpha + F$	
3(c)	M1 Correct number of terms, with $10g$ resolved	
	A1 Correct answer. Allow $2g$	
	For any inequality which never becomes an equation, usual rules: Max M1A0	

Question Number	Scheme	Marks
4.		
	Use of $T_2 = 0$	M1
	$M(C), 64g \times 0.625 = Mg(d - 2.5)$ **OR e.g.** $M(C), 64g \times 0.625 = Mgx$	M1 A1
	Other equations: (T_1 would then have to be eliminated to give an equation in M and d only, to earn the M mark) $T_1 = Mg + 64g$ $M(A), 64g \times 1.875 + Mgd = 2.5T_1$ $M(G), 64g \times (d - 1.875) = T_1 \times (d - 2.5)$ $M(D), 64g \times 4.125 + Mg(6 - d) = 3.5T_1$ $M(B), 64g \times 6.125 + Mg(8 - d) = 5.5T_1$ $M(X), Mg(d - 1.875) = 0.625T_1$	
		
	Use of $S_1 = 0$	M1
	$M(D), 48g \times 1.5 = Mg(6 - d)$ **OR e.g.** $M(D), 48g \times 1.5 = Mg(3.5 - x)$	M1 A1
	Other equations: (S_2 would then have to be eliminated to give an equation in M and d only, to earn the M mark) $S_2 = Mg + 48g$ $M(A), 48g \times 7.5 + Mgd = 6S_2$ $M(C), 48g \times 5 + Mg(d - 2.5) = 3.5S_2$ $M(G), 48g \times (7.5 - d) = S_2 \times (6 - d)$ $M(B), 48g \times 0.5 + Mg(8 - d) = 2S_2$ $M(Y), Mg(7.5 - d) = 1.5S_2$	
	Solve for M	**DM**1
	$M = 32$ exact answer.	A1
		(8)
		(8)

	Notes for Question 4	
	M1 $T_2 = 0$ seen or implied	
	M1 Correct number of terms, dimensionally correct equation in M and one unknown length. (allow without *g*'s, omission of a length is an M error)	
	A1 Correct equation in *M* and *d only* or another unknown length.	
	M1 $S_1 = 0$ seen or implied	
	M1 Correct number of terms, dimensionally correct equation in M and same unknown length. (allow without *g*'s, omission of a length is an M error)	
	A1 Correct equation in *M* and *d only* or same unknown length.	
	DM1 Solving for *M*, dependent on all previous M marks	
	A1 Correct exact answer	

Question Number	Scheme	Marks
5(a)	Put $t = 2$ to give $-3\mathbf{i} + 4\mathbf{j}$	M1
	$\sqrt{(-3)^2 + 4^2}$ The – sign is not required	M1
	5 (m s^{-1})	A1
		(3)
(b)	e.g. $\tan\theta = \frac{3}{4}$	M1
	A correct equation	A1**ft**
	37° or 323° nearest degree	A1
		(3)
(c)	$\mathbf{v} = (7 - 5t)\mathbf{i} + (12t - 20)\mathbf{j}$	
	$= (7\mathbf{i} - 20\mathbf{j}) + t(-5\mathbf{i} + 12\mathbf{j})$	M1
	$\frac{\mathbf{v} - (7\mathbf{i} - 20\mathbf{j})}{t} = (-5\mathbf{i} + 12\mathbf{j})$	M1 A1
	OR: $t = 0$, $\mathbf{v} = 7\mathbf{i} - 20\mathbf{j}$	M1
	$\frac{(-3\mathbf{i} + 4\mathbf{j}) - (7\mathbf{i} - 20\mathbf{j})}{2} = (-5\mathbf{i} + 12\mathbf{j})$	M1A1
	OR: Differentiate wrt t	M2
	$\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = \mathbf{a} = (-5\mathbf{i} + 12\mathbf{j})$	A1
		(3)
(d)	$\frac{(7 - 5t)}{(12t - 20)} = \frac{-5}{8}$	M1 A1
	Solve for t	M1
	$t = 2.2$	A1
		(4)
		(13)

	Notes for Question 5	
5(a)	M1 Allow column vectors	
	M1 Finding the magnitude of their **v**	
	A1 Correct answer	
5(b)	M1 For a relevant trig equation	
	A1**ft** A correct equation follow through on their **v**	
	A1 Correct answer (must be in degrees to nearest degree)	
5(c)	M1 Collecting terms in t and constant terms (may be implied)	
	M1 Rearranging to required form	
	A1 Correct answer (isw if they find the magnitude)	
OR:	M1 Finding the initial velocity or some other specific velocity	
	M1 Use of $\mathbf{a} = \frac{\mathbf{v} - \mathbf{u}}{t}$ with $t = 2$ (or possibly another appropriate value)	
	A1 Correct answer (isw if they find the magnitude)	
5(d)	M1 Attempt at equation in t only, using ratio of components, allow reciprocal and a sign error	
	A1 Correct equation	

	M1 Solve for t (equation must have come from considering ratios)	
	A1 Correct answer	

Question Number	Scheme	Marks
6(a)	$2000 - 500 - 500g\sin\alpha = 500a$ (truck)	M1 A2
	$a = 0.256$ or 0.26 (m s^{-2}) (32/125 is A0)	A1
		(4)
(b)	$D - 1200 - 500 - 1500g\sin\alpha - 500g\sin\alpha = 2000a$ (system)	M1 A2
	OR: $D - 1200 - 1500g\sin\alpha - 2000 = 1500a$ (engine)	
	$D = 7700$	A1
	N.B. They may write down the system and engine equations and then: (a) solve them for a (b) solve them for D.	
		(4)
		(8)
	Notes for Question 6	
6(a)	M1 Using equation(s) of motion to give an equation in a only, with correct number of terms and 500g resolved, condone sign errors	
	A1 Equation with at most one error	
	A1 Correct equation	
	A1 Correct answer	
6(b)	M1 Using an equation of motion to give an equation in D and a only, with correct number of terms and 500g (or 1500g) resolved, condone sign errors	
	A1 Equation with at most one error (a does not need to be substituted) Treat omission of g as one error	
	A1 Correct equation	
	A1 Correct answer	

Question Number	Scheme	Marks
7(a)	$5mg - T = 5ma$ **OR** $5mg - T = -5ma$	M1 A1
	$T - 3mg = 3ma$ $\quad\quad$ $T - 3mg = -3ma$	M1 A1
	Solve for T	DM1
	$T = \frac{15mg}{4}$ oe (allow unsimplified and not in terms of mg at this stage)	A1
	Force on pulley = $2T$	M1
	$\frac{15mg}{2}$ oe (must be a single positive term)	A1
		(8)
(b)	The tension is the same on both sides of the pulley.	B1
	Tension is same across the pulley	(1)
		(9)
	Notes for Question 7	
7.(a)	M1 Correct number of terms, condone sign errors (M0 if m's missing)	
	A1 Correct equation	
	M1 Correct number of terms, condone sign errors (M0 if m's missing)	
	A1 Correct equation	
	DM1 Solve for T, dependent on previous two M marks, and must be in terms of m.	
	A1 Correct expression for T	
	M1 Correct method	
	A1 Correct answer	
(b)	B1 Any equivalent statement. B0 if any incorrect extras B0 if pulley not mentioned.	

Question Number	Scheme			Marks
8(a)	$s = \frac{1}{2} \times 3 \times 4^2$	**OR**	$s = \frac{1}{2} \times 4 \times 12$	M1
	$= 24$ (m)			A1
				(2)
(b)	12 (m s^{-1}); 42 (m s^{-1})			B1
	$12 \times 20 + \frac{1}{2} \times 1.5 \times 20^2$ (= 540)	**OR**	$\left(\frac{12+42}{2}\right) \times 20$	M1 A1ft
	$42 \times 2 + \frac{1}{2}(-4) \times 2^2$ (= 76)	**OR**	$\left(\frac{42+34}{2}\right) \times 2$	M1 A1**ft**
	Total = 640 (m)			A1 cao
				(6)
				(8)
	Notes for Question 8			
8(a)	M1 Complete method to find distance travelled in first 4 s Must be area of a triangle from a *v-t* graph			
	A1 Correct answer			
8(b)	B1 Both speeds seen anywhere e.g. on a diagram or in part (a)			
	M1 Complete method to find total distance travelled in next 20 s Must be area of a trapezium from a *v-t* graph (they may use a rectangle + triangle)			
	A1 **ft** Correct unsimplified distance, **ft** on their 12			
	M1 Complete method to find total distance travelled in next 2 s Must be area of a trapezium from a *v-t* graph (they may use a rectangle + triangle)			
	A1 **ft** Correct unsimplified distance, **ft** on their 42			
	A1 cao for total distance			