Question	Scheme	Marks	Notes
	$\mathbf{I} = m\mathbf{v} - m\mathbf{u}$	M1	Must be subtracting but condone subtraction in wrong order
1a	$= 0.3((7\mathbf{i}+7\mathbf{j})-5\mathbf{i}) (= 0.6\mathbf{i}+2.1\mathbf{j})$	A1	correct unsimplified equation Allow \pm
	$ \mathbf{I} = \sqrt{0.6^2 + 2.1^2}$	M1	Use of Pythagoras
	$=\frac{3\sqrt{53}}{10}$	A1	2.2 or better (2.18403)
		(4)	
	Correct method for a relevant angle	M1	e.g. use of trigonometry or scalar product for their I θ or 90 - θ
1b	Correct trig ratio for the required angle and no other angle involved.	A1	From correct I e.g. $\tan \theta = \frac{7}{2}$ or $\cos \theta = \frac{10}{\sqrt{53} \times 5}$
	$\theta = 74.1^{\circ}$	A1	74° or better (74.0546°) or 360 – 74 (286) (1.29 radians)
		(3)	

Question	Scheme	Marks	Notes			
Accept column vectors throughout						
	Use of $\mathbf{r} = \int \mathbf{v} \mathrm{d}t$	M1	Powers going up by 1. Allow one slip in the powers			
	$\mathbf{r} = \left(\frac{4}{3}t^3 - \frac{5}{2}t^2 + A\right)\mathbf{i} + \left(-5t^2 - 12t + B\right)\mathbf{j}$	A1	Allow without constant of integration			
2a	Use $t = 2$ and $\mathbf{r} = 2\mathbf{i} + 6\mathbf{j}$ when $t = 0$: $\mathbf{r} = \left(\frac{4}{3} \times 8 - \frac{5}{2} \times 4 + 2\right)\mathbf{i} + \left(-5 \times 4 - 12 \times 2 + 6\right)\mathbf{j}$	M1	Correct use of given value to obtain r			
	$=\frac{8}{3}\mathbf{i}-38\mathbf{j}$	A1	Correct answer only Allow 2.7 or better ISW if they go on to find the magnitude.			
		(4)				
2b	v in direction of i - 2j	M1	Use velocity and direction to form an equation in <i>T</i> Condone if they have (-)2 on the wrong side of their equation			
	$\Rightarrow -2(4T^{2} - 5T) = (-10T - 12) (8T^{2} - 20T - 12 = 0)$	A1	Correct unsimplified equation in <i>T</i> (or <i>t</i>) only			
	$\Rightarrow T = 3$	A1	Only. Allow $t = 3$.			
		(3)				
2c	Use of $\mathbf{a} = \frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t}$ $(\mathbf{a} = (8t - 5)\mathbf{i} - 10\mathbf{j})$	M1	Powers going down by 1 Allow one slip in the powers			
	Use of Pythagoras and $t = 2.5$	M1	Correct use of their derivative to obtain acceleration			
	$ a = \sqrt{(20-5)^2 + 10^2} = \sqrt{325} (= 5\sqrt{13}) \text{m} \text{s}^{-2}$	A1	Any equivalent simplified exact form. Ignore decimals after exact answer seen.			
		(3)				

Question			Scheme	2		Marks	Notes
They must have a dissection for which they should know or find the position of the							
		0		<i>. . . .</i>		ssumption	about the position
of the cent	tre of mas	s of a tra	pezium	results ii	n 0/5.		Correct distances
	Dist PO	Large tri 0	Small tri -2y	Small tri 2y	Wholed	B1	from PQ or a parallel axis for their complete dissection
	Mass ratio	27 <i>xy</i>	12 <i>xy</i>	12 <i>xy</i>	27 <i>xy</i>	B1	Correct mass ratios for a complete dissection
3a Moments about PQ: $(27xy \times 0) - 12xy \times (-2y) + 12xy \times 2y = 27xyd$						M1	Or a parallel axis. Dimensionally correct. Need all non-zero terms and no extras. Condone sign error(s). Allow for $\pm d$ Check the logic carefully.
					<i>y</i> = 27 <i>xyd</i>	A1	Correct unsimplified equation. Allow for $\pm d$ Allow for correct distance from a parallel axis
	$d = \frac{48}{27}y = \frac{16}{9}y *$					A1*	Obtain given result from fully correct working.
There are many different approaches to this. NB If they are using a trapezium they must show method for the distance. For <i>PQBC</i> the correct value for distance centre of mass from <i>PQ</i> is $\frac{8y}{5}$							
D 11 1					$\mathcal{Q}^{\text{IS}} = \frac{1}{5}$		

Possible alternative moments equations include: $15xy \times \frac{8y}{5} + 9xy \times \frac{4y}{3} + 3xy \times 4y = 27xyd \text{ using } PQBC, PQDE \text{ and } DEA$ $12xy \times 2y + 15xy \times \frac{8y}{5} = 27xyd \text{ using } PQA \text{ and } PQBC$ $2 \times 3xy \times y - 3xy \times y + 2 \times 6xy \times 1.5y + 2 \times 3xy \times 2y = 27xyd \text{ working from } BC \text{ for the folded}$ figure. $2 \times 3xy \times 2y + 4 \times \frac{1}{2} 3xy \times y + 2 \times 6xy \times 1.5y + 3xy \times 4y = 27xyd \text{ working down from } PQ$ (5)

Question	Scheme	Marks	Notes
	P 2x $\frac{16}{9}y$ Q		
3Ь	Use of trigonometry	M1	Trig ratio for a relevant angle In their working they need a valid attempt to find α or 90°- α .
	$\tan \alpha = \frac{\frac{16}{9}y}{2x} = \frac{64}{81}$	A1	Correct unsimplified equation in <i>x</i> and <i>y</i>
	$\Rightarrow x = \frac{9}{8}y$	A1	Correct only. (x = 1.125y) (Accept x = 1.1y or better)
		(3)	

	$\longrightarrow u ku \longleftarrow$		
	$ \begin{array}{cccc} P \\ 3m \end{array} & \begin{array}{cccc} Q \\ 5m \end{array} \\ 2v & \longrightarrow v \end{array} $		Correct use of $I = mv - mu$:
4a	Impulse-momentum equation for <i>P</i> :	M1	Evidence of subtraction (can go straight to + you do not need to see $-(-)$) and dimensionally correct. Use of $3m$
	15mv = 3m(2v - (-u))	A1	Correct unsimplified equation
-	$9mv = 3mu \Rightarrow u = 3v$ *	A1*	Obtain given answer from correct working
	Impulse-momentum equation for Q and CLM:	M1	CLM dimensionally consistent, all 4 terms, condone sign error(s). Correct use of $I = mv - mu$: Evidence of subtraction and dimensionally correct. Use of $5m$
4a alt	$15mv = 5m(v + ku), k = 2\frac{v}{u} \text{ and}$ substitute into CLM: $3mu - 5m\frac{2v}{u}u = 5mv - 6mv$	A1	Correct unsimplified equation in <i>u</i> and <i>v</i>
-	$\Rightarrow u = 3v$ *	A1*	Obtain given answer from correct working
		(3)	
	Impulse-momentum equation for Q or use of CLM:	M1	Dimensionally consistent. All relevant terms.
4b	15mv = 5m(v - (-ku)) or $3mu - 5mku = 5mv - 6mv$	A1	Correct unsimplified equation
	$10v = 5ku = 15kv \Longrightarrow k = \frac{2}{3}$	A1	Correct only. Accept 0.67 or better
		(3)	
	Use of impact law:	M1	Must be used the right way round. Condone sign error(s)
4c	$2v + v = e\left(u + ku\right) \left(=e \times 3v \times \frac{5}{3}\right)$	Alft	Correct unsimplified equation. Follow their <i>k</i> .
	$\Rightarrow e = \frac{3}{5}$	A1	Correct only
		(3)	

	Change in KE	M1	Allow for gain rather than loss. Dimensionally correct. Need to use all 4 terms and to be using the correct values for mass.
4d	$\frac{1}{2} \times 3m \left(u^2 - (2v)^2 \right) + \frac{1}{2} \times 5m \left((ku)^2 - v^2 \right)$	A1	Correct unsimplified equation. Allow for gain rather than loss. A0 if an error occurs before they form a single expression
	$\left(\frac{1}{2}\times 3m\left(5v^2\right)+\frac{1}{2}\times 5m\left(3v^2\right)=15mv^2\right)$		NB: $15mv^2 = \frac{5}{3}mu^2$
	$\lambda = 15$	A1	Correct only. Accept $15mv^2$
		(3)	

Question	Scheme		rks	Notes	
	$R_B \qquad F_B$ $R_B \qquad F_B$ $R_A \qquad 15g$ $R_A \qquad 5c$ F_A				
5a	Moments about <i>A</i> :	M1		Dimensionally correct. Include all relevant terms. Condone sign error(s) and sin/cos confusion.	
	$15g \times 3\cos 75^{\circ}$	A1		Unsimplified equation with at	
	$= F_B \times 6\cos 75^\circ + R_B \times 6\sin 75^\circ$	A1		most one error Correct unsimplified equation	
				Use of $F_B = 0.2R_B$ in their	
	$15g \times 3\cos 75^{\circ}$ = $R_B \times 1.2\cos 75^{\circ} + R_B \times 6\sin 75^{\circ}$	M1		attempt at the moments equation. Seen in part (a), not just on the diagram.	
	$R_B = 19(N)$ or $R_B = 18.7(N)$	A1		2 sf or 3 sf Ignore if go on to find the total force at A	
			(5)		
	They need to form 2 equations. M correct equation	ark th	em in	the order seen. M1A1 for each	
	Resolve horizontally:	M1	First equation. Include all relevant terms. Dimensionally correct. Condone sign error(s) and sin/cos confusion		
	$F_A = R_B (= 18.6925)$	A1	Corr	ect unsimplified equation	
5Ъ	Resolve vertically:	M1	relev corre	and equation. Include all vant terms. Dimensionally ect. Condone sign error(s) and os confusion	
	$R_A + F_B = 15g$ ($R_A = 143.26$)	A1	Corr	ect unsimplified equation	
	M1A1 for alternatives e.g. moments about <i>B</i>		0	$\times 3\cos 75^{\circ}$ $\times 6\cos 75^{\circ} - F_A \times 6\sin 75^{\circ}$	
	Use $F_A = \mu R_A$ to solve for μ	D M1		endent on the 2 preceding M	
	$\mu = 0.13$ or better		g cancels (0.1304784)		
		(6)			

Question	Scheme	Marks	Notes
	Equation of motion	M1	Need all terms and dimensionally correct
6a	$F - 600 = 900 \times 2$	A1	Correct unsimplified equation
0a	$\frac{24000}{V} - 600 = 1800$	M1	Use of $24000 = FV$ Allow with 24 for 24000 or with a 0 missing
	<i>V</i> = 10	A1	Correct only
		(4)	
6b	Equation of motion	M1	Need all terms and dimensionally correct. Mark omission of g as an accuracy error, not a dimension error. Condone sign error(s) and sin/cos confusion If they form separate equations for each vehicle they need both equations and to eliminate T to score the M1
	$F - (700 + 900)g\sin\theta - (550 + 600) = 1600a$ $\left(\frac{24000}{8} - (1600)g\sin\theta - 1150 = 1600a\right)$	A1 A1	Unsimplified combined equation with at most one error – allow with F Correct combined unsimplified equation with correct substitution for F
	$a = 0.456 (0.46) (\mathrm{ms}^{-2})$	A1	2 sf or 3 sf not $\frac{73}{160}$
		(4)	
6с	Work-energy equation	M1	Must be work-energy. Must be using the mass of the trailer only and the resistance for the trailer only. Dimensionally correct. All relevant terms, no duplication of terms and no extras. Condone sign error(s) and sin/cos confusion. Unsimplified equation with at most one error
	$\frac{1}{2} \times 700 \times 9^2 = 550d + 700gd\sin\theta$	AI A1	at most one error Correct unsimplified equation
	d = 27 (27.3)	A1	2 sf or 3 sf
		(4)	

7aEnergy equationM1dimensionally correct. Condone sign error.7a $\frac{1}{2}mv^2 = \frac{1}{2}m(9+4) + mg \times 20$ A1Correct unsimplified equation $v = 20 (20.1) (ms^{-1})$ A12 sf or 3 sf only. Not $9\sqrt{5}$ (3)Complete method to find the direction as an angleM1Complete method to find the direction as an angle(3)Complete method to find the direction as an angleComplete method to find the direction as an angleComplete method to find the direction as an angle.Correct unsimplified equation for a relevant angle. Follow their part (a)Correct unsimplified equation for a relevant angle. Follow their part (a)Correct unsimplified equation for a single(3)Correct unsimplified equation. Follow their part (a)Complete method to find the direction as a vector in i and j or as a column vector7bA1Correct unsimplified equation. Follow their part (a)Complete method to find the direction as a vector in i and j or as a column vector7bM1Correct unsimplified equation. Follow their part (a)Complete method to find the direction as a vector in i and j or as a column vector7cComplete method to find the direction as a vector in i and j or as a column vectorM1Correct unsimplified equation. Follow their part (a)Complete method to	Question	Scheme	Marks	Notes
$\frac{2 mv^2 = 2m(9+4) + mg \times 20}{v = 20 (20.1) (ms^{-1})}$ A1 Correct unsimplified equation $v = 20 (20.1) (ms^{-1})$ A1 2 sf or 3 sf only. Not $9\sqrt{5}$ (3) Complete method to find the direction as an angle $\cos \alpha = \frac{3}{\text{their (a)}}$ A1 Correct unsimplified equation for a relevant angle. Correct unsimplified equation for a relevant angle. Follow their part (a) Or equivalent. 2 sf or 3 sf. Needs to be clear on a diagram or in words where the angle is measured. Accept "to the horizontal" (3) Complete method to find the direction as a vector in i and j or as a column vector Component = $\sqrt{(a)^2 - 9}$ A1ft Correct unsimplified equation. Follow their part (a) Direction 3i - 19.9j A1 Correct unsimplified equation. Follow the orizontal Form an equation in t (3) Complete method using suvat Condone sign errors. (3) Form an equation in t (3) Complete method using suvat Condone sign errors. (3) Form an equation in t (3) Complete method using suvat Condone sign errors. (3) Correct unsimplified equation (3) Complete method using suvat Condone sign errors. (3) Correct unsimplified equation (3) Complete method using suvat Condone sign errors. (3) Complete method using suvat Condone sign errors. (3) Correct unsimplified equation (3) Complete method using suvat Condone sign errors. (3) Correct unsimplified equation (3) Complete method using suvat Condone sign errors. (3) Correct unsimplified equation (3) Correct unsimplified equation (3) Correct unsimplified equation (3) Correct unsimplified equation (3) Complete method using suvat Condone sign errors. (3) Correct unsimplified equation (3) Correc		Energy equation	M1	
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7bComplete method to find the direction as an angleM1Complete method to find trig ratio for relevant angle7b $\cos \alpha = \frac{3}{\text{their (a)}}$ A1ftCorrect unsimplified equation for a relevant angle. Follow their part (a) $\alpha = 81^{\circ} (81.4^{\circ})$ below the horizontalA1Or equivalent. 2 sf or 3 sf. Needs to be clear on a diagram or in words where the angle is measured. Accept "to the horizontal"7b(3)7b(3)7bComplete method to find the direction as a vector in i and j or as a column vector7b(3)7cComponent = $\sqrt{(a)^2 - 9}$ A1ftCorrect unsimplified equation. Follow their part (a)7cForm an equation in t e.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1)\sin \alpha = 2 - gt$ 7c(3) <t< td=""><td></td><td>$v = 20 (20.1) (ms^{-1})$</td><td>A1</td><td>2 sf or 3 sf only. Not $9\sqrt{5}$</td></t<>		$v = 20 (20.1) (ms^{-1})$	A1	2 sf or 3 sf only. Not $9\sqrt{5}$
angleM1relevant angle7b $\cos \alpha = \frac{3}{\text{their (a)}}$ A1ftCorrect unsimplified equation for a relevant angle. Follow their part (a)7b $\alpha = 81^{\circ} (81.4^{\circ})$ below the horizontalA1ftCorrect unsimplified equation for a relevant angle. Follow their part (a)7b $\alpha = 81^{\circ} (81.4^{\circ})$ below the horizontalA1Needs to be clear on a diagram or in words where the angle is measured. Accept "to the horizontal"7bComplete method to find the direction as a vector in i and j or as a column vectorM17bComponent = $\sqrt{(a)^2 - 9}$ A1ft7bCorrect unsimplified equation. Follow their part (a)7cForm an equation in tM17cForm an equation in tM17cCorrect unsimplified equation7ce.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1)\sin \alpha = 2 - gt$ A17cCorrect unsimplified equation7c(3) </td <td></td> <td></td> <td>(3)</td> <td></td>			(3)	
7b $\cos \alpha = \frac{1}{\text{their (a)}}$ A1ftrelevant angle. Follow their part (a) Or equivalent. 2 sf or 3 sf. Needs to be clear on a diagram or in words where the angle is measured. Accept "to the horizontal"7b $\alpha = 81^{\circ} (81.4^{\circ})$ below the horizontalA1 2 sf or 3 sf. Needs to be clear on a diagram or in words where the angle is measured. Accept "to the horizontal"7b(3)7b(3)7bComplete method to find the direction as a vector in i and j or as a column vector7b(3)7bDirection 3i - 19.9jA12 sf or 3 sf. ISW after correct vector seen7cForm an equation in t (-20.1) sin $\alpha = 2 - gt$ 7c(3)7c		*	M1	<u> </u>
$\alpha = 81^{\circ} (81.4^{\circ}) \text{ below the horizontal}$ $\alpha = 81^{\circ} (81.4^{\circ}) \text{ below the horizontal}$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$ $A1$	7b	$\cos \alpha = \frac{3}{\text{their (a)}}$	A1ft	relevant angle. Follow their part (a)
7b altComplete method to find the direction as a vector in i and j or as a column vectorM17b altComponent = $\sqrt{(a)^2 - 9}$ A1ftCorrect unsimplified equation. Follow 		$\alpha = 81^{\circ} (81.4^{\circ})$ below the horizontal		2 sf or 3 sf. Needs to be clear on a diagram or in words where the angle is measured.
7b altvector in i and j or as a column vectorM17b altComponent = $\sqrt{(a)^2 - 9}$ A1 ftCorrect unsimplified equation. Follow their part (a)Direction 3i - 19.9jA12 sf or 3 sf. ISW after correct vector seen7cForm an equation in tM1Complete method using suvat Condone sign errors.7ce.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1)\sin \alpha = 2 - gt$ A12 sf or 3 sf only7cImage: Correct unsimplified equationCorrect unsimplified equation7cImage: Correct unsimplified equationCorrect unsimplified equation7dImage: Correct unsimplified equationImage: Correct unsimpli			(3)	
altComponent = $\sqrt{(a)^2 - 9}$ Alttheir part (a)Direction 3i - 19.9jA12 sf or 3 sf. ISW after correct vector seen(3)7cForm an equation in tM1Complete method using suvat Condone sign errors.7ce.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1) sin \alpha = 2 - gt$ A1Correct unsimplified equationt = 2.2 (2.23) (s)A12 sf or 3 sf only(3)Perpendicular velocity = 3i - λj B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or imp Complete method to solve for vertical component If using angles, they should be using 56.3° for the perpendicular direction.		-	M1	
Direction $3i - 19.9j$ A1ISW after correct vector seen(3)(3)Form an equation in tM1Complete method using suvat Condone sign errors.ce.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1)\sin \alpha = 2 - gt$ t = 2.2 (2.23) (s)A1Correct unsimplified equation(3)Perpendicular velocity $= 3i - \lambda j$ B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 2 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and vertical not equal to ± 3 . Seen or implified component unchanged and seen or		$Component = \sqrt{(a)^2 - 9}$	A1ft	
Form an equation in tM1Complete method using suvat Condone sign errors.7ce.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1)\sin \alpha = 2 - gt$ A1Correct unsimplified equation $t = 2.2 (2.23) (s)$ A12 sf or 3 sf only(3)Perpendicular velocity $= 3\mathbf{i} - \lambda \mathbf{j}$ B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or imp Complete method to solve for vertical component If using angles, they should be using 56.3° for the perpendicular direction.		Direction 3 i – 19.9 j	A1	
7cM1Condone sign errors.7ce.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1)\sin \alpha = 2 - gt$ A1Correct unsimplified equation $t = 2.2 (2.23) (s)$ A12 sf or 3 sf only(3)Perpendicular velocity $= 3\mathbf{i} - \lambda \mathbf{j}$ B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or implication $(3\mathbf{i} + 2\mathbf{j}).(3\mathbf{i} - \lambda\mathbf{j}) = 0$ M1Complete method to solve for vertical component If using angles, they should be using 56.3° for the perpendicular direction.			(3)	
$\frac{(-20.1)\sin \alpha = 2 - gt}{t = 2.2 (2.23) (s)}$ A1 2 sf or 3 sf only (3) Perpendicular velocity = 3i - λj B1 Horizontal component unchanged and vertical not equal to ± 2 . Seen or imp (3i + 2j).(3i - λj) = 0 M1 Given the perpendicular direction. M1 Given the perpendicular direction.		Form an equation in <i>t</i>	M1	· ·
$t = 2.2(2.23)(s)$ A12 sf or 3 sf only(3)Perpendicular velocity $= 3\mathbf{i} - \lambda \mathbf{j}$ B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or implement of the solution	7c		A1	Correct unsimplified equation
Perpendicular velocity = $3\mathbf{i} - \lambda \mathbf{j}$ B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or imp Complete method to solve for vertical component If using angles, they should be using 56.3° for the perpendicular direction.			A1	2 sf or 3 sf only
Perpendicular velocity = $3\mathbf{i} - \lambda \mathbf{j}$ B1Horizontal component unchanged and vertical not equal to ± 2 . Seen or imp Complete method to solve for vertical component If using angles, they should be using 56.3° for the perpendicular direction.			(3)	
$(3\mathbf{i}+2\mathbf{j}).(3\mathbf{i}-\lambda\mathbf{j})=0$ M1 Complete method to solve for vertical component If using angles, they should be using 56.3° for the perpendicular direction.		Perpendicular velocity $= 3\mathbf{i} - \lambda \mathbf{j}$		Horizontal component unchanged and vertical not equal to ± 2 . Seen or implied
$\Rightarrow \mathbf{v} = \begin{pmatrix} (2\mathbf{i}) & 9\mathbf{i} \end{pmatrix} \begin{pmatrix} m & c^{-1} \end{pmatrix}$		$(3\mathbf{i}+2\mathbf{j}).(3\mathbf{i}-\lambda\mathbf{j})=0$	M1	Complete method to solve for vertical component
$\rightarrow V = ((3I) - \frac{1}{2}J)(IIIS)$ AI implied	7d	$\Rightarrow \mathbf{v} = \left((3\mathbf{i}) - \frac{9}{2}\mathbf{j} \right) (\mathbf{m}\mathbf{s}^{-1})$	A1	Correct vertical component seen or implied
dM_1 component of perpendicular velocity.			dM1	component of perpendicular velocity. Dependent on the previous M1 Working
$\frac{\left(\frac{9}{2}\right)^2 = 2^2 + 2gs \text{ or}}{\frac{1}{2}m(13) + mgs = \frac{1}{2}m\left(9 + \frac{81}{4}\right)}$ $h = 20 - s = 19(19.2)$ A1 Correct unsimplified equation for their distance $A1$ $Correct unsimplified equation for their distance$		$\left(\frac{9}{2}\right)^{2} = 2^{2} + 2gs \text{ or}$ $\frac{1}{2}m(13) + mgs = \frac{1}{2}m\left(9 + \frac{81}{4}\right)$	A1	Correct unsimplified equation for their distance
h = 20 - s = 19 (19.2) A1 2 sf or 3 sf		h = 20 - s = 19(19.2)	A1	2 sf or 3 sf
(6)			(6)	