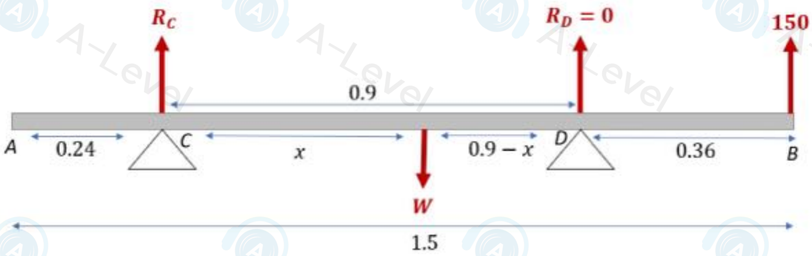
Question Number	Scheme	Marks
4.	$R_D = 0$ for scenario 1 or $R_C = 0$ for scenario 2	B1
	Scenario 1 M(C) $(150\times 1.26) = Wx$	M1 A1
	Scenario 2 M(D) $(225\times 0.36) = W\times(0.9 - x)$	M1 A1
	Solve simultaneously for W (or x) e.g. $0.81W = 243$	dM1
	$W = 300$	A1
	$x = 0.63$	A1
		(8)
	NOTES	
B1	**N.B.** B0 means there are no other marks available. $R_D = 0$ for scenario 1 seen on a diagram or implied by working. OR: $R_C = 0$ for scenario 2 seen on a diagram or implied by working.	
M1	Complete method to form an equation in W and a consistent unknown distance *only*, for scenario 1. All equations used must be dimensionally correct and have the correct no. of terms but condone sign errors. (M0 if $R_D = 0$ is never used)	
A1	Correct unsimplified equation in W and x or their defined unknown distance.	
M1	Complete method to form an equation in W and a consistent unknown distance *only*, for scenario 2. All equations used must be dimensionally correct and have the correct no. of terms but condone sign errors. (M0 if $R_C = 0$ is never used)	
A1	Correct unsimplified equation in W and x or their defined unknown distance	
dM1	Dependent on both M's, solve simultaneous equations for either W or their unknown	
A1	Correct answer for W	
A1	Correct answer for x This must be the distance stated in the question, from C to the centre of mass. **N.B.** If they include g in a moments equation, they lose the A mark for that equation and both final A marks.	

Scenario 1



Equations with unknown distance, x, measured from C.
Complete method will involve one moments equation with $R_D = 0$ or two equations with R_C eliminated and $R_D = 0$.

M0 if R_D never equals zero

Vert $\quad R_C + 150 = W$

M(A) $\quad (R_C \times 0.24) + (150 \times 1.5) = W(x + 0.24)$

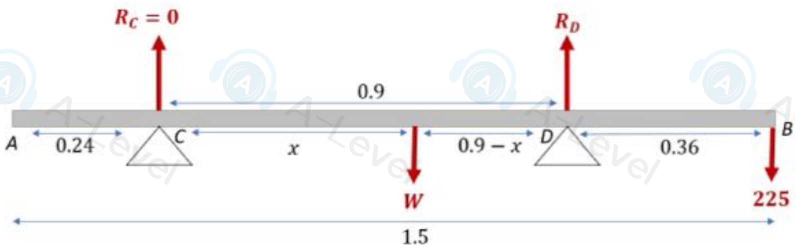
M(C) $\quad (150 \times 1.26) = Wx$

M(G) $\quad R_C\, x = 150(1.26 - x)$

M(D) $\quad (R_C \times 0.9) = (150 \times 0.36) + W(0.9 - x)$

M(B) $\quad (R_C \times 1.26) = W(1.26 - x)$

Scenario 2



Equations with unknown distance, x, measured from C
Complete method will involve one moments equation with $R_C = 0$ or two equations with R_D eliminated and $R_C = 0$.

M0 if R_C never equals zero

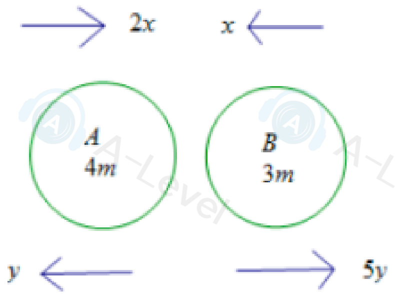
Vert $\quad R_D = 225 + W$

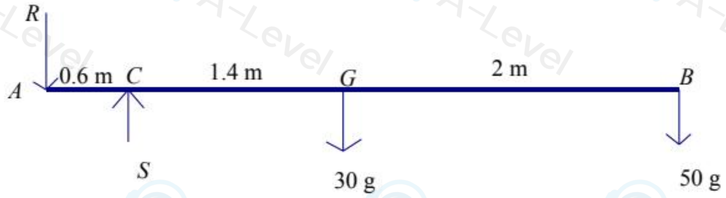
M(A) $\quad (R_D \times 1.14) = (225 \times 1.5) + W(x + 0.24)$

M(C) $\quad (225 \times 1.26) + Wx = (R_D \times 0.9)$

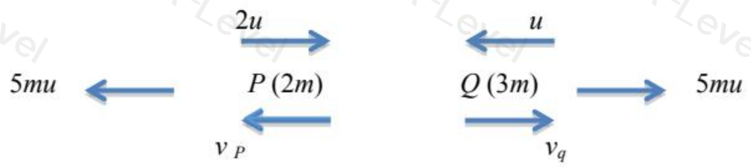
M(G) $\quad R_D(0.9 - x) = 225(1.26 - x)$

M(D) $\quad (225 \times 0.36) = W(0.9 - x)$

Q	Scheme	Marks	Notes
1			
(a)	Use of CLM Or equating impulses	M1	Dimensionally correct. Condone sign errors and allow missing m's and extra g's.
	$(4m\times 2x)-3mx=(3m\times 5y)-4my$ Or: $3m(5y--x)=4m(y--2x)$	A1	Correct unsimplified equation and must see all 4 terms but allow missing m's.
	$y=\dfrac{5}{11}x$ *	A1*	Obtain given answer from correct working with m's seen. Allow $y=\dfrac{5x}{11}$ but A0 if x is *clearly* in the denominator of the fraction.
		[3]	
(b)	Use of $I=mv-mu$	M1	Dimensionally correct. Condone sign errors and y not substituted but mass and velocities must match. M0 if m is used for mass or g is included or m is missing.
	$\pm 3m\left(\dfrac{25}{11}x+x\right)$ or $\left(\pm 4m\left(\dfrac{5}{11}x+2x\right)\right)$	A1	Correct unsimplified expression
	$\dfrac{108}{11}mx$ oe	A1	$9.8mx$ or better $(9.8181..mx)$, must be positive.
		[3]	
		(6)	

Question Number	Scheme	Marks	Notes
4.(a)			
	$M(A)$ (30g x 2) + (50g x 4) = 0.6 S	M1	Moments equation. Requires all terms and dimensionally correct. Condone sign errors. Allow M1 if g missing
	$M(C)$ $(0.6\times R)=(1.4\times 30\text{g})+(3.4\times 50\text{g})$ $M(G)$ $(2\times R)=(1.4\times S)+(2\times 50\text{g})$ $M(B)$ $(4\times R)+(2\times 30g)=(3.4\times S)$	A1	Correct unsimplified equation
	$(\uparrow)$ $R+30g+50g=S$ $(R+784=S)$	M1	Resolve vertically. Requires all 4 terms. Condone sign errors
		A1	Correct equation (with R or their R)
	NB: The second M1A1 can also be earned for a second moments equation		
	$R=3460$ or 3500 or $\frac{1060g}{3}$ (N) Not 353.3g	A1	One force correct
	$S=4250$ or 4200 or $\frac{1300g}{3}$ (N) Not 433.3g	A1	Both forces correct If both forces are given as decimal multiples of g mark this as an accuracy penalty A0A1
		(6)	
4.(b)	$M(C)$ (30g x 1.4) + (Mg x 3.4) = 0.6 x 5000	M1	Use $R=5000$ and complete method to form an equation in M or weight. Needs all terms present and dimensionally correct. Condone sign errors. Accept inequality. Use of R and S from (a) is M0
		A1	Correct equation in M (not weight) (implied by $M=77.68$)
	$M=77$ kg	A1	77.7 is A0 even is the penalty for over-specified answers has already been applied
		(3)	
4.(c)	The weight of the diver acts at a point.	B1	Accept "the mass of the diver is at a point".
		(1)	
		[10]	

Question Number	Scheme	Marks
2(a)	Correct relationship between the speeds after the collision. v and $v+1$ OR $w-1$ and w	B1
	$(3m\times 1.5)+(m\times -1.5)=3mv+m(v+1)$ [Or $(3m\times 1.5)+(m\times -1.5)=3m(w-1)+mw$]	M1 A1
	Speed of $A = \frac{1}{2}$ $(\mathrm{m\,s^{-1}})$ Speed of $B = \frac{3}{2}$ $(\mathrm{m\,s^{-1}})$	A1 A1
		(5)
2(b)	For B: $\pm m(1.5 - -1.5)$ **OR** For A: $\pm 3m(0.5-1.5)$	M1 A1ft
	$3m$ (Ns)	A1
		(3)
		(8)
	NOTES	
(a) **B1**	*speed* of B = 1 + *speed* of A . Must be seen **before** the CLM equation is used i.e. algebraic not numerical quantities	
M1	Dimensionally correct CLM equation with correct number of terms. Allow consistent extra g 's or cancelled m 's. Ignore sign errors. Allow the use of 2 unknowns for speeds after. (M0 if same speeds)	
A1	Correct equation in 1 unknown	
A1	Correct speed of A	
A1	Correct speed of B	
(b) **M1**	Dimensionally correct impulse-momentum equation using A or B with correct number of appropriate terms. Condone sign errors but must be difference of momenta. M0 if g is included.	
A1ft	Correct unsimplified equation. Follow through their answer in (a),but if using B, terms must have same signs, if using A, terms must have opposite signs.	
A1	Cao (must be positive)	

Question Number	Scheme	Marks
1.(a)	 $5mu = 2m(v_P - -2u)$ $v_P = \frac{1}{2}u$	M1 A1 A1 (3)
(b)	Reversed	B1 (1)
(c)	$5mu = 3m(v_Q - -u)$ $v_Q = \frac{2}{3}u$ **OR** $2m2u - 3mu = -2m\frac{1}{2}u + 3m\ v_Q$ $v_Q = \frac{2}{3}u$	M1 A1 A1 (3) **OR** M1 A1 A1 (3) **7**
	Notes	
1.(a)	First M1 for a complete method to find v_P (M0 for CLM only, with 2 unknowns) for use of $5mu$ = change in momentum of P (must have $2m$ in both terms) (M0 if *clearly* adding momenta) but condone sign errors. First A1 for a correct equation in v_P only. Second A1 for ½ u (A0 if –ve)	
1.(b)	B1 for reversed – only allow if ½ u or - ½ u has been correctly obtained in (a). Allow: '(Yes) it has' but NOT just 'Yes' nor 'has been changed' nor just "opposite"	
1.(c)	First M1 for a complete method to find v_Q (M0 for CLM only, with 2 unknowns) for use of $5mu$ = change in momentum of Q (must have $3m$ in both terms) (M0 if *clearly* adding momenta) but condone sign errors. First A1 for a correct equation in v_Q only. Second A1 for $\frac{2}{3}u$ or $0.67u$ or better (A0 if –ve) **OR** First M1 for a complete method to find v_Q for use of CLM with correct no. of terms and their v_P (M0 for CLM only, with 2 unknowns) but condone sign errors. First A1 for a correct equation in v_Q only. Second A1 for $\frac{2}{3}u$ or $0.67u$ or better (A0 if –ve) **N.B.** They may find v_Q first i.e. do (c) first, then use CLM in (a).	