MyStudyBro - Revision Exercise Tool

This Revision Handout includes the Questions and Answers of a total of 5 exercises!

Chapters:

Collisions - M1 (Pearson Edexcel)

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1. Two particles, A and B, have masses $2m$ and $3m$ respectively. They are moving towards each other in opposite directions along the same straight line on a smooth horizontal plane when they collide directly. Immediately before they collide, the speed of A is $3u$ and the speed of B is u. As a result of the collision, the speed of A is halved and the direction of motion of each particle is reversed.

(i) Find the speed of B immediately after the collision.

(ii) Find the magnitude of the impulse exerted on A by B in the collision.

(6)

Question Number	Scheme	Marks
1(i)	$6mu - 3mu = -2m.\frac{3u}{2} + 3mv$ $v = 2u$	M1 A1 A1
(ii)	$I = \pm 2m(\frac{3u}{2} - -3u)$ Magnitude $= 9mu$ **OR**: $I = \pm 3m(2u - -u)$ Magnitude $= 9mu$	M1 A1 A1 M1 A1 A1 **6**
	Notes	
1(i)	M1 for CLM with correct no. of terms to give an equation in one unknown. Allow consistent extra g's and/or cancelled m's. Condone sign errors (They may obtain this equation by finding the impulse on each and eliminating the impulse – apply the *same* criteria, including condone sign errors)	
	First A1 for a correct unsimplified equation. Allow: $6mu - 3mu = -2m.\frac{3u}{2} - 3mv$	
	Second A1 for $2u$ (must be positive) (**N.B.** If all terms in the CLM are given the same sign, this leads to $2u$ M1A0A0)	
(ii)	M1 for dimensionally correct Impulse-momentum equation with consistent use of $2m$ or $3m$ (i.e. M0 if g included or m omitted.) **N.B**. Mark the actual equation not the formula (some candidates use $I = m(v+u)$ when the direction has been reversed)	
	First A1 for a correct unsimplified equation	
	Second A1 for $9mu$ (must be positive)	

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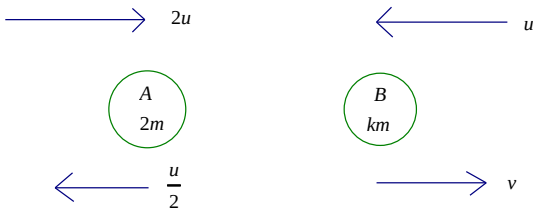
3. Two particles A and B have mass $2m$ and km respectively. The particles are moving in opposite directions along the same straight smooth horizontal line so that the particles collide directly. Immediately before the collision A has speed $2u$ and B has speed u. The direction of motion of each particle is reversed by the collision. Immediately after the collision the speed of A is $\frac{u}{2}$.

(a) Find, in terms of m and u, the magnitude of the impulse exerted by B on A in the collision.

(3)

(b) Show that $k < 5$

(4)

Question Number	Scheme	Marks
3a		
	Impulse on $A \quad = 2m\left(\frac{u}{2}-(-2u)\right)$	M1A1
	Magnitude of impulse $= 5mu$	A1
		(3)
3b	CLM: $2m\times 2u - km\times u = 2m\times\left(-\frac{u}{2}\right)+kmv$	M1A1
	Use of $v>0$: $kmv = 5mu - kmu > 0$	**DM**1
	$\Rightarrow k<5$ **Given Answer**	A1
		(4)
3b alt	**Alternative**: Impulse on B: $5mu = km\left(v-(-u)\right)$ M1A1	
	$v=\frac{5u}{k}-u$ **OR** $k=\frac{5u}{u+v}$	
	Use of $v>0$: $\frac{5u}{k}-u>0\Rightarrow k<5$ **OR** if $v>0$, then $k<5$ **Given Answer** **DM**1A1	
	(4)	
		[7]
	Notes for question 3	
3a	M1 for using impulse = change in momentum for A (M0 if *clearly* adding momenta or if g is included or if not using $2m$ in *both* terms) but condone sign errors.	
	First A1 for $2m\left(\frac{u}{2}-(-2u)\right)$ or $-2m\left(\frac{u}{2}-(-2u)\right)$	
	Second A1 for $5mu$ (must be positive since magnitude) terms collected	
3a alt	**Alternative**: Use CLM to find $v=\frac{5u}{k}-u$ then use Impulse on B: = km ($(5u/k - u) + u$) M1A1 for the complete method = $5mu$ A1	
3b	First M1 for CLM with correct no. of terms, all dimensionally correct. Condone consistent g's or cancelled m's and sign errors.	
	First A1 for a correct equation (allow $-v$ in place of v)	
	Second **DM**1 for use of $v > 0$ or $v < 0$ as appropriate	
	Second A1 for given answer correctly obtained.	

Question Number	Scheme	Marks
3balt	First M1 for using their impulse on A = change in momentum for B (M0 if *clearly* adding momenta or if g is included or if not using km in *both* terms) but condone sign errors.	
	First A1 for a correct equation (allow $-v$ in place of v)	
	Second **DM**1 for use of $v > 0$ or $v < 0$, as appropriate, but must be from a correct v or k, to deduce given answer.	
	Second A1 for given answer correctly obtained.	

1

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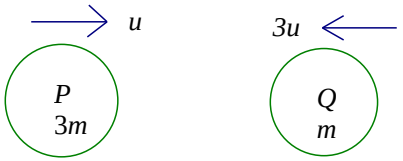
1. Particle P has mass $3m$ and particle Q has mass m. The particles are moving towards each other in opposite directions along the same straight line on a smooth horizontal plane. The particles collide directly. Immediately before the collision the speed of P is u and the speed of Q is $3u$. In the collision, the magnitude of the impulse exerted by Q on P is $5mu$.

(i) Find the speed of P immediately after the collision.

(ii) Find the speed of Q immediately after the collision.

(6)

Mechanics 1 - WME01 June 2018
Mark Scheme

Question Number	Scheme	Marks	Notes
			Mark parts (i) and (ii) together For marking:1st equation in one unknown M1A1 2nd equation in one unknown M1A1 1st value A1, 2nd value A1
1i.	Impulse - momentum equation for P	M1	Must be trying to subtract. Terms dimensionally consistent.
	$5mu = 3m(v_P - -u)$	A1	Correct unsimplified equation
	$v_P = \frac{2u}{3}$	A1	Final answer positive Condone unexplained sign change
1ii.	Impulse momentum equation for Q	M1	Must be trying to subtract Terms dimensionally consistent.
	$5mu = m(v_Q - -3u)$	A1	Correct unsimplified equation
	$v_Q = 2u$	A1	
1ii alt	Use of CLM	M1	Need all terms and dimensionally consistent. Condone sign errors.
	$3mu - 3mu = -3m\frac{2u}{3} + mv_Q$ or $3mu - 3mu = 3mv_P + 2mu$	A1	Correct unsimplified equation
	$v_Q = 2u$	A1	Final answer positive Condone unexplained sign change
		[6]	

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1. A particle P of mass 0.8 kg is moving along a straight horizontal line on a smooth hoizontal surface with speed $4\,\text{m s}^{-1}$. A second particle Q of mass 2 kg is moving, in the opposite direction to P, along the same straight line with speed $2\,\text{m s}^{-1}$. The particles collide directly. Immediately after the collision the direction of motion of each particle is reversed and the speed of P is $2.5\,\text{m s}^{-1}$.

(a) Find the speed of Q immediately after the collision.

(3)

(b) Find the magnitude of the impulse exerted by Q on P in the collision, stating the units of your answer.

(3)

Oct 2018 IAL
WME01 (M1)
FINAL

Question Number	Scheme	Marks
1(a)	$0.8\times4-2\times2=2v-0.8\times2.5$	M1A1
	$v=0.6$ m s^{-1}	A1 (3)
(b)	$I=0.8(4+2.5)=5.2$, Ns or kg m s^{-1}	M1A1,B1 (3)
	OR: $I=2(0.6+2)=5.2$, Ns or kg m s^{-1}	M1A1,B1 **[6]**
	Notes for qu 1	
1a	M1 for CLM, correct no. of terms, dim correct, condone extra g's throughout and sign errors, in one unknown, with correct pairings of mass and velocity. N.B. Apply <u>same</u> criteria to an equation that has been found by eliminating the impulse from two imp-mom equations.	
	First A1 for a correct equation (condone extra g's)	
	Second A1 for 0.6 (Must be positive)	
1b	M1 for Impulse – Momentum equation for either particle, correct no. of terms, with correct velocities, condone sign errors N.B. Mark the actual equation not the formula (some candidates use $I=m(v+u)$ when the direction has been reversed)	
	M0 if g included on momentum terms	
	A1 for 5.2 (Must be positive)	
	B1 for Ns or kg m s^{-1} **N.B.** M0A0B1 is possible	

Leave blank

3. Two particles P and Q have masses $4m$ and m respectively. They are moving in opposite directions towards each other along the same straight line on a smooth horizontal plane and collide directly. Immediately before the collision the speed of P is $2u$ and the speed of Q is $4u$. In the collision, the particles join together to form a single particle.

Find, in terms of m and u, the magnitude of the impulse exerted by P on Q in the collision.

(6)

Question Number	Scheme	Marks
	Second A1 for $R_C = 80$ (N) Second M1 for a moments equation or a vertical resolution Third A1 for a correct equation (R_C and/or R_D do NOT need to be substituted but if one is, it can be their value found from a previous equation) Fourth A1 for $R_D = 1400$ (N) Enter marks for equations on ePEN, in the order they appear	
2b	First M1 for a moments equation or a vertical resolution First A1 for a correct equation (R_C and/or R_D do NOT need to be substituted but if one is, it can be their value found from a previous equation) Second M1 for a moments equation or a vertical resolution Second A1 for a correct equation (R_C and/or R_D do NOT need to be substituted but if one is, it can be their value found from a previous equation) Third A1 for $x = 2.5$ Enter marks for equations on ePEN, in the order they appear **N.B.** Equations may contain any or all of R_C , R_D or x for M marks but must contain only **one** of R_C or R_D to earn the A mark. **N.B.** If they assume that R_D = 520, they lose all the marks for part (b). **N.B** If they start with $2R$ = 1480 and then add or subtract (or both) 520 to their R value, M0**.** **N.B.** If brackets are omitted in a moments equation e.g. (520 + R_C).4 is written as 520 + R_C.4, the M mark can be scored	
3	$8mu - 4mu = 5mv$	M1A1
	$v = 0.8u$	A1
	For P: $-I = 4m(0.8u - 2u)$	M1 A1
	$I = 4.8mu$	A1
	OR For Q: $I = m(0.8u + 4u)$	M1 A1
	$I = 4.8mu$	A1
		6
	Notes	
3	First M1 for CLM with correct no. of terms, all dimensionally correct, to give an equation in m, u and their v only. Condone consistent g's or cancelled m's and sign errors. (N.B. The CLM equation could be obtained by equating the magnitudes of the impulses on each particle) First A1 for a correct equation (they may have - 5mv) Second A1 for 0.8u or – 0.8u (as appropriate) Second M1 for using Impulse = Change in Momentum for either P or Q (M0 if *clearly* adding momenta or if g is included or if different mass in the two momentum terms) but condone sign errors.	

Question Number	Scheme	Marks
	Third A1 for $4m(0.8u-2u)$ or $-4m(0.8u-2u)$ **OR** for $m(0.8u+4u)$ or $-m(0.8u+4u)$ Fourth A1 for 4.8*mu* (must be positive since magnitude)	
4(i)	$\lvert\mathbf{F}_2\rvert^2 = 8^2+14^2-2\times 8\times 14\cos 30$	M1 A1
	Solve for $\lvert\mathbf{F}_2\rvert$= 8.1 (N) or better	M1 A1 (4)
	OR: $\lvert\mathbf{F}_2\rvert\cos\alpha = 14\cos 30 - 8$ $\lvert\mathbf{F}_2\rvert\sin\alpha = 14\sin 30$	M1 A1
	Solve for $\lvert\mathbf{F}_2\rvert$= 8.1 (N) or better	M1 A1 (4)
4(ii)	$\frac{\sin\theta}{8} = \frac{\sin 30}{8.12467}$ or $\frac{\sin\phi}{14} = \frac{\sin 30}{8.12467}$	M1 A1
	Solve: $\theta = 29.49^o$ or $\phi = 120.51^o$	M1 A1
	Bearing is 149° (nearest degree)	A1 (5)
	OR: $\lvert\mathbf{F}_2\rvert\cos\alpha = 14\cos 30 - 8 = 4.124(355.)$ $\lvert\mathbf{F}_2\rvert\sin\alpha = 14\sin 30$	M1 A1
	Solve: $\alpha = 59.49^o$	M1 A1
	Bearing is 149° (nearest degree)	A1 (5)
	Notes	
4(i)	First M1 for use of cos rule with 30° First A1 for a correct equation **OR:** First M1 for 'resolving' in 2 directions with 30° / 60° (**N.B.** M0 here if cos/sin confused) First A1 for TWO correct equations Second M1 for solving for $\lvert\mathbf{F}_2\rvert$, <u>independent</u> *but* must be solving a 'correct cosine formula but with wrong angle' if using method 1 **OR** for eliminating α from two equations, <u>independent</u> *but* equations must have the correct structure if using method 2 Second A1 for 8.1 (N) or better	
4(ii)	First M1 for use of sin rule with 30° First A1 for a correct equation (<u>allow 8.12 or better</u>) **OR:** First M1 for 'resolving' in 2 directions with 30° / 60°	