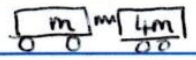
A2 Review Questions

P.20 Momentum & Energy

① D

② Before



After

$\Sigma P = 0$ $\quad\quad$ $\Sigma P = 0$.

so $V_m \times m = V_{4m} \times 4m$.

$V_m = 4V_{4m}$.

so velocity of m is 4 x velocity of 4m. And opposite direction. Kinetic energy came from elastic energy stored in coiled spring.

③ Elastic collision: Kinetic energy is conserved.

Inelastic collision; Kinetic energy is not conserved and transfered to heat, light and sound.

④ Before

After.

a) $\Sigma P = 21V_x + (7 \times 0)$ $\quad\quad$ $\Sigma P = 21V_x = (21+7)V_y$

$21V_x = 28 \times 3.5$

$V_x = \frac{98}{21} = 4.67 ms^{-1} \approx 4.7 ms^{-1}$

b) $E_{k_b} = \frac{1}{2}mv^2$ $\quad\quad$ $E_{k_a} = \frac{1}{2}mv^2$

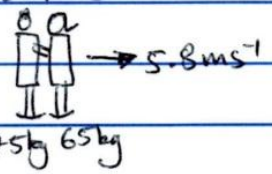
$= 0.5 \times 21 \times 4.7^2$ $\quad\quad$ $= 0.5 \times (21+7) \times 3.5^2$

$= 231.945$ $\quad\quad$ $= 171.5$

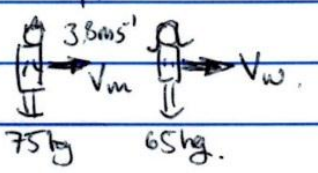
$\Delta E_k = 231.945 - 171.5 = 60.445$

$\%\ loss = \frac{\Delta E_k}{total} \times 100 = \frac{60.445}{231.945} \times 100 = 26.1\%$

⑤ Before



After



a) $\Sigma P_b = (75+65)5.8$ $\quad\quad$ $\Sigma P_a = (75 \times 3.8) + 65V_w$

$= 812\ kg\,ms^{-1}$ $\quad\quad$ $= 285 + 65V_w$.

$\Sigma P_b = \Sigma P_a \Rightarrow \frac{812 - 285}{65} = V_w = 8.1 ms^{-1}$

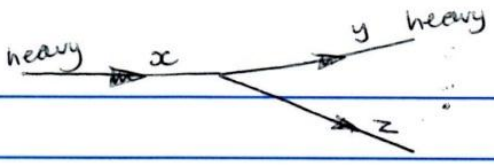
b) $E_{k_b} = \frac{1}{2}mv^2 = 0.5 \times 140 \times 5.8^2$ $\quad\quad$ $E_{k_a} = \frac{1}{2}m_m v_m^2 + \frac{1}{2}m_w v_w^2$

$= 2354.8\ J$ $\quad\quad$ $= (0.5 \times 75 \times 3.8^2) + (0.5 \times 65 \times 8.1^2)$

$= 2673.825$

$\Delta E_k = 2673.825 - 2354.8 = +319.0\ J$ (increased)

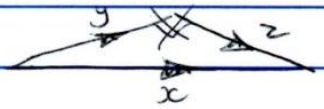
(6) (A)



Elastic so $\frac{1}{2} m_x V_x^2 = \frac{1}{2} m_y V_y^2 + \frac{1}{2} m_z V_z^2$

Mass DOESN'T cancel out $\therefore V_x^2 \neq V_y^2 + V_z^2$

so NOT a $\perp$ triangle ie.



(7)

$E_{k_b} = \frac{1}{2} m_\alpha V_\alpha^2$ OR $E_{k_b} = \frac{p^2}{2m}$

$= \frac{(10 \times 10^{-20})^2}{2 \times 6.65 \times 10^{-27}}$

$= 7.519 \times 10^{-13}$ J

$E_{k_a} = E_{k\alpha} + E_{k\,He}$

$= \frac{p_\alpha^2}{2m_\alpha} + \frac{p_{He}^2}{2m_{He}}$

$= \frac{(8.18 \times 10^{-20})^2}{2 \times 6.65 \times 10^{-27}} + \frac{(5.72 \times 10^{-20})^2}{2 \times 6.65 \times 10^{-27}}$

$= 5.03 \times 10^{-13} + 1.040 \times 10^{-13}$ → WRONG and took 20mins

$= 6.07 \times 10^{-13}$ J $\therefore$ E_k not conserved $\therefore$ not elastic.

OR mass of α = mass of He.

if elastic $u_\alpha^2 = v_\alpha^2 + v_{He}^2$

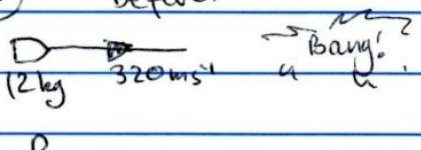
$(1.5 \times 10^7)^2 \stackrel{?}{=} (1.23 \times 10^7)^2 + (0.86 \times 10^7)^2$

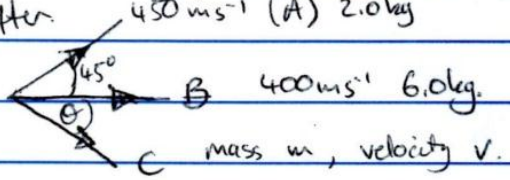
$2.25 \times 10^{14} = 1.513 \times 10^{14} + 7.396 \times 10^{13}$

$2.25 \times 10^{14} = 2.25 \times 10^{14}$ → correct! and took 5mins.

E_{k_b} Does equal E_{k_a} $\therefore$ Elastic

(8)



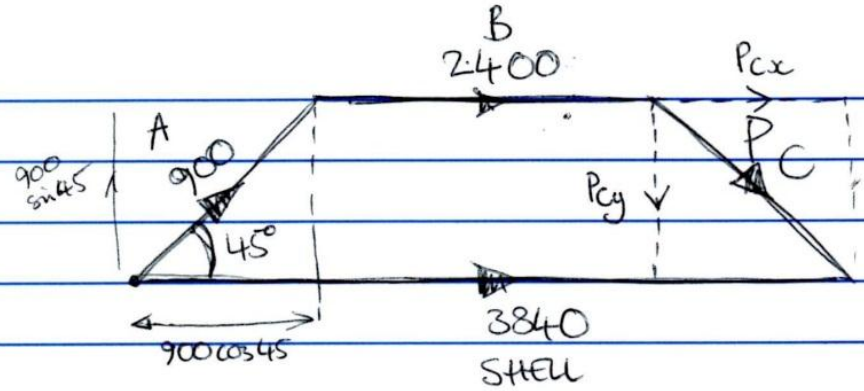


a) $P_{shell} = 12 \times 320 = 3840$ kgms^{-1}

$P_A = 2 \times 450 = 900$ kgms^{-1} $P_B = 400 \times 6 = 2400$ kgms^{-1}

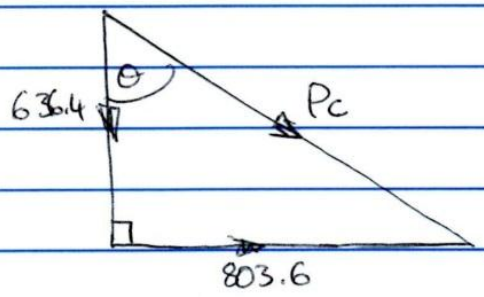
b)

b)



$P_{cx} = 3840 - 2400 - 900\cos 45 = 803.6 \text{ kgms}^{-1}$

$P_{cy} = 900 \sin 45 = 636.40 \text{ kgms}^{-1}$



$P_c^2 = 636.4^2 + 803.6^2$

$P_c = \sqrt{636.4^2 + 803.6^2}$

$= 1025.07 \text{ kgms}^{-1}$

Mass of C = 12 − 6 − 2 = 4kg. $\therefore V_c = \frac{P_c}{m_c}$

$= \frac{1025.07}{4} = \underline{\underline{256.3 \text{ ms}^{-1}}}$

$\tan\theta = \frac{803.6}{636.4}$ $\quad \theta = \tan^{-1}\frac{803.6}{636.4}$

$= \underline{\underline{51.6°}}$ ~~below horizontal~~

$90 - 51.6 = \underline{\underline{38.4°}}$ below horizontal