Momentum FProblems ("ASSIGN 5")

Note Title

(1) $\vec{p} = m\vec{v} = 950\,kg \times 40\,\frac{km}{h}[West] \times \frac{1}{3.6} = \boxed{1.06 \times 10^4\ kg\cdot\frac{m}{s}[W]}$

(2) $\vec{p} = m\vec{v} \therefore \vec{v} = \frac{\vec{p}}{m}$ $\quad \vec{v} = \frac{16\ kg\cdot m/s}{0.825\ kg} = 19.4\ m/s = \boxed{69.8\ \frac{km}{h}[E]}$

(3) $\Delta\vec{p} = \Delta(m\vec{v}) = \Delta m \cdot \vec{v} = -40\,kg \times \left(\frac{50}{3.6}\right) m/s = -556\ kg\cdot\frac{m}{s}[E]$

$= \boxed{556\ kg\cdot\frac{m}{s}[W]}$

(4) $\Delta\vec{p} = m\Delta\vec{v}$ $\quad$ 4.0 m/s ↑, 0, 3.0 m/s ↓ $\quad \Delta v = v' - v$

$\Delta v = -3 - 4 = -7.0\ m/s\,[N]$ or $+7.0\ m/s\,[S]$

$\therefore \Delta\vec{p} = 5.0(7.0) = \boxed{35.0\ kg\cdot m/s\,[S]}$

(7) [E] →

140 kg G → 30 km/h, W $\quad$ GW → ?

$30\ km/h =$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$140\,kg \times 30\,km/h + 0 = (m_1 + m_2)v'$

$4200\ kg\cdot\frac{km}{h} = 225\ kg\cdot v'$

$\boxed{187\ km/h\,[E] = v'}$

$= 5.19\ m/s\,[E]$

(6) $m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$85(40) + 140(-30) = 85v_1' + 0$

$-9.41 = v_1'$ $\quad \therefore v' = \boxed{9.41\ km/h\,[N]}$

$= \boxed{2.61\ m/s\,[N]}$

(7) c) $\vec{\Delta p} = m\vec{\Delta v} = 150(7\ m/s) = \boxed{1050\ kg\cdot m/s}$

b) Impulse $= \vec{\Delta p} = \boxed{1050\ kg\,m/s}$

c) impulse on couch $= 1050\ N\cdot s$ $\quad imp = F\Delta t$ $\quad F = \frac{1050\ N\cdot s}{0.05\ s} = \boxed{21{,}000\ N}$

(8) a) impulse $= \Delta p = mv$ $\quad$ speed @ impact: $v^2 = v_0^2 + 2ad$

$v^2 = 0 + 2(9.8)(5.0)$

$v = 9.90\ m/s$

$\therefore \Delta v = 9.90\ m/s$

$\Delta p = 70\ kg(9.90\ m/s) = \boxed{693\ kg\cdot m/s}$

b) 

$A = 3.0\ cm^2 = 3.0\times10^{-4}\ m^2$

STRENGTH $= 1.7\times10^8\ N/m^2$

$\therefore$ max force $= 1.7\times10^8\ \frac{N}{m^2} \times 3.0\times10^{-4}\ m^2$

$= 51{,}000\ N$

Now, $\Delta t = 0.0020\ s$ $\therefore$ $F = \frac{\Delta p}{\Delta t} = \frac{693\ N\cdot s}{0.0020\ s} = 347{,}000\ N$

$\therefore$ he shatters his legs $(347{,}000 > 2\times51{,}000)$

c) $F = \frac{\Delta p}{\Delta t} = \frac{693\ N\cdot s}{0.050\ s} = 13{,}900\ N$ $\quad \therefore$ 6930 N each leg

$\therefore$ no fractures