James J. Griffin
301-405-6115

Ch 6: CQ 14, 33, 39 / EX 12, 17, 20
Ch 7: CQ 3, 9 / EX 3, 6.

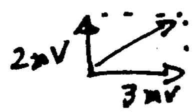
6CQ14 The **higher bouncing ball** experiences greater impulse; as follows

$$\text{Impulse} = \vec{F}_{net}\,\Delta t = \Delta m\vec{v} = m\vec{v}_f - m\vec{v}_i.$$

and its magnitude is $|\vec{F}_{net}\Delta t| = m(v_f + v_i)$. (Because $\vec{v}_i$ is down and $\vec{v}_f$ is up, $|\vec{v}_f - \vec{v}_i| = |\vec{v}_f| + |\vec{v}_i| = v_f + v_i$.) Then the larger $|\vec{v}_f|$, the larger the CHANGE in MOMENTUM & the larger the Impulse.

6CQ33 **Zero!** Because $\vec{P}_i^{TOT} = 0$, and MOMENTUM is conserved we can be sure that $\vec{P}_f^{TOT} \equiv 0$.

6CQ39: $\vec{P}_i^{TOT} = (P_x^{TOT}, P_y^{TOT}) = (3mv, 2mv) \equiv \vec{P}_f^{TOT}$ ... by CONS. of MOMENTUM.



Then **(D)** is the closest estimate to the final momentum of the pair: $\vec{P}_f = \vec{P}_i = 4m\vec{v}_F$
$= (4m v_{fx}, 4m v_{fy})$

Since the particles stick together there is only 1 final velocity, $\vec{v}_f$ directed at an angle $\tan\vartheta = \frac{v_{fy}}{v_{fx}} = \frac{2}{3} \Rightarrow$ **$\vartheta = 33.7°$**

6.Ex12: See next page

6.Ex17 Before: $P_i^{TOT} = 1200 \cdot 14 + 2000 \cdot 25 = 66800$ kg-m/sec

After: $P_f^{TOT} =$ **66.8×10^3 kg·m/sec $\equiv P_i^{TOT}$** by Conservation of Momentum

→ 6.Ex 12: See NEXT PAGE

James J. Griffin
301-405-6115

6 Ex 12

$$F \cdot \Delta t = \Delta(mv) = mv_f - mv_i$$

$$F = \frac{m(v_f - v_i)}{\Delta t} = \frac{(0.2\,kg)[16-(-8)]\,m/sec}{0.04\,sec} = \frac{(0.2)(24)}{0.04} = 120 \frac{kg\,m}{sec^2}$$

[Note – sign of v_i!]

$$\boxed{F = 120\,N}$$

6. Ex 20

$$P_i^{TOT} = m \cdot v_i = P_f^{TOT} = (m + 3m) v_f \quad \text{Conservation of } P^{TOT}$$

$$v_f = \frac{m v_i}{4m} = \frac{v_i}{4} = \frac{10}{4} m/sec = \boxed{2.5\,m/sec = v_f}$$

(and mass of boxcars is irrelevant!)

Ch 7: CQ 3. Conservation of Momentum, because Mechanical Energy may be converted into heat energy in the collision and that is difficult to account for. MOMENTUM is simpler and its conservation is more directly useful in violent collisions.

7: CQ 9. [MiniVan] has higher $K.E. = \frac{1}{2} m v^2$ by $\frac{m_{MV}}{m_{SP}}$ factor $= 2X$

7 Ex 3

4 kg: $v_i^4 = +6\,m/sec$ (to Right) ; $v_f^4 = +2\,m/sec$

1 kg: $v_i^1 = -6\,m/sec$ (to Left) ; $v_f^1 = +10\,m/sec$

$$P_i = m^4 v_i^4 + m^1 v_i^1 = +4 \cdot 6 - 1 \cdot 6 = +18\,kg\,m/sec$$

$$P_f = m^4 v_f^4 + m^1 v_f^1 = +2 \cdot 4 + 10 \cdot 1 = +18\,kg\,m/sec$$

$\Big\}\ \vec{P}_i = \vec{P}_f$

YES: MOMENTUM IS CONSERVED

$$(KE)_i = \frac{1}{2} m^4 (v_i^4)^2 + \frac{1}{2} m^1 (v_i^1)^2 = \frac{1}{2} 4 \cdot 36 + \frac{1}{2} \cdot 1 \cdot 36 = 90 \text{ joules}$$

$$(KE)_f = \frac{1}{2} m^4 (v_f^4)^2 + \frac{1}{2} m^1 (v_f^1)^2 = \frac{1}{2} \cdot 4 \cdot 4 + \frac{1}{2} \cdot 1 \cdot 100 = 58 \text{ joules}$$

KE IS NOT conserved; KE decreases.

In Principle this collision could have occurred. But in practice hockey pucks rarely lose so much KE in a collision because they are rather elastic objects. I would like to hear from the student how this oddity occurred.

James J. Griffin
301-405-6115

7. Ex 6 $P_i = 4(5) - 1 \cdot 0 = 20 \ kg \cdot m/sec = P_f$ (by CONSERVATION of PTOT)

Since $P_f \equiv P_i$: $P_f = (4+1) \cdot v_f = 20 \Rightarrow v_f = \frac{20}{5} = 4 \ m/sec.$

$(KE)_i = \frac{1}{2} \cdot 4 \ (5)^2 + 0 = 50 J$

$(KE)_f = \frac{1}{2} \ 5 \cdot (4)^2 = 40 J$

$\Rightarrow$ **10 J of KE were lost.**