

Homework Solutions, Physics 117
Home Work Problem Set # 5

James J. Griffin
301-405-6115

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Solutions by _____

Ch 6: CQ - 14, 33, 39 / Ex 12, 17, 20

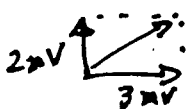
Ch 7: CQ 3, 9 / Ex 3, 6.

6CQ14 The **higher bouncing ball** experiences greater impulse; as follows
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: $\vec{P}_i^{TOT} = (P_x^{TOT}, P_y^{TOT}) = (3m v, 2m v) \equiv \vec{P}_f^{TOT}$
... by CONS. of MOMENTUM.



Then **(D)** is the closest estimate to \vec{P}_f^{TOT}
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 $\tan \theta = \frac{v_{fy}}{v_{fx}} = \frac{2}{3} \Rightarrow \theta = 33.7^\circ$

6. Ex 12: See next page

6. Ex 17

Before:

$$\vec{P}_i^{TOT} = 1200 \cdot 14 + 2000 \cdot 25 = 66800 \text{ kg}\cdot\text{m}/\text{sec}$$

$$\text{After: } \vec{P}_f^{TOT} = 66.8 \times 10^3 \text{ kg}\cdot\text{m}/\text{sec} \equiv \vec{P}_i^{TOT}$$

by Conservation of Momentum

6. Ex 12: See NEXT PAGE

6 Ex 12

$$\vec{F} \cdot \Delta t = \Delta(m\vec{v}) = m\vec{v}_f - m\vec{v}_i$$

$$\vec{F} = \frac{m(\vec{v}_f - \vec{v}_i)}{\Delta t} = \frac{(0.2 \text{ kg})[16 - (-8)] \text{ m/sec}}{0.04 \text{ sec}} = \frac{(0.2)(24)}{0.04} = 120 \frac{\text{kg} \cdot \text{m}}{\text{sec}^2}$$

$$\boxed{\vec{F} = 120 \text{ N}}$$

[Note - sign of v_i !]

6. Ex 20

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

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

(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 4. MiniVan has higher K.E. = $\frac{1}{2} m v^2$ by $\frac{m_{\text{MiniVan}}}{m_{\text{SP}}}$ factor = 2x.

7 Ex 3

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

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

$$P_i = m^+ v_i^+ + m^- v_i^- = +4 \cdot 6 - 1 \cdot 6 = +18 \text{ kg m/sec} \quad \left. \begin{array}{l} \\ \end{array} \right\} \vec{P}_i = \vec{P}_f$$

$$P_f = m^+ v_f^+ + m^- v_f^- = +2 \cdot 4 + 10 \cdot 1 = +14 \text{ kg m/sec}$$

YES: MOMENTUM IS CONSERVED

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

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

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

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7. Ex 6

$$P_i = 4(5) - 1 \cdot 0 = 20 \text{ kg} \cdot \text{m}/\text{sec} = P_f \text{ (by CONSERVATION of PTOT)}$$

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

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

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

$$\left. \begin{array}{l} (KE)_i = 50 \text{ J} \\ (KE)_f = 40 \text{ J} \end{array} \right\} \Rightarrow \boxed{10 \text{ J of KE were lost.}}$$