Ch. 6 Homework

Phy 1C
C

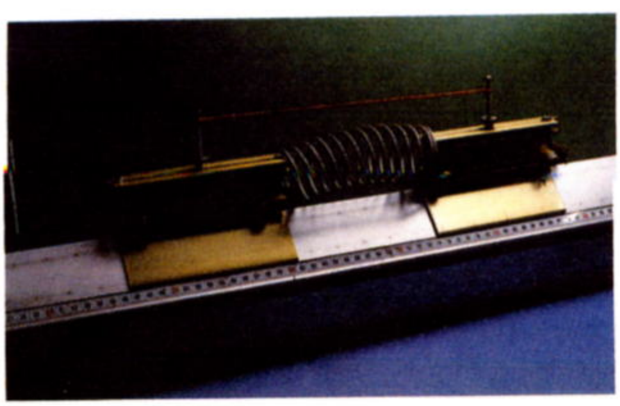
Qs 4–6, 9, 11, 15, 23
Ps 1, 3, 5–8, 10
Extra:
Add to P. 10
EP#1 Part b) What is the final speed of the two cars, if they collide & stick together?

EP #2

Two railway cars are moving. Car 1 has a mass of 10,000 kg and moves at 3 m/s. Car 2 is full of coal and has a mass of 30,000 kg. If the two collide, latch together, and move off at $v_f = 1.5$ m/s, what was car 2's initial speed?

EP #3

a) The figure shows two air-track gliders held together with a string. A spring is tightly compressed between the gliders and is released by burning the string. The mass of the glider on the left is twice that of the glider on the right, and they are initially at rest. What is the total momentum of both gliders after the release?



David Rogers

b) If the glider on the right in Question 33 has a speed of 2 meters per second after the release, how fast will the glider on the left be moving?

Questions

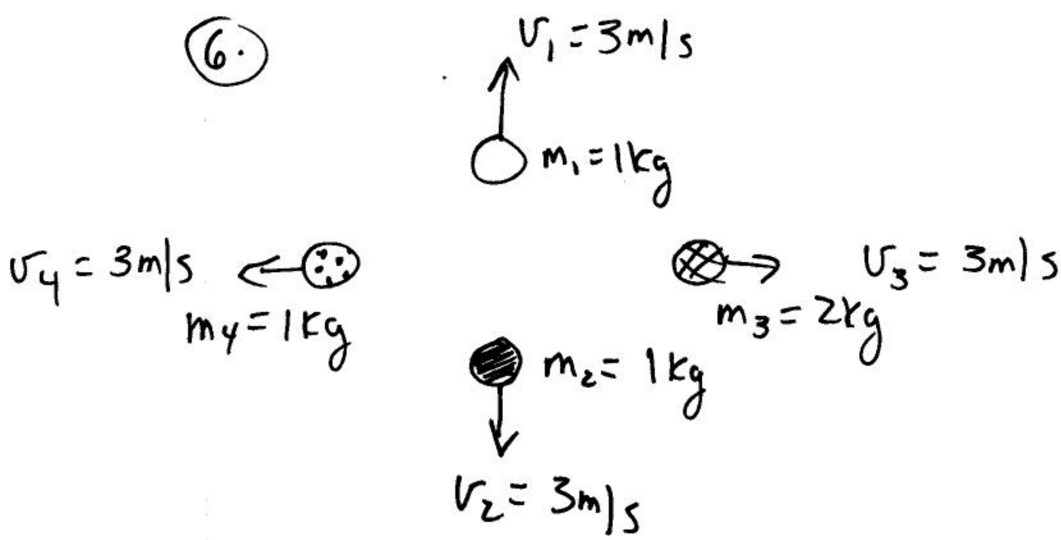
④

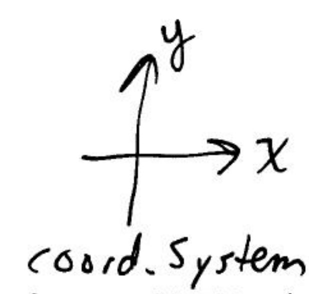
$P_{TOT} = m_1 v_1 + m_2 v_2 = 2kg(1m/s) - 1kg(2m/s) = \boxed{0}$

⑤

$P_{TOT} = m_1 v_1 + m_2 v_2 = 1kg(2m/s) - (1kg)(1m/s) = \boxed{1 \frac{kgm}{s} \text{ to left}}$

⑥





In y-dir, $P_{TOT}(y) = m_1 v_1 + m_2 v_2 = (1kg)(3m/s) - (1kg)(3m/s)$

$P_{TOT}(y) = 0$

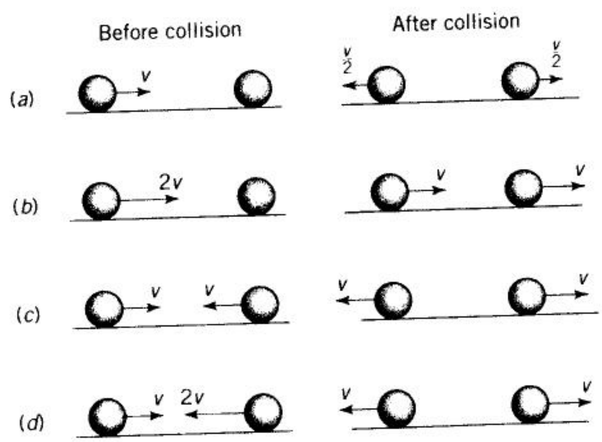
In x-dir, $P_{TOT}(x) = m_3 v_3 + m_4 v_4 = (2kg)(3m/s) - (1kg)(3m/s)$

$\boxed{P_{TOT}(x) = 3 \text{ kgm/s to left}} = P_{TOT}$ for system

Qs (cont)

(9.)

9. Which of the collisions in the figure are possible and which are impossible? The objects have identical masses. (*Hint:* Which collisions violate conservation of momentum?)



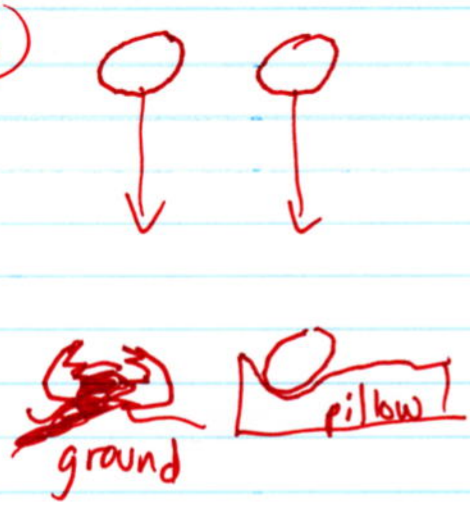
a) $P_{TOT}(\text{before}) = m_1 v_1$ to right
$P_{TOT}(\text{after}) = 0$
} Can **Not** Happen

b) $P(\text{before}) = 2mv$ to right
$P(\text{after}) = mv + mv = 2mv$ to right
} OK

c) $P(\text{before}) = mv - mv = 0$
$P(\text{after}) = -mv + mv = 0$
} OK

d) $P(\text{before}) = mv - 2mv = -mv$
$P(\text{after}) = -mv + mv = 0$
} Can **NOT** Happen

Qs (cont)

(11.) 

$\Delta(mv) = F\Delta t$

Both eggs drop same distance & have same mass, so the landing speed is same.

Also, the change in momentum for each egg is the same.

However, the egg which hits the pillow has a longer time to stop (due to the cushioning) & thus requires less force to stop & will not break.

(15.) The same idea as above. When dropping from a height, you want to take as much time to slow to a stop as possible. Bending your legs & rolling provide a longer stopping time, which means less force & thus less chance of broken bones.

(23.) Stopping cars decellerate quickly. Your body experiences the same impulse with or without the seat belt. The seat belt just gives you more time to slow down.

Ch. 6 HW

Problems

(1.) $p = mv$ $\quad p_{TOT} = \Sigma p$

a) $p = (200g)(300 m/s) = 60000$ gm/s

b) $p = 1000$ kg $(0.1 m/s) = 100$ kgm/s

c) $p = 70$ kg $(10 m/s) = 700$ kg m/s

d) $p = 10{,}000$ kg $(0.01 m/s) = 100$ kg m/s

(3.) $p_{TOT} = p_1 + p_2 + \ldots$

a) $p_{TOT} = m_1 v_1 + m_2 v_2 = 1kg(5m/s) - 1kg(5m/s) = 0$

b) $p_{TOT} = 2kg(7m/s) - 3kg(7m/s) = -7$ kgm/s (to left)
(7 m/s Right; 7 m/s left)

c) $p_{TOT} = (1000kg)(20m/s) + (1000kg)(40m/s) = 60{,}000 \frac{kgm}{s}$ to east

d) $p_{TOT} = (1000kg)(40m/s) - (1000kg)(30m/s) = 10{,}000 \frac{kgm}{s}$ to west
(40 m/s west; 30 m/s east)

(5.) A.

Impulse $= \Delta(mv) = F\Delta t$

a) $\Delta(mv) = 0.5kg\ (35m/s - 0) = 17.5$ kgm/s

b) $\Delta(mv) = 0.2kg(15m/s - 0) = 3$ kgm/s

c) $\Delta(mv) = 12{,}000$ kg $(4m/s - 0) = 48{,}000$ kgm/s

Probs (cont)

(5.) (cont)

B average force = ?

$$\text{Impulse} = \Delta(mv) = F\Delta t \rightarrow F = \frac{\Delta(mv)}{\Delta t}$$

a) $\frac{17.5 \text{ kgm/s}}{1 \text{sec}} = 17.5 N$

b) $\frac{3 \text{ kgm/s}}{0.1 \text{sec}} = 30 N$

c) $\frac{48{,}000 \text{ kgm/s}}{2 \text{sec}} = 24{,}000 N$

C.

Damage relates to total force & total area over which force is spread.

$$\frac{\text{Force}}{\text{Area}} = \text{Pressure}$$

(6.) a) Impulse = Δmv

Car

a) $\Delta(mv) = 1400 \text{kg}(90 \text{Km/hr})$

$= 126{,}000 \text{ kg km/hr}$

Ambulance

$\Delta(mv) = 3000 \text{Kg} (80 \text{Km/hr} - 0)$

$= 240{,}000 \text{ kg km/hr}$

b) $F_{vehicle} = \frac{\Delta mv}{\Delta t} = \frac{126{,}000 \text{ kg km/hr}}{0.8 \text{sec}}$

$= 157{,}500 N$

$F = \frac{240{,}000 \text{ kg km/hr}}{2 \text{sec}}$

$= 120{,}000 N$

c) $F_{veh} = F_{wall}$

(6.) (cont)

d.) $accel = \frac{F}{m}$

$a_{car} = \frac{157,500\ N}{1400\ kg}$

$= 112\ m/s^2$

$a_{amb} = \frac{120,000\ N}{3000\ kg}$

$= 40\ m/s^2$

(7.) Margie
$m = 45\ kg$
$v_A = 14\ ft/s$

Bill
$m = 65\ kg$
$v_B = ?$

$P_{TOT}(before) = 0 = P_{after}$

$P_{after} = (mv)_{Mar} + (mv)_{Bill} = 0$

$45\ kg(14\ ft/s) = 65\ kg\ v_B$

$9.7\ ft/s = v_B$

b) Either works, Cons. of Mom. is easier

(8.) Throw the oranges in the opposite direction & you will slow down due to conservation of momentum.

(10.) a) $P_{TOT} = m_1 v_1 + m_2 v_2$

$= 1000\ kg\ (50\ m/s)$ east $- 1000\ kg\ (25\ m/s)$ west

$P_{TOT} = 25,000\ kg\ m/s$ east

Ch. 6 HW

Probs. (cont)

(10.) speed of 2 cars if they collide & stick?

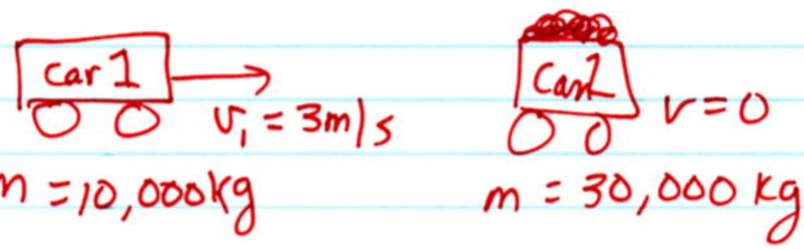
$P(\text{before}) = 25{,}000\ \text{kg m/s}$ to east [from part A]

$P_{bef} = P_{aft} = 25{,}000\ \text{kg m/s} = (m_1 + m_2) v_f$

$$\frac{25{,}000\ \text{kg m/s}}{2000\ \text{kg}} = v_f$$

$$\boxed{12.5\ \text{m/s} = v_f}$$

Extra Prob #2



$P_{before} = m_1 v_1 = 10{,}000\ \text{kg}\ (3\text{m/s}) = 30{,}000\ \text{kg m/s}$

$P_{after} = P_{before} = 30{,}000\ \text{kg m/s} = (m_1 + m_2) v_f$

$$\frac{30{,}000\ \text{kg m/s}}{40{,}000\ \text{kg}} = v_f$$

$$\boxed{0.75\ \text{m/s} = v_f}$$

Ch. 6 HW

Ex Prob #3

a)

$P_{TOT}(\text{before}) = 0$

$m_2 = \frac{1}{2} m_1$ $\quad P_{TOT}(\text{after}) = 0$

b) If m_2 has speed $v_2 = 2\,m/s$ what is $v_1 = ?$

$$P_{TOT} = 0 = m_1 v_1 + m_2 v_2$$

$$\therefore \quad m_1 v_1 = -m_2 v_2$$

$$m_1 v_1 = -\left(\tfrac{1}{2} m_1\right)(2\,m/s)$$

$$v_1 = -\frac{(\frac{1}{2} m_1)(2\,m/s)}{m_1}$$

$$\boxed{v_1 = -1\,m/s}$$