AP Physics Chapter 9 Conceptual Questions (4, 5, 8-10, 13-15)

(4) Equal. - same F & t so... same $\Delta \vec{p}$

(5) Less than. Same force, but less accel. for lead cart over 1m so more time force acts on lead cart ~ greater impulse leads to $> \Delta \vec{p}$.

(8) Crumple zone allows for > time of $\Delta \vec{v}$ & therefore less force ($\vec{F} \cdot t = m \Delta \vec{v}$)

(9) $F \cdot t = \Delta p$

$F t = p_f - p_i$

$4 = p_f - 2$

$6 = p_f$

$6 = (2\,kg)(3\,m/s)$

$+3\,m/s$

(10) $F \cdot t = p_f - p_i$

$-4 = p_f - 2$

$-2 = p_f$

$v_f = -1\,m/s$

(13) No. $\vec{p}_i \neq 0$ so

a) $\vec{p}_f \neq 0$

billiard balls

b) yes. if $\vec{p}_i$ transferred completely to another object

billiard balls again...

(14) Same $\vec{p}$. Both zero before

a) push - for this to be maintained they must have equal & oppositely directed momenta.

b) Paula has more speed since momenta equal & she has less mass

(15) ~~$p_x = -3\,kg \cdot m/s$~~ ~~p_y~~ oops

$p_{1x} = -2$ $\quad p_{1y} = +2$

$p_{2x} = +3$ $\quad p_{2y} = 0$

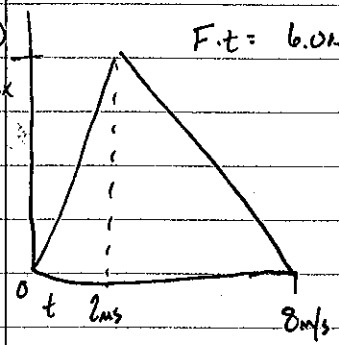
$p_{ix} = +1$ $\quad p_{iy} = +2$

$p_{3x} = -1\,kg \cdot m/s$ $\quad p_{3y} = -2\,kg \cdot m/s$

(to make $\vec{p}_i = \vec{p}_f = 0$)

AP Physics Chapter 9 Exercises & Problems (5, 12, 13, 16, 19, 22)

(5)



$\frac{1}{2}(F_{max})(2E^{-3}) + \frac{1}{2}(F_{max})(6E^{-3}) = 6$

$F_{max}(8E^{-3}) = 12$

$F_{max} = 1500N$

(12) Impulse $= (500N)(8E^{-3}s)$

$\Delta\vec{p} = 4N\cdot s$

$p_f - p_i = 4N\cdot s$

$(.250kg)(v_f) - (.250kg)(-10) = 4$

$v_f = 6m/s$

(13) $\Delta\vec{p} = F\cdot t$

$(.600)(3) - (.600)(-3) = F\cdot t$

$+3.6\ N\cdot s = F\cdot t$

Area of the triangle is

$\frac{1}{2}$(base)(height)

$3.6 = \frac{1}{2}(\Delta t)(36N)$

$\Delta t = 0.2$ sec

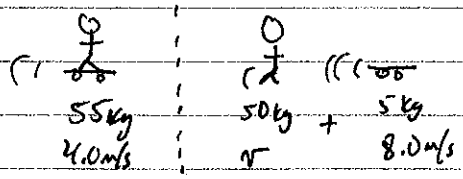
(16) 30m/s horizontal

both glider & skydiver maintain horizontal velocity of 30m/s. Same total momentum but now in two widely separated objects.

(19) $(1500kg)(2.0m/s) = (10kg)(v)$

$300m/s$

(22)



$(55)(4) = (50)(v) + 5(8)$

$v = 3.6m/s$

AP Physics Chapter 9 E&P (23, 24, 27c, 30, 32)

$\vec{p}_i = p_f$

(23) x: $+2 + -4 = 0 + p_{fx}$

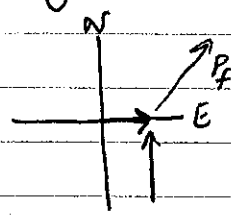
y: $+2 + +1 = -1 + p_{fy}$

$p_{fx} = -2$ $\quad p_{fy} = 4$

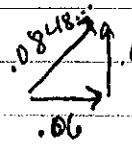
$(\vec{p}_f)_1 = -2\ \text{kg·m/s}\,\hat{i} + 4\ \text{kg·m/s}\,\hat{j}$

(24) 20g · 3 m/s east

30g · 2.0 m/s North



Same momentum



1.7 m/s 45° N of E

(27) $F_x = 10N \sin\left(\frac{2\pi}{4.0s} t\right)$

$m = 0.250\text{kg}$

$0 \le t \le 2.0s$

$J = \int_0^2 10N \sin\left(\frac{2\pi}{4.0s} t\right) dt$

use integral table in Appendix (A-3)

$J = 10N \int_0^2 \sin\left(\frac{\pi}{2} t\right) dt$

$\left[\int \sin(ax)\,dx = \frac{-1}{a}\cos(ax)\right]$

$J = 10 \cdot \left[-\frac{2}{\pi}\cos\left(\frac{\pi}{2}t\right)\Big|_0^2\right]$

$J = 10 \cdot \left[\frac{2}{\pi} - \frac{-2}{\pi}\right]$

$J = 10 \cdot \left[\frac{4}{\pi}\right] = 12.7324\ \text{N·s}$

on $m = 0.250\text{kg}$ $\quad J = \Delta\vec{p}$ $\quad p_i = 0$ $\quad v_i = 0$

yields $\Delta\vec{v} = v_f = 51\text{m/s}$

I believe Answer in book is incorrect - you can check me though!

(32) $v_{top} = 0$ $\quad \vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{x}$

$v_{bottom\ strike} = -5.94\ \text{m/s}$

$\Delta\vec{y} = -1.8\text{m}$

$\vec{a} = -9.80\text{m/s}^2$

$\vec{p}_i = (.040\text{kg})(-5.94\ \text{m/s}) = -.2376\ \text{kg·m/s}$

$v_{top} = 0$ $\quad \vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{x}$

$v_{rebound} =$ $\quad 0 = v_i = 2(-9.80)(1.2)$

$\Delta\vec{y} = 1.8 \times \frac{2}{3} = 1.2\text{m}$ $\quad v_{rebound} = +4.85\ \text{m/s}$

$a = -9.80\text{m/s}^2$

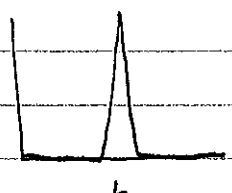
$\vec{p}_f = (.040\text{kg})(4.85) = +0.1940\ \text{kg·m/s}$

$\Delta\vec{p} = \vec{p}_f - \vec{p}_i = +0.4316\ \text{kg·m/s}$

$J = F \cdot t = \Delta\vec{p}$

a) ~~J=T~~ $J = 0.43\ \text{kg·m/s}$ up

b)



c) A few milliseconds

5ms?

(32) at $t = 0$, $v_i = 0$

$p_x = 6t^2$ kg·m/s

$F_x(t) = ?$

$$F = \frac{d\vec{p}}{dt}$$

$$F(t) = \frac{d}{dt} 6t^2$$

$$F_x(t) = 12t \text{ N}$$

AP Physics Chapter 9 Ex (43, 44 RF, 58, 59)

(43) Two problems - tackle proj. motion first.

H	V
$x = 30m$	$y = -200m$
$a = 0$	$a = -9.80 m/s^2$
$v = ?$	$v_i = 0$
	$t =$

$\Delta y = v_i t + \frac{1}{2} a t^2$

$t = 6.3887...$ sec

→ $4.69574\,2753$ m/s

so box/rocket must be moving at this speed when leaving cliff to reach explorer

Cons. of $\vec{p}$ problem:

$1kg(v_R) + 5kg(0) = 6kg(4.6957...m/s)$

$v_R = 28$ m/s

(44) Reference Frames

(20g) → 12m/s ; (40g) 0m/s ; (60g) $v = 4$m/s

a) $\vec{p}_{total} = (.020kg)(12m/s) + 0 = 0.24$ N·s in S

b) ~~$.24 = (.040 kg)$~~ if p_{total} in S' is zero then each object, in this frame, has equal & opposite momenta

$.02(12 - v_S') = .04(v_S')$

$.24 - .02 v_S' = .04 v_S'$

$.24 = .06 v_S'$

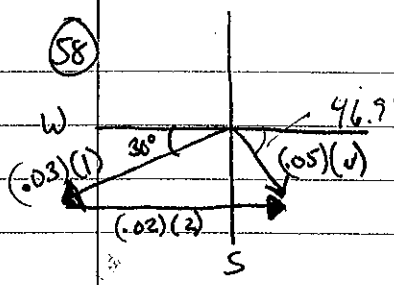
$v_S' = 4$m/s left

$\vec{V} = -4$m/s

c) 0

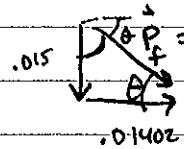
d) makes sense in S, after collision velocity is +4m/s so in S' it would be 0m/s & therefore $\vec{V} = -4$m/s to make this so.

(58)



$m_{Total} = 0.050 kg$

$\tan^{-1}\left(\frac{.015}{.01402}\right) = \theta$



$P_f = .020531157$

46.9° S of E

P_x: $-(.03)(1)\cos 30° + (.02)(2) = 0.01402$ kg·m/s East

P_y: $-(.03)(1)\sin 30° = -0.015$, 0.015 kg·m/s South

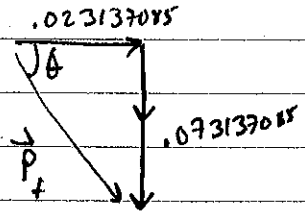
$P_f = 0.020531157 = (.05)(v)$

$v = 0.41 m/s$ 47° S of E

(59)

P_x: $+(.04)(4\cos 45°) + -(.03)(3) = +0.023137085$

P_y: $(.02)(2) + -(.04)(4\sin 45°) = -.073137085$



$P_f = .07671 = (.09)(v)$

$v = 0.85 m/s$ @ 72° below +x

$\tan^{-1}\left(\frac{.07...}{.023...}\right) = \theta = 72.4°$