Homework - chapter 36 [7, 17, 19, 29, 37, 43, 55, 65]

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classical Physics - 2 (220)

OL02 - Professor V.

Q7] $l = l_0 \sqrt{1 - v^2/c^2} \rightarrow$

$V = c\sqrt{1 - \left(\frac{l}{l_0}\right)^2}$; $t = \frac{l}{v} = \frac{l}{c\sqrt{1 - \left(\frac{l}{l_0}\right)^2}}$

$= \frac{25ly}{c\sqrt{1 - \left(\frac{25ly}{65ly}\right)^2}} = \frac{(25y)c}{c(0.923)} = \boxed{27y}$

Q17] $l\,base = l\sqrt{1 - v^2/c^2} = l\sqrt{1 - (0.95)^2} = \boxed{0.31 l}$

$\theta = \cos^{-1}\frac{0.50 l}{2.0 l} = 75.52°$ - rest of the angle

The vertical component of $l\,vert = 2l\sin\theta =$
$2l\sin 75.52° = 1.936 l$ is unchanged.

$l\,horizontal = 0.50 l\sqrt{1 - v^2/c^2} = 0.50 l\sqrt{1 - (0.95)^2}$
$= 0.156 l$

Using pythagorean theorem,

$l\,log = \sqrt{l^2_{hori} + l^2_{vert}} = \sqrt{(0.156 l)^2 + (1.936 l)^2}$
$= 1.942 l = \boxed{1.94 l}$

Q19] $u_x = \frac{(u'_x + v)}{\left(1 + \frac{vu'_x}{c^2}\right)} = \frac{(0.90c - 0.60c)}{[1 + (0.60)(0.90)]} = \boxed{0.65c}$

$$u_x = \frac{(u'_x + v)}{\left(1 + \frac{v u'_x}{c^2}\right)} \longrightarrow v = \frac{u_x - u'_x}{\left(1 - \frac{u'_x u_x}{c^2}\right)}$$

$$= \frac{(-.60c) - (-0.90c)}{\left(1 - \frac{(0.90c)(-0.60c)}{c^2}\right)} = \boxed{0.65c}$$

29] a] $l_x = l_0 \cos\theta$; $l_y = l_0 \sin\theta = l'_y - l'_x = l_x\sqrt{1-v^2/c^2}$
$= l_0 \cos\theta \sqrt{1-v^2/c^2}$

$$l = \sqrt{l_x'^2 + l_y'^2} = \sqrt{l_0^2 \cos^2\theta (1 - v^2/c^2) + l_0^2 \sin^2\theta}$$
$$= \boxed{l_0\sqrt{1-(v\cos\theta/c)^2}}$$

b] $\theta' = \tan^{-1} \frac{l'_y}{l'_x} = \tan^{-1}\left(\frac{l_0 \sin\theta}{l_0\cos\theta\sqrt{1-v^2/c^2}}\right)$

$$= \tan^{-1}\left(\frac{\tan\theta}{\sqrt{1-v^2/c^2}}\right) = \boxed{\tan^{-1}(\gamma \tan\theta)}$$

37] $P_1 = P_2 \rightarrow \frac{m_1 v_1}{\sqrt{1 - v_1^2/c^2}} = \frac{m_2 v_2}{\sqrt{1 - v_2^2/c^2}} \rightarrow$

$$\frac{v^2}{(1 - v_1^2/c^2)} = \left(\frac{m_2}{m_1}\right)^2 \frac{v_2^2}{(1 - v_2^2/c^2)} = \left(\frac{6.68 \times 10^{-27}\,kg}{1.67\times 10^{-27}\,kg}\right)$$

$$\left[\frac{(0.60c)^2}{1-(0.60)^2}\right] = 9.0c^2 \rightarrow v_1 = \sqrt{0.90}\,c = \boxed{0.95c}$$

43] Each photon has momentum 0.50 meV/c
So mass of photon 0.50 meV. total momentum is 0, so product mass will not be moving.
So the heavily particle would have a mass of $\boxed{1.00\,meV/c^2}$, which is 1.78×10^{-30} kg.

55] a] $K = \frac{1}{2}K = \frac{1}{2}(K + mc^2) \rightarrow K = mc^2$

$K = (\gamma - 1)mc^2 = mc^2 \rightarrow \gamma = 2 = \frac{1}{\sqrt{1 - v^2/c^2}} \rightarrow$

$v = \sqrt{\frac{3}{4}}\,c = \boxed{0.866c}$

b] $K = (\gamma - 1)mc^2 = \frac{1}{2}mc^2 \rightarrow \gamma = 3/2 = \frac{1}{\sqrt{1 - v^2/c^2}}$

$v = \sqrt{\frac{5}{9}}\,c = \boxed{0.745c}$

65] $f = f_0\sqrt{\frac{c+v}{c-v}} = f_0\sqrt{\frac{1+v/c}{1-v/c}} = (95.0\,MHz)\sqrt{\frac{1+0.70}{1-0.70}}$

$= 226\,MHz = \boxed{230\,MHz}$