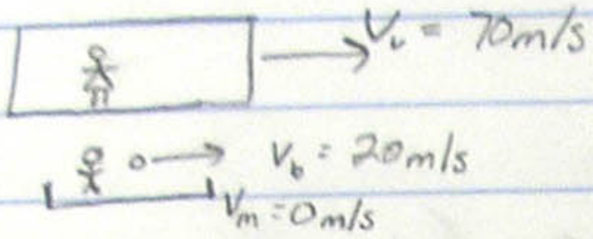
Ch 10 C: 6, 11, 17, 22
P: 4, 6, 8

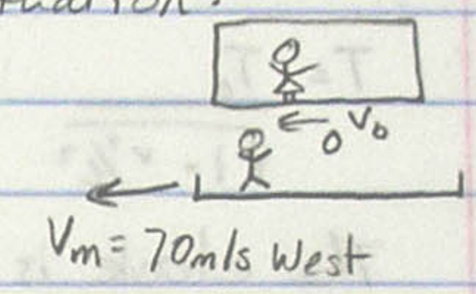
Physics 107
Homework 5

10/18/06

Ch10 C6.



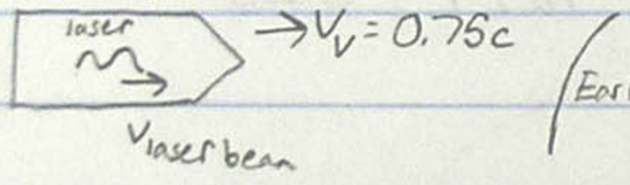
These speeds are slow compared to the speed of light so we can use Galilean relativity to determine the speed and direction of the ball relative to Velma. From Velma's point of view, Mort is traveling westward at 70m/s, and she is standing still. → How Velma sees situation:



V_b = 70m/s West + 20m/s East
= 70m/s − 20m/s
V_b = 50m/s West from Velma's point of view.

C11. Vibrations on the plane are different on the ground and in the air. What you see out the window would be different. Many other possibilities. Each of these requires some direct or indirect contact with the outside world

C17.



A laser emits an electromagnetic wave. Electromagnetic waves travel at the speed of light. Velma sees the beam move away from her at the speed of light, c. The Earth-based observer sees it approach at the speed of light also.

C22. A person cannot travel to the center of the galaxy in less than 26,000 yrs as measured on Earth, but could in less years of his or her own time. As seen from the Earth, nothing can travel faster than the speed of light, so it would be impossible for the person to travel that distance faster than light can. As seen from the people traveling, if they approach the speed of light, the rate of progression of time slows due to time dilation so they would see less time pass during the trip.

P4 $v_v = 150000 km/s = 1.5 \times 10^8 m/s$

$c = 3 \times 10^8 m/s$

fraction of light speed: $\frac{v_v}{c} = \frac{1.5 \times 10^8 m/s}{3 \times 10^8 m/s} = \frac{1}{2}$

Velma is traveling at 0.5c.

$T = \frac{T_0}{\sqrt{1 - v^2/c^2}} = \frac{T_0}{\sqrt{1 - (\frac{0.5c}{c})^2}} = \frac{T_0}{\sqrt{1 - 0.25}} = \frac{T_0}{\sqrt{.75}} = 1.15\, T_0 = T$

The clock is at rest with respect to Mort, so he measures the proper time, T_0. $\Rightarrow T_0 = 1 second$

$T = 1.15 \cdot T_0 = 1.15(1s) = \underline{1.15s}$ for Velma

P6. $T = \left(\frac{1}{\sqrt{1 - v^2/c^2}}\right) T_0$

$1 = \frac{1}{\sqrt{1 - (v/c)^2}} \frac{T_0}{T}$

$\frac{T_0}{T} = \sqrt{1 - \left(\frac{v}{c}\right)^2} = 0.25$

$1 - (v/c)^2 = (0.25)^2$

$(v/c)^2 = (1 - 0.25^2)$

$v/c = \sqrt{1 - 0.0625} = 0.938$

$v = \underline{0.938\, c} = \underline{2.81 \times 10^8 m/s}$ relative to mort

The clock is at rest with respect to Velma + she measures proper time

Mort sees $T_0/T = 0.25$

P8. $P = 1000 MW = 1000 \times 10^6 W = 1 \times 10^9 W = 1 \times 10^9 J/s$

$= \frac{E}{t}$

$t = 1 day = 24 \cancel{hrs} \cdot \left(\frac{60 \cancel{min}}{1 \cancel{hr}}\right)\left(\frac{60 sec}{1 \cancel{min}}\right) = 8.64 \times 10^4 s$

$E = P \cdot t = (1 \times 10^9 J/\cancel{s})(8.64 \times 10^4 \cancel{s}) = \underline{8.64 \times 10^{13} J} = 86.4$ TerraJoules

$E = mc^2$ $\quad m = E/c^2 = (8.64 \times 10^{13} J)/(3 \times 10^8 m/s)^2$

$= 9.6 \times 10^{-4} kg = \underline{0.96 g}$