1. $L = \dfrac{L_0}{\gamma}$: So $\gamma = \dfrac{20\text{m}}{10\text{m}}$ $\underline{\gamma = 2}$.

$\gamma = \left(1 - \dfrac{u^2}{c^2}\right)^{-1/2} \rightarrow 1 - \dfrac{u^2}{c^2} = \dfrac{1}{4} \rightarrow \dfrac{u}{c} = \dfrac{\sqrt{3}}{2}$ $\underline{u = 2.6 \times 10^8\ \text{ms}^{-1}}$.

2. Length of changing room in Paul's frame (*P*) $L' = \dfrac{L}{\gamma} = \dfrac{10\text{m}}{2} \rightarrow \underline{5\text{m}}$.

3. Space-time coord. in frame (*S*)
F: $x_F = L(10\text{m})$, $t_F = L/u$ (38.5 ns)
B: $x_B = 0$, $t_B = L/u$ (38.5 ns)

4. Lorentz Transformations for space-time coordinates, x', t' in (*P*):

$x'_F = \gamma\left(x_F - ut_F\right) = \gamma(L - uL/u) = 0$ as expected

$x'_B = \gamma\left(x_B - ut_B\right) = \gamma(0 - uL/u) = -\gamma L$ as expected

$t'_F = \gamma(t_F - ux_F/c^2) = \gamma(L/u - uL/c^2) = \dfrac{\gamma L}{u}(1 - u^2/c^2) = \dfrac{L}{\gamma u}$

$t'_B = \gamma(t_B - ux_B/c^2) = \gamma(L/u - 0) = \dfrac{\gamma L}{u}$

5. Using $\gamma = 2$ in expressions for t'_F and $t'_B \rightarrow t'_B = 4t'_F$

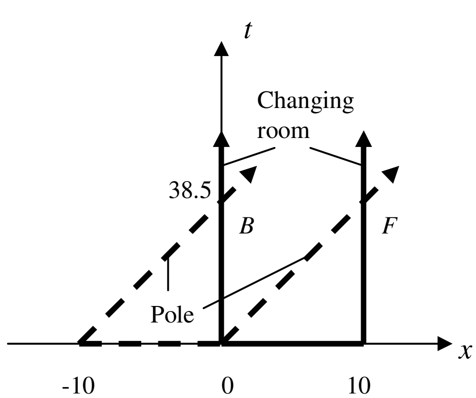
$t_F = \dfrac{L}{u} = \dfrac{10\text{m}}{2.6 \times 10^8\ \text{ms}^{-1}} = 38.5\ \text{ns}$

$t_B = \dfrac{L}{u} = 38.5\ \text{ns}$

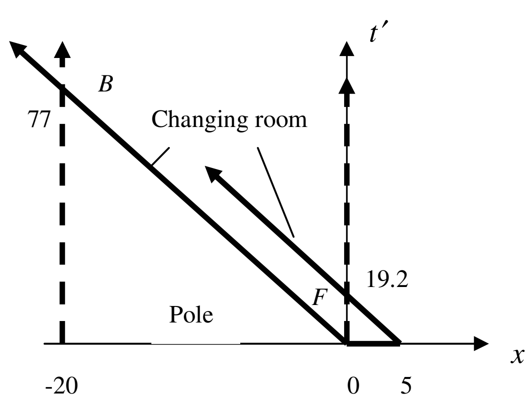
$t'_F = \dfrac{L}{\gamma u} = \dfrac{38.5\text{ns}}{2} = 19.2\ \text{ns}$

$t'_B = \dfrac{\gamma L}{u} = 2 \times 38.5\ \text{ns} = 77.0\ \text{ns}$

6. So according to Paul, the *F*ront (*exit*) door OPENS long before the *B*ack (*entrance*) door CLOSES.
His chances are GOOD. He passes through the changing rooms unscathed.



Sports ground frame (*S*)



Paul's frame (*P*)