1 (a) $10m\sqrt{1-(0.8)^2} = 10m\sqrt{1-0.64} = 10m\sqrt{.36}$

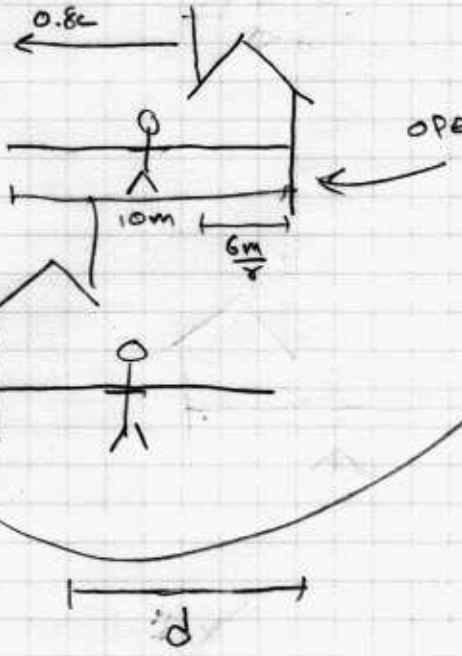
$= \boxed{6m}$ FITS

(b) OPEN & CLOSING CAN'T BE SIMULTANEOUS ... OPENING MUST HAPPEN FIRST

(c) SIMULTANEITY:

$$\Delta t = \frac{\Delta x' \frac{v}{c^2}}{\sqrt{1 - v^2/c^2}}$$ TIME DELAY

HOW MUCH TIME IS NEEDED?



$10m \equiv \ell$

$6m \equiv \Delta x'$

CLOSE HERE

DISTANCE TRAVELLED

$$d = 10m - 6m(1 - v^2/c^2)^{1/2}$$

TIME = $\frac{d}{v}$ TO GO d

$$= \frac{\ell - \Delta x'\sqrt{1 - v^2/c^2}}{0.8c}$$

NOTE: $\ell\sqrt{1 - v^2/c^2} = \Delta x'$!

$$= \frac{\Delta x' - \Delta x'(1 - v^2/c^2)}{\sqrt{1 - v^2/c^2}\, v}$$

ANOTHER WAY:

$(6m)^2 = (10m)^2 - (\Delta t)^2$

↑ EVENT DIST IN GARAGE FRAME ($\Delta t_{GARAGE} = 0$)

INTERVAL IN POLE FRAME

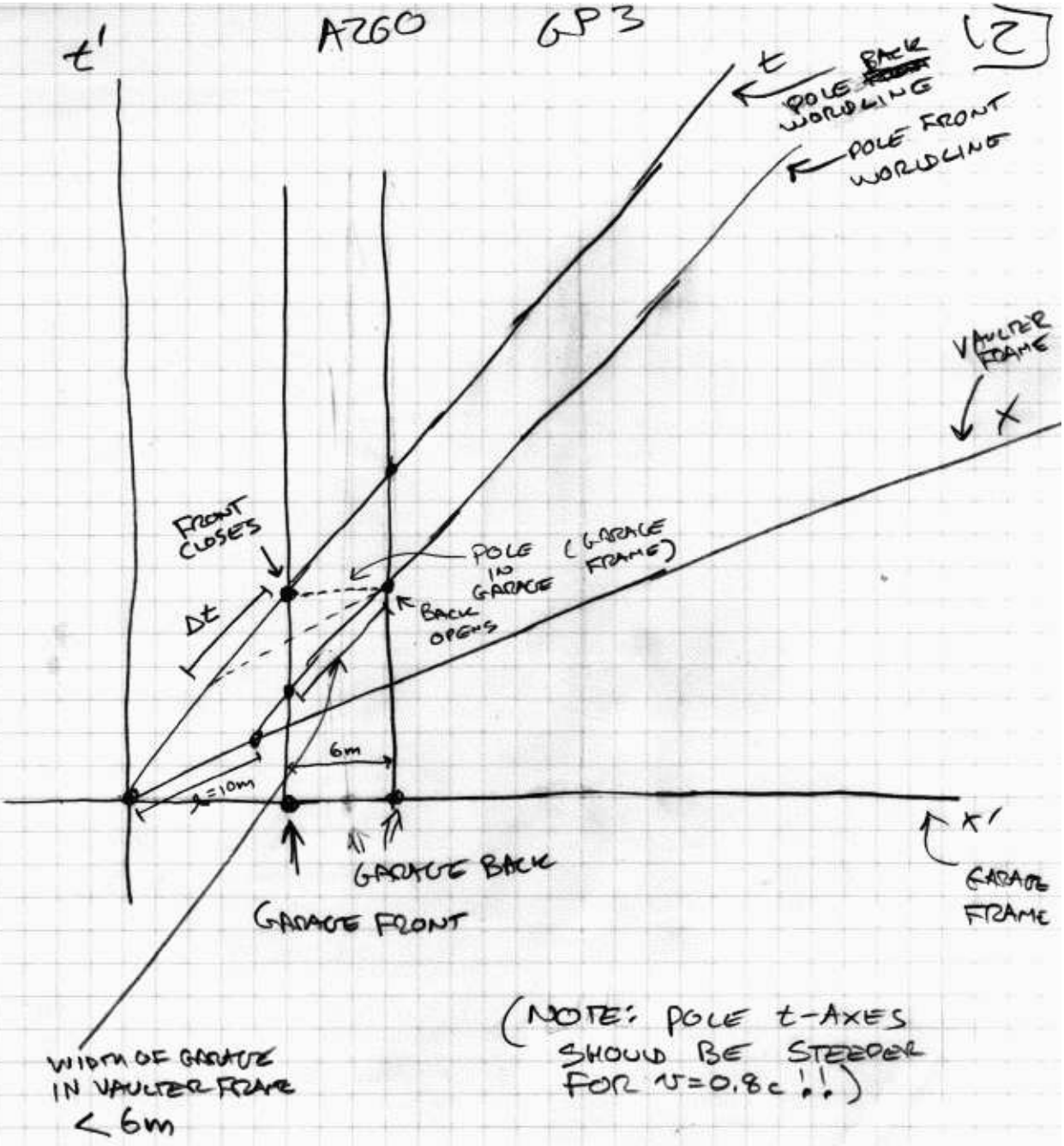
HEY, IT WORKS!

$(\Delta t)^2 = (10m)^2 - (6m)^2$

$\Delta t = (8m)$ OF TIME $= 2.7 \times 10^{-8}$ s

$$\text{TIME} = \frac{\Delta x' v/c^2}{\sqrt{1 - v^2/c^2}} = \frac{(6m)(0.8)}{0.6} = 8m \text{ (OF TIME)}$$

(1) (d) [12]



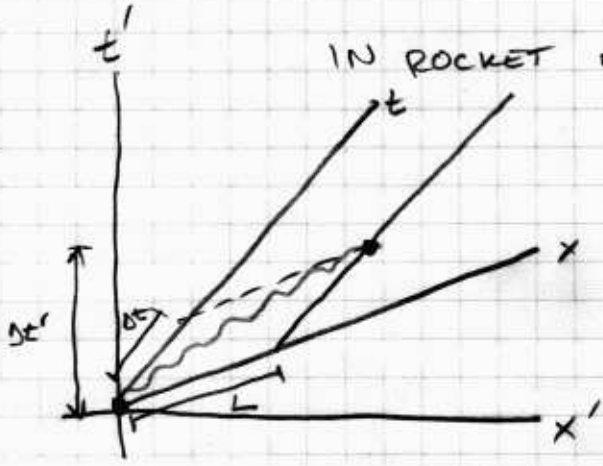
(NOTE: POLE t-AXES SHOULD BE STEEPER FOR $v=0.8c$!!)

(2) (a) IN EARTH FRAME, $L' = L\sqrt{1-0.8^2} = 0.6L$

BUT PHOTON HAS TO CATCH UP! $c\Delta t' = L' + v\Delta t' = L' + 0.8c\Delta t'$

$c(0.2)\Delta t' = 0.6L$

$$\boxed{\Delta t' = \frac{3L}{c}}$$



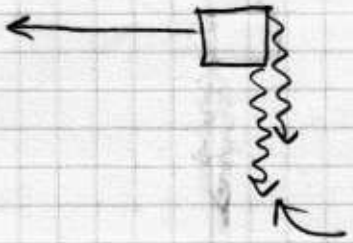
IN ROCKET FRAME $L = L$ (WHEE!)

$c\Delta t = L \Rightarrow \boxed{\Delta t = \frac{L}{c}}$

(SO HOW DO YOU RECONCILE THIS WITH TIME DILATION?)

(ANS: SIMULTANEITY)

TOP VIEW:



CONSIDER TWO PHOTONS LEAVING THE BACK CORNERS

THIS ONE WILL REACH THE FILM FIRST

THE ONE REACHING FROM THE BACK WILL ARRIVE @ FILM AS A LATER PHOTON FROM THE FRONT ARRIVES:

CAMERA

TO

THIS LOOKS (FOR THE TRAILING SIDE) LIKE A ROTATION

$\frac{d}{h} = \sin\theta$

$\frac{vt}{ct} = \sin\theta$

$\boxed{\frac{v}{c} = \sin\theta}$

SO YOU SEE:

$h = ct$ ← TIME FOR PHOTON TO CATCH UP

$d = vt$ = DIST FRONT HAS MOVED IN THAT TIME

NOTE: FOR LORENTZ CONTRACTION, YOU MEASURE A SHORTER LENGTH.

HERE, IT LOOKS LIKE A ROTATION. THIS COMBINES TRANSFORMATION EFFECTS AND LIGHT PROPOGATION TIME EFFECTS

WHAT ABOUT THE SIDE FACING YOU? LORENTZ CONTRACTED. WHAT ANGLE WOULD YOU NEED TO GET THE SAME LENGTH FROM STATIONARY FORESHORTENING?

$\cos\theta = \sqrt{1-v^2/c^2} \Rightarrow \cos^2\theta = 1 - v^2/c^2$

$\sin^2\theta = v^2/c^2$

$\boxed{\sin\theta = v/c}$

WHERE θ...