

NAME: _____	Quiz #7b: Phys270
	Section 101

2. [10 pts] A cow is running at a relativistic velocity towards a shed. The shed has two doors opposite one another. The cow is 2m long as measured in the cow's rest frame and the shed is 1m long as measured in the shed's rest frame. A farmer in the shed's reference frame observes the cow fit into the shed, and closes the two paper thin doors and traps the cow momentarily before the cow plows through the backdoor.

a. [3 pts] At what minimum speed is the cow running [leave your answer in terms of the speed of light c]?

We need, $\sqrt{1 - v^2/c^2} \cdot 2\text{m} \leq 1\text{m}$ (length contraction)

$\rightarrow 1 - v^2/c^2 \leq 1/4 \Rightarrow v \geq \frac{\sqrt{3}}{2} c = v_{\min}$

b. [4 pts] From the cow's perspective, how long is the barn (that is, the spacing between the doors) based on your answer to part a?

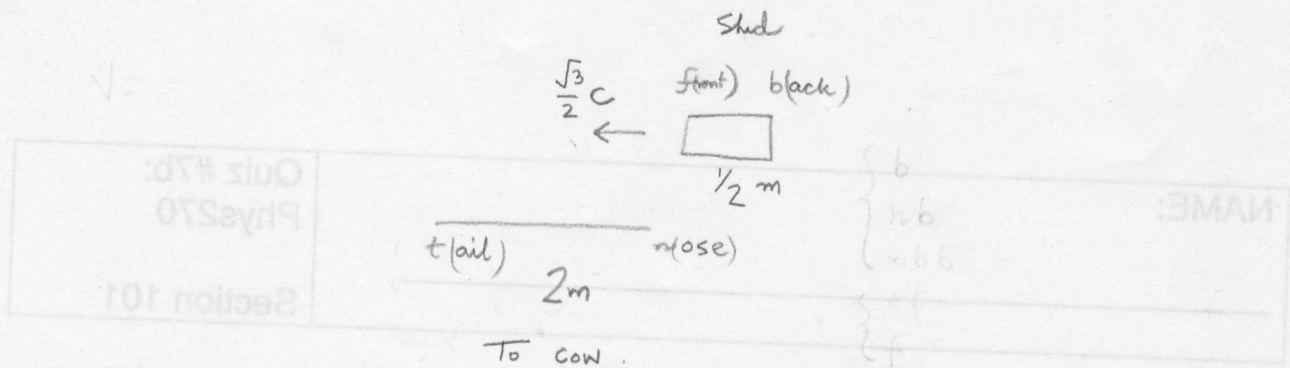
$\sqrt{1 - v^2/c^2} \cdot 1\text{m} \stackrel{v=v_{\min}}{=} \sqrt{1 - \frac{3}{4}} \text{m} = \frac{1}{2} \text{m}$

c. [3 pts] Order the following events in the cow's reference frame (and state which events occur at the same time):

If $v = v_{\min}$

- 1 event a: Cow breaches the back door
- 1 event b: Cow's nose reaches back door
- 2 event c: Cow's tail reaches front door
- 3 event d: Cow's tail reaches back door
- 1 event e: Farmer closes back door
- 2 event f: Farmer closes front door

explanation on back.



It's just like the railroad car problem where the car this time is moving to the left. To the car (or the shed) the closing of front and back doors are simultaneous (like two explosions happening at the edges of the car). By the same token as in the case of the car with explosion the cow will decide the explosion on the right (or closing of back door here) occurred first. [Look at the supplemental soln of conceptual questions 3,4. The only difference is that the car is now moving to the left].

Moreover to shed (farmer) the nose of the cow reaching the back door happened at the same place and same time as closing the back door (and effectively, breaching it too). Hence they are like same events in special relativity (As events are 'characterised' by the posn and time at which they occur place and no further distinction is made) meaning that they will seem to happen at the same place same time to any observer. Hence events e, b, a seem to happen at the same time also to the cow. Same for events c & f.