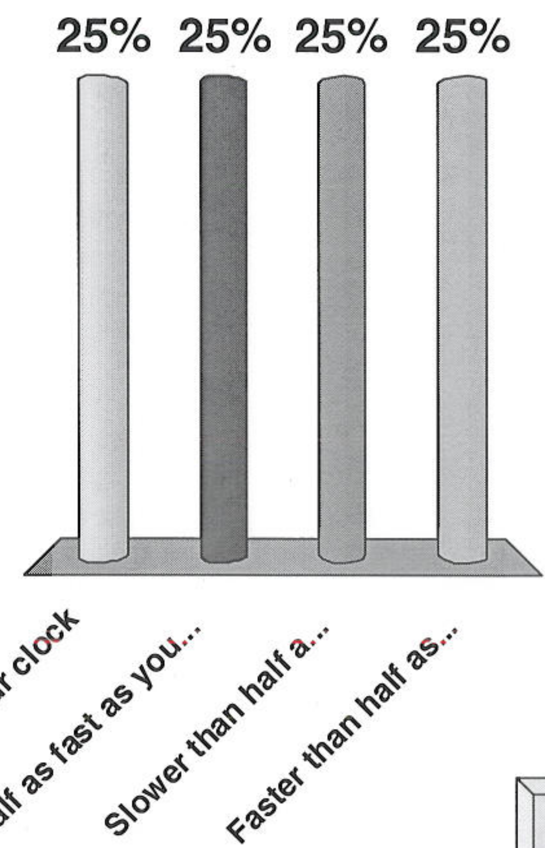
If you see a clock running traveling through space at 0.5c, then you will observe the clock running

1. As fast as your clock
2. Half as fast as your clock
3. Slower than half as fast as your clock
4. Faster than half as fast as your clock



Need to Do Quick Calc

$\Delta t = \gamma \Delta \tau$

$\Delta \tau = \sqrt{1-\beta^2}\,\Delta t = \sqrt{1-0.25}\,\Delta t = \sqrt{0.75}\,\Delta t \approx 0.85\,\Delta t$

0 of 250

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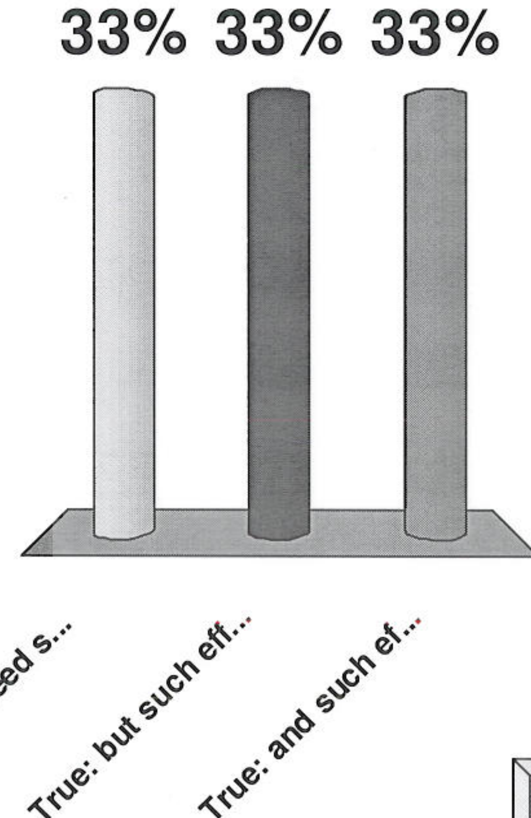
Time dilation and length contraction effects occur even at speeds small compared to the speed of light (0.00001c). This statement is:

1. False: we need speeds reasonably close to the speed of light (~0.1c or greater)
2. True: but such effects are never measurable unless speeds are close to the speed of light
3. True: and such effects are definitely measurable.



GPS Satellites ~7000 mi/h

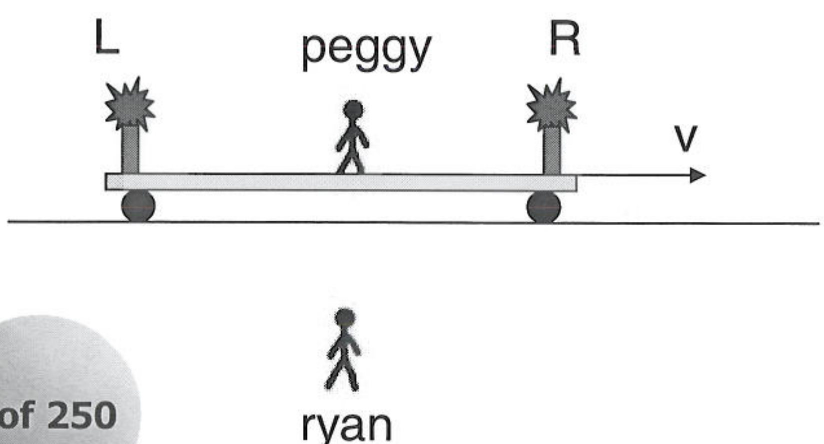
~ special relativity correction is about 7 μsec/day

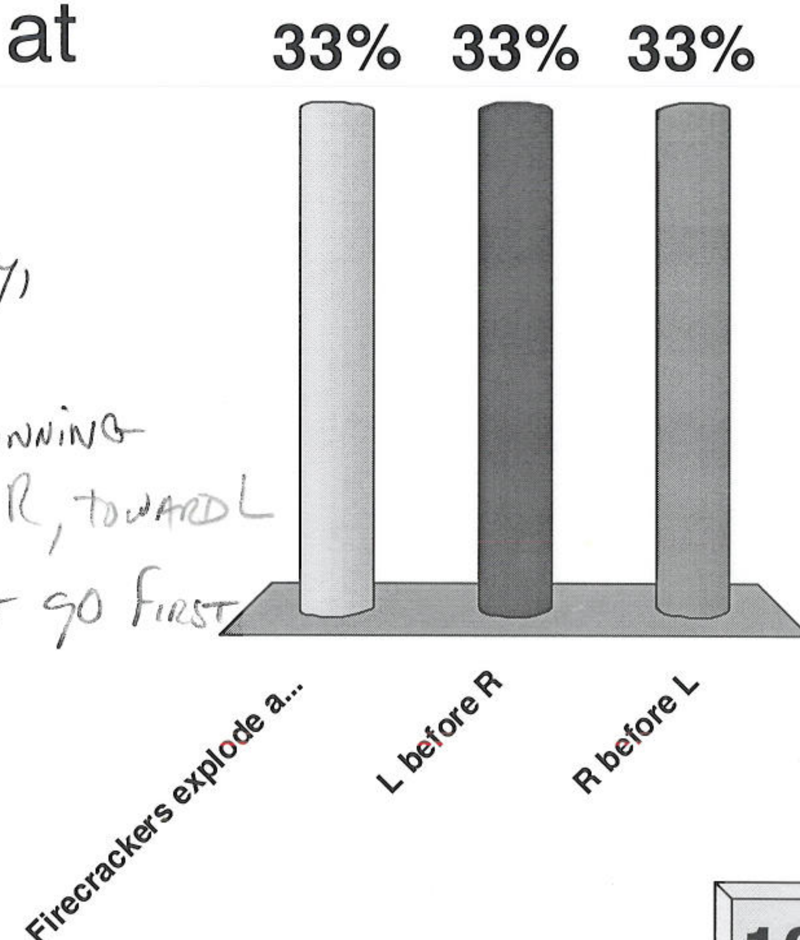
⇒ ~2000 km/day

In the scene below, Ryan sees the two firecrackers explode at the same time. What does Peggy see in her frame?

1. Firecrackers explode at the same time
2. L before R
3. R before L

in her frame, Peggy sees Ryan running from R, toward L. R must go first





0 of 250

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In the scene below, Peggy sees the two firecrackers explode at the same time. What does Ryan see in ~~her~~ his frame?

1. Firecrackers explode at the same time
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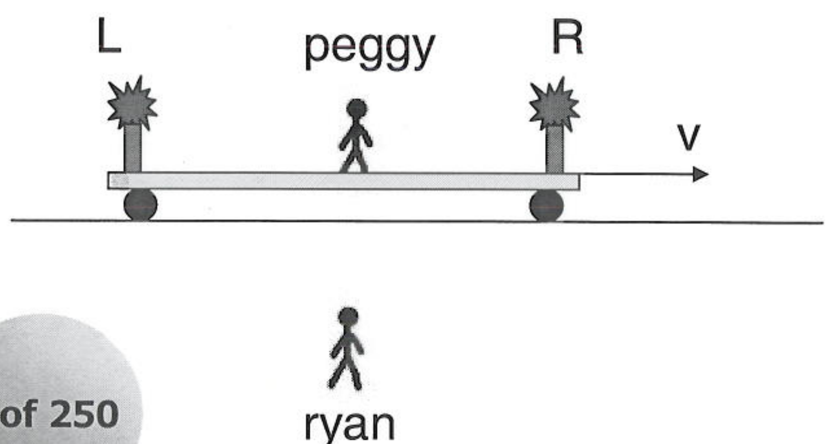
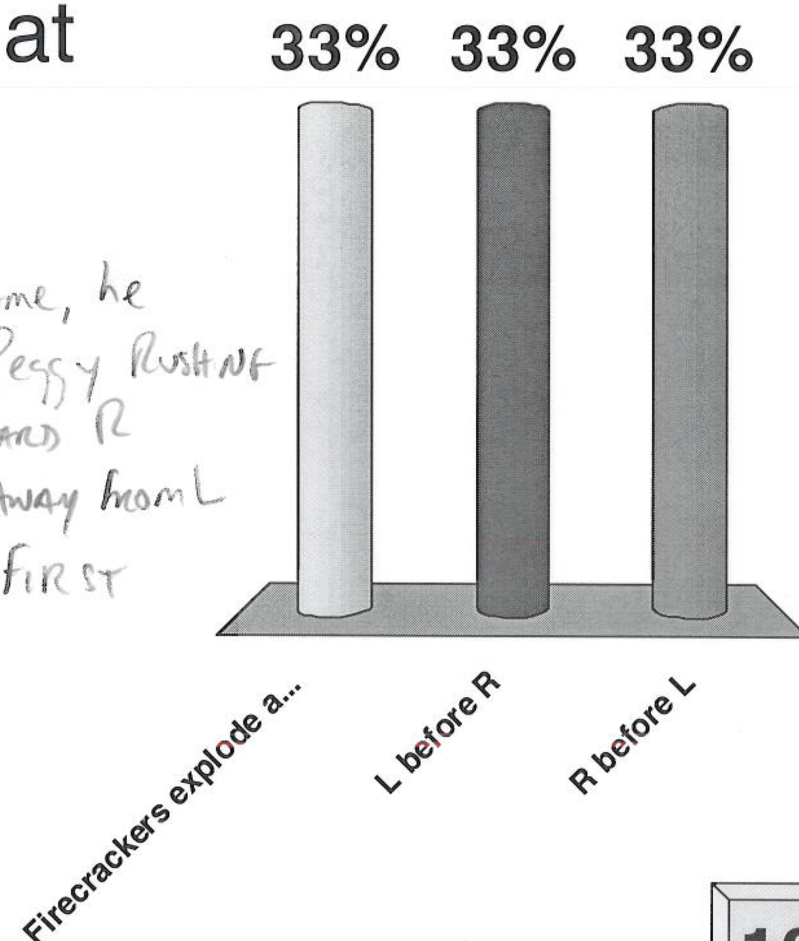


in his frame, he sees Peggy rushing toward R and away from L
L first



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John is driving his Hummer past Jane. He measures a time t_1 for the full length of the Hummer to pass Jane. Jane meanwhile measures a time t_2 for the full length of the Hummer to pass. Which statement is true?

John Jane

1. $t_1 = t_2$
2. $t_1 < t_2$
3. $t_1 > t_2$

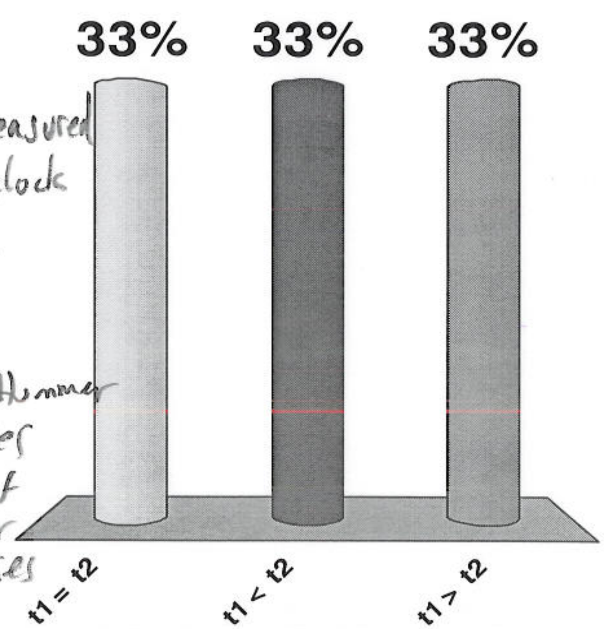
$\Delta t = \gamma \Delta \tau$

↑ time measured by same clock at both events

⇒ JANE

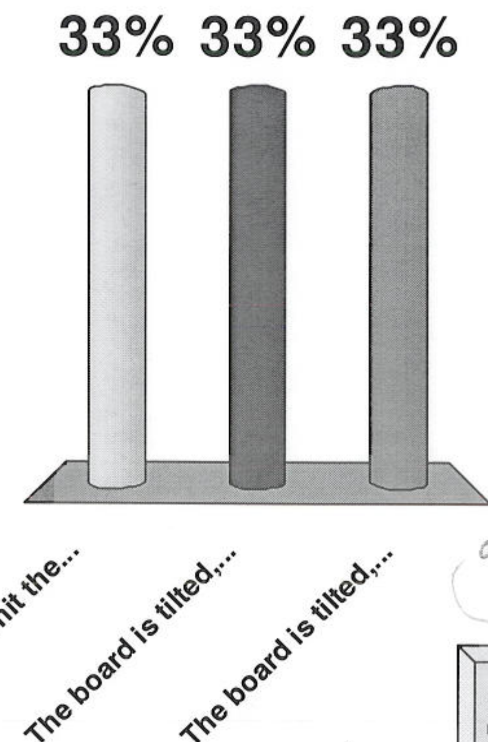
evt A front of Hummer passes

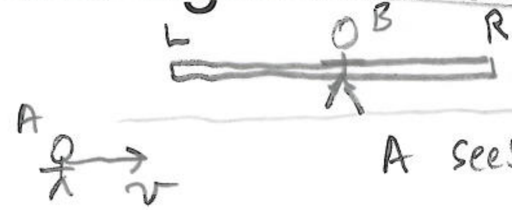
evt B back of Hummer passes



You are holding a long wooden board at its midpoint. You drop it flat, such that the two ends appear to you to hit the ground at the same time. Your friend is flying by near the speed of light, from the left to the right. She observes:

1. Both ends hit the ground at the same time, just like you
2. The board is tilted, with the left end striking first
3. The board is tilted, with the right end striking first





A sees B running from Light of R hitting ground and toward light of L hitting gnd. R must hit first in her frame so that Light hits B at same time as L

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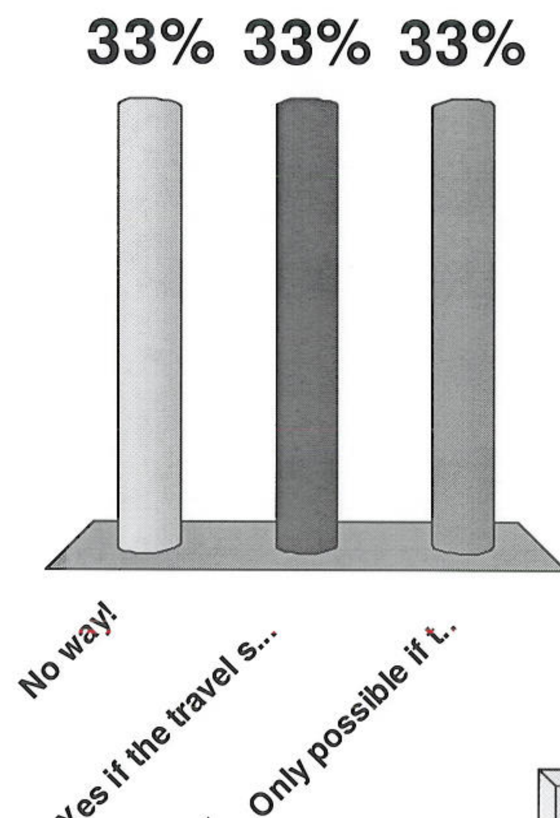
Human lifetimes are usually less than 100 years, and nothing can travel faster than light. Is it possible for a human to survive a journey of 200 light years?

1. No way!
2. Yes if the travel speed is large enough
3. Only possible if the human is frozen and then revived.



0 of 250

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- if we wanted trip to take 50 yr
- Assume $v \sim c$ then $L = 50ly$

$L = \frac{L_R}{\gamma}$

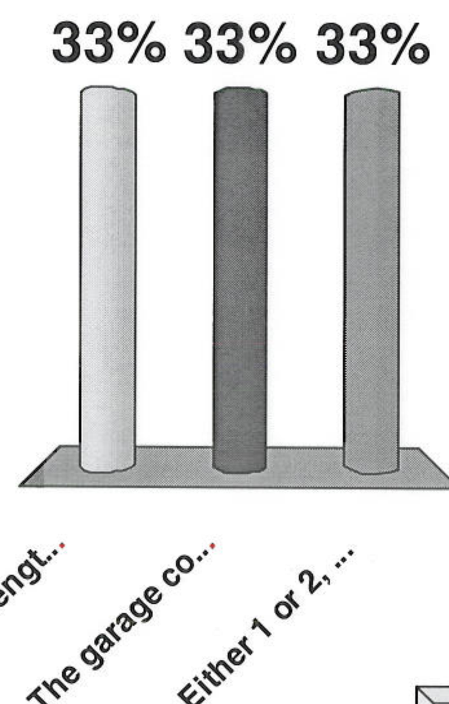
Or $\gamma = \frac{L_R}{L} = \frac{200ly}{50ly} = 4$

$\gamma = \frac{1}{\sqrt{1-\beta^2}}$

$\beta = \sqrt{1 - 1/\gamma^2} = \sqrt{\frac{15}{16}}$

You own a 5.0m long car, and a 5.0m long garage, with both dimensions measured at rest with respect to you. One day, the car is driven at a speed close to the speed of light toward the garage. Which statement is correct:

1. The car length contracts so that it will be completely enclosed by the garage.
2. The garage contracts so that one end of the car sticks out just as the front of the car reaches the back of the garage.
3. Either 1 or 2, depending on the motion of the observer



0 of 250

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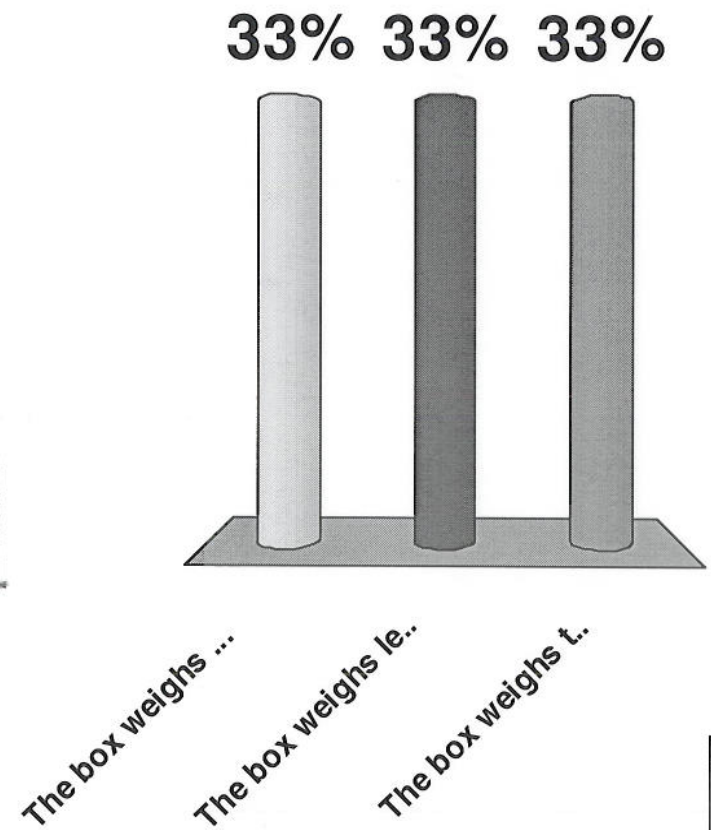
OBSERVER ON GROUND
⇒ car is CONTRACTED

OBSERVER IN CAR
⇒ garage is contracted

A nukular bomb is exploded inside of a container made of a novel material, strong enough to contain all of the energy released by the bomb without breaking. If you weigh the box before and after the explosion, you will find:

1. The box weighs more after than before
2. The box weighs less after than before
3. The box weighs the same after as before

$E = mc^2$



0 of 250

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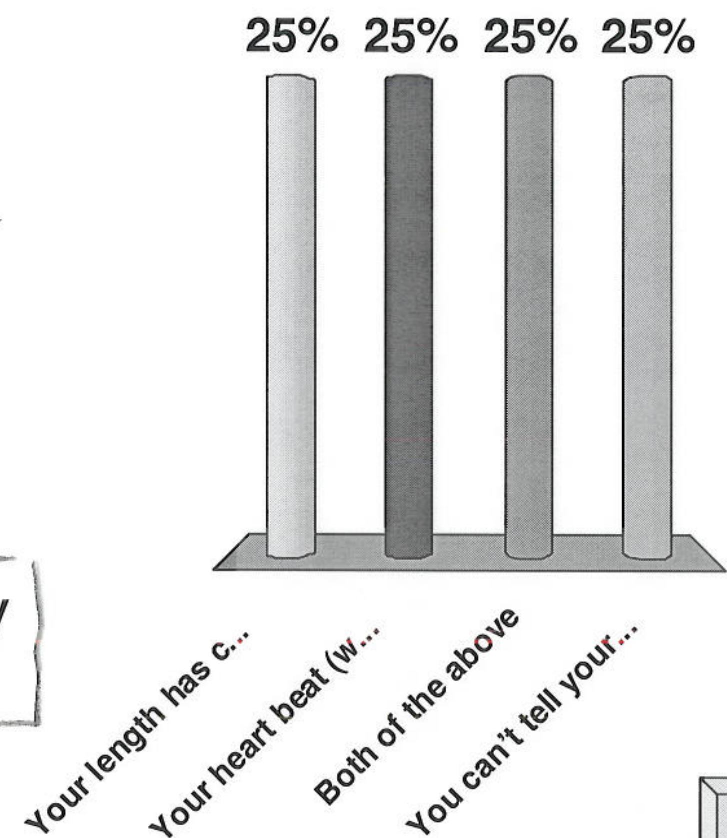
You are leave earth on a spaceship bound for Alpha Centauri. You know you are traveling close to the speed of light, because:

1. Your length (as observed by yo) has contracted in the direction of motion
2. Your heart beat (as observed by you) (which is sort of a clock) has slowed down
3. Both of the above
4. You can't tell your speed by changes in yourself



0 of 250

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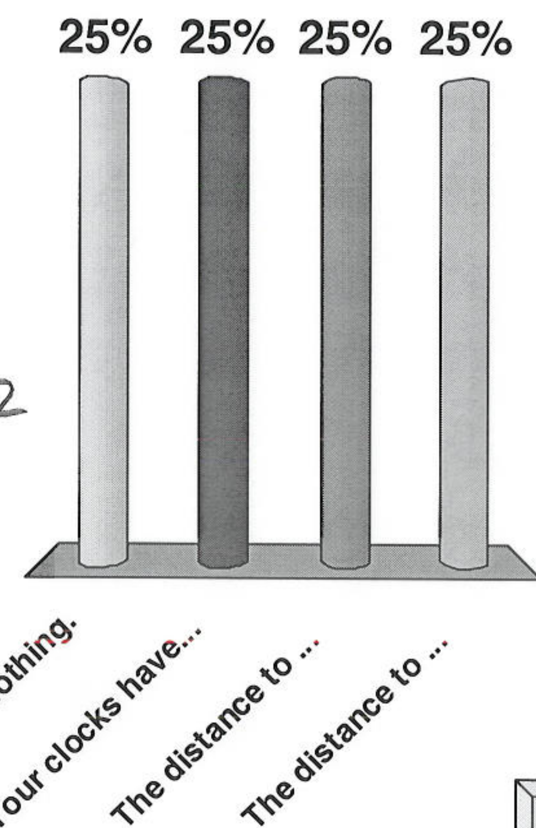
You are leave earth on a spaceship bound for Alpha Centauri. Observers on earth determine that clocks on your ship have slowed by a factor of 2. What effect will you observe?

1. Nothing.
2. Your clocks have slowed down by a factor of 2.
3. The distance to Alpha Centauri has decreased by a factor of 2.
4. The distance to Alpha Centauri has increased by a factor of 2.

$\gamma = 2$



0 of 250

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$\Delta t = \gamma \Delta \tau$

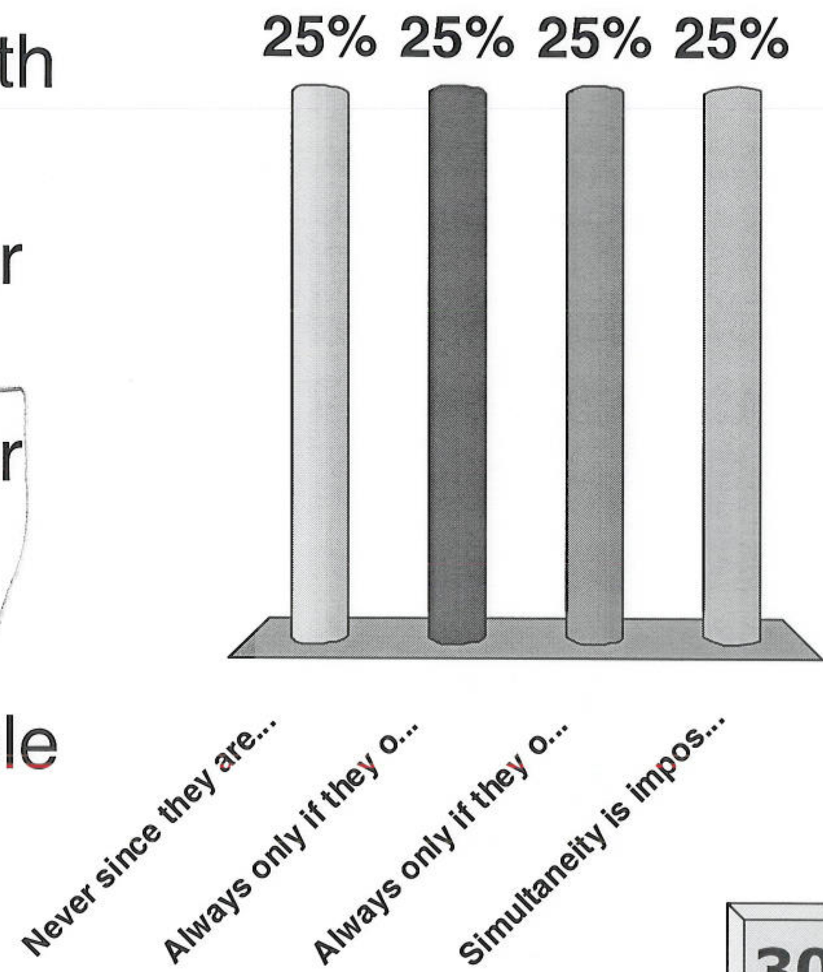
time on earth — time on your ship

$L = \frac{\ell}{\gamma}$

Distance you "measure" — distance measured before your ship left

Two observers in relative motion will agree that two events are simultaneous:

1. Never since they are both moving
2. Always only if they occur at the same time
3. Always only if they occur at the same place and time
4. Simultaneity is impossible in Relativity



0 of 250

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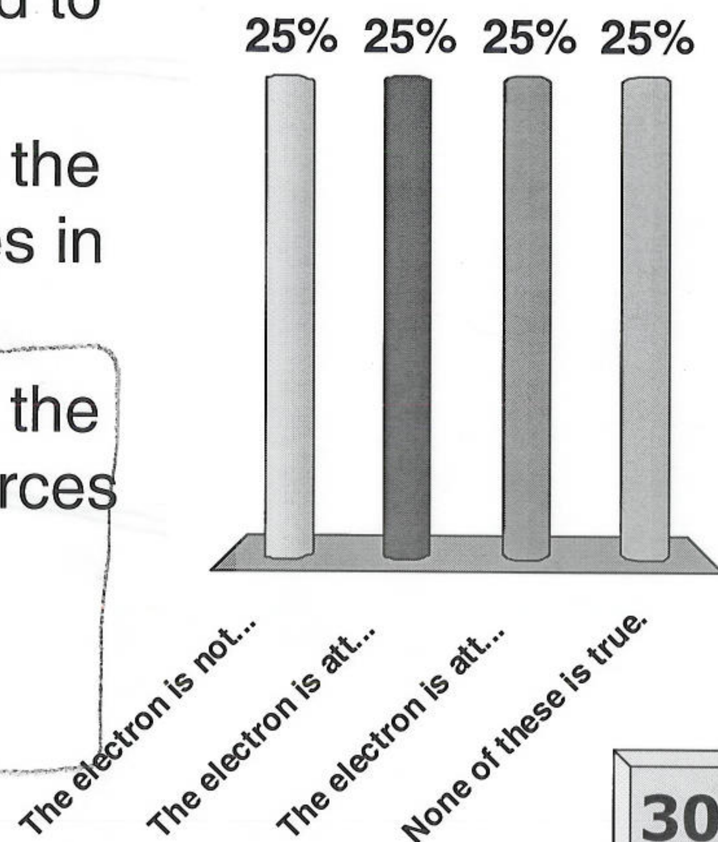
An electron is moving parallel to a current carrying wire, opposite the direction of the current. It is attracted to the wire. If we view the situation from a reference frame attached to the ~~wire~~ electron.

1. The electron is not attracted to the wire.
2. The electron is attracted to the wire, due to magnetic forces in this frame as well.
3. The electron is attracted to the wire, due to electrostatic forces in this frame, as a result of relativistic contraction of charges in the wire.
4. None of these is true.



0 of 250

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