MICHELSON MORLEY VIDEO NOTES Name: _____

(Find video by searching YouTube for Episode 42: The Lorentz Transformation) Period: _____

1. What is the speed of *light* in km/s? Convert this to km/hr. What is the speed of *earth* relative to the sun in km/hr? What is the ratio of these two speeds? (light/earth)

2. What was Fitzgerald's explanation for the outcome of the Michelson-Morley experiment?

3. What is special about the way observers measure the speed of light?

4. What basic principle was at the heart of Galileo's law of inertia?

5. What does the Greek letter γ mean in relativity? How is it used in relativistic equations?

6. Does time speed up or slow down in a moving reference frame? Explain time dilation.

7. What are Einstein's two fundamental postulates for his theory of relativity?

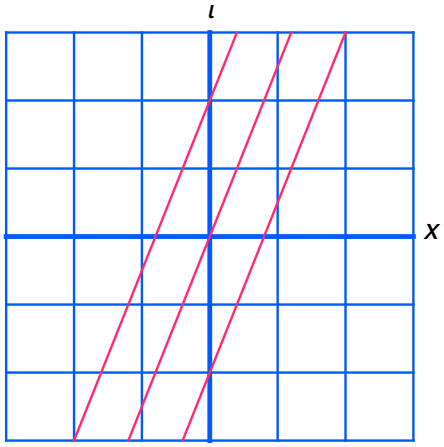
8. What is a spacetime diagram useful for visualizing? *(starting at 19:40 minutes into the video, Spacetime diagrams will be analyzed and drawn on the next page. Spacetime diagrams show simultaneity, time dilation and length contraction.)*

9. Who was perhaps the last great classical physicist? Why is he considered "classical"?

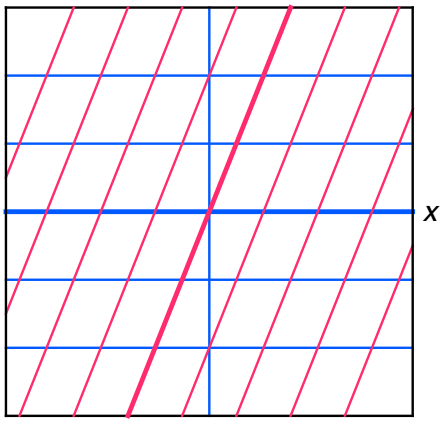
Spacetime Diagrams

Galilean Relativity

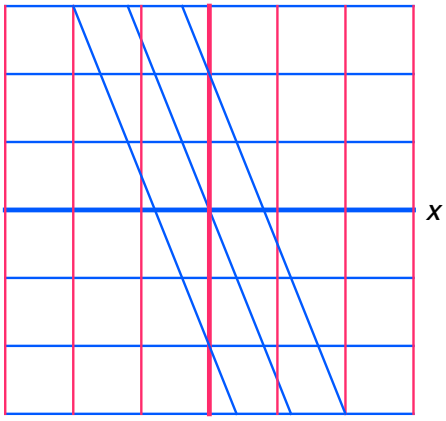
1. At 20:40 point in video, the axes for Albert (in blue) are shown below with the space axis (*x*) drawn horizontally and the time axis (*t*) drawn vertically. The time axis for Galileo is drawn tilted (in red). **Label Galileo's time axis as *t'*.**



2. At 20:50, the time axes are shown for Galileo (in red) and they are all tilted. One time axis for Albert (in blue) is still shown.**Label Galileo's time axis as *t'* and Albert's time axis as *t*.**



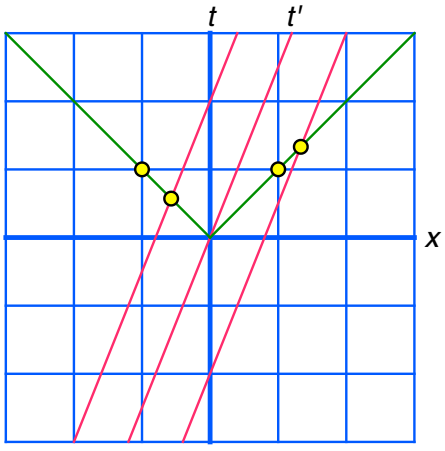
3. At 21:00, the time axes are shown for Galileo (in red) and are "straightened out" so they are now vertical. The time axes for Albert (in blue) are now tilted! **Label Galileo's time axis as *t'* and Albert's time axis as *t*.**



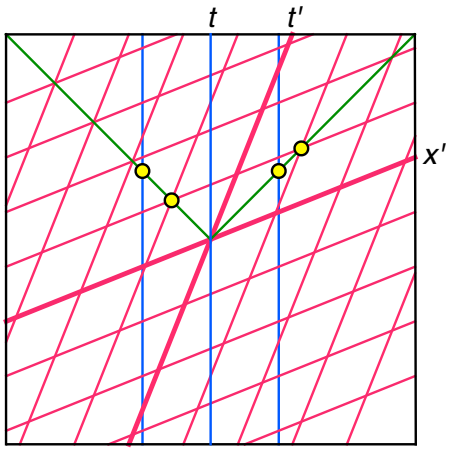
What does the motion for Albert look like from Galileo's reference frame? Which direction does Albert move?

Simultaneity for Einsteinian Relativity

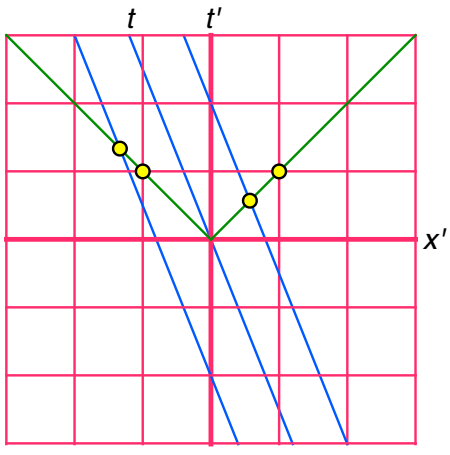
4. At 21:45, the axes for Albert (blue) are shown. Light clock signals are shown as yellow circles. Label each signal with **A** for Albert and **H** for Henry, and draw a line to show how Albert's signals are simultaneous.



5. At 22:20, the axes for Henry (red) are shown. Light clock signals are shown as yellow circles. Label each signal with **A** for Albert and **H** for Henry, and draw a line to show how Henry's signals are simultaneous.



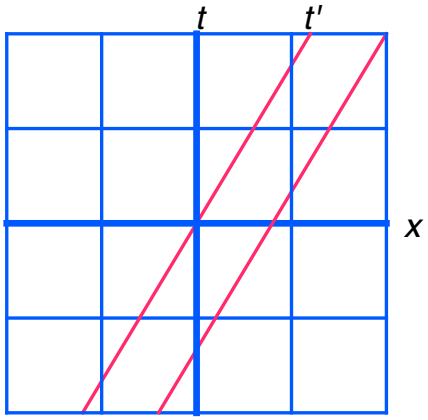
6. At 22:52, the axes for Henry (red) are "straightened out" so they're vertical. The time axes for Albert (blue) are now tilted. Label each signal with **A** for Albert and **H** for Henry, and draw a line to show how Henry's signals are simultaneous.



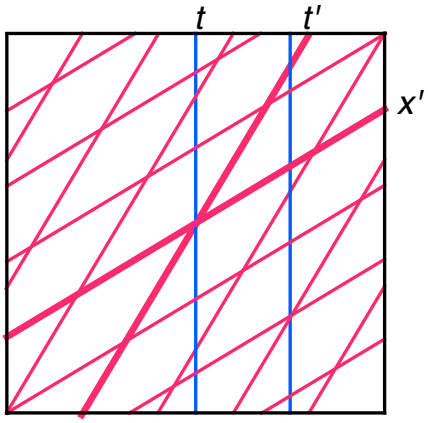
What do the observers, Albert and Henry, each claim about simultaneity?

Length Contraction for Einsteinian Relativity

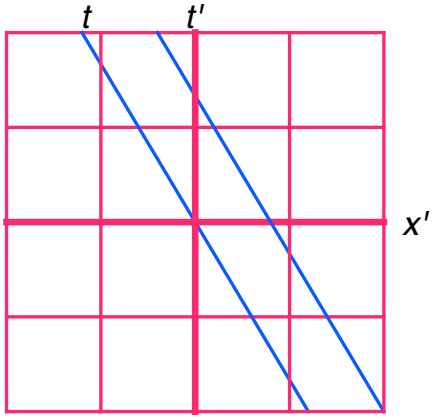
7. At 23:35, the axes for Albert (blue) are shown. Draw and label (Δx_A) a meter stick for Albert, which is one grid square wide. Then draw and label (Δx_H) a length-contracted view of Henry's meter stick.



8. At 23:45, the axes for Henry (red) are shown. Draw and label (Δx_H) a meter stick for Henry, which is one grid "diamond" wide. Then draw and label (Δx_A) a length-contracted view of Albert's meter stick.



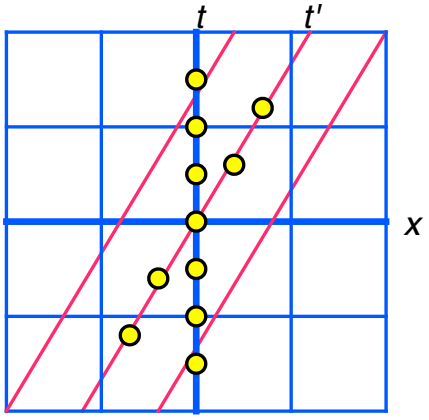
9. At 23:53, the axes for Henry (red) are "straightened out" so they're vertical. Draw and label (Δx_H) a meter stick for Henry, which is one grid square wide. Then draw and label (Δx_A) a length-contracted view of Albert's meter stick.



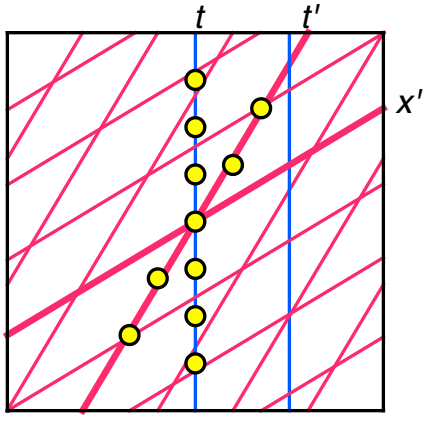
What do the observers, Albert and Henry, each claim about length contraction?

Time Dilation for Einsteinian Relativity

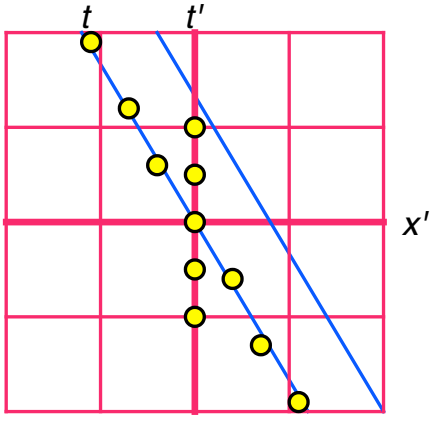
10. At 24:30, the axes for Albert (blue) are shown. Draw and label (Δt_A) an increment of time for Albert, which is one-half of a grid square tall. Then draw and label (Δt_H) a time-dilated view of Henry's increment of time.



11. At 24:40, the axes for Henry (red) are shown. Draw and label (Δt_H) an increment of time for Henry, which is one-half of a grid "diamond" tall. Draw and label (Δt_A) a time-dilated view of Albert's increment of time.



12. At 24:45, the axes for Henry (red) are "straightened out" so they're vertical. Draw and label (Δt_H) an increment of time for Henry, which is one-half of a grid square tall. Draw and label (Δt_A) a time-dilated view of Albert's increment of time.



What do the observers, Albert and Henry, each claim about time dilation?