Spacetime Diagrams I Questions

- 1. Four different possible worldlines are shown to the right:
 - a. Which worldline shows an object not moving?

(x coord does not change.)

b. Which worldline is moving the fastest?

Which could not be a worldline? c. (can 4 be every where at the



could also just label them "B"

a

х

NAME:

d. What is the velocity of worldline A? (For this worksheet, let each grid be 1x1 is *convenient units, e.g. 1 second x 1 light-second.*)

$$V = \frac{\Delta x}{\Delta t} = \frac{2}{4} = 0.5 \quad \text{So} \left[\frac{1}{4} \right]$$

e. What is the velocity of worldline C?

$$V = \frac{0x}{0t} = \frac{-3}{4} = \frac{(-0.75 \text{ c})}{-0.75 \text{ c}}$$

2. Sketch a spacetime diagram for each of the following: a. An object at rest at a positive x coordinate

b. An object moving to the left with a constant speed of 0.75c.



at 2/3 the speed of light.

c. Two events, C and D that are timelike. D must be above the slope 1

line going through C. 4. Sketch a spacetime diagram for each of the following: An object starting with a negative x coordinate

and moving with a constant speed of 0.5c to the

any slope ot

a.

right.

point at 0.4c.

Two events, C and D that are simultaneous and c. spacelike.



t

1 = 0.5

b







slope of
$$\frac{5}{4}$$

slope of -

side 1

of the

origin

Spacetime Diagrams I Questions

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- 5. Imagine a ship takes off from earth (A) at half the speed of t the light. After 3 years (earth time) a signal is sent from the earth (B) to the spaceship to come back to the earth. E When the ship receives the signal (C) it sends a signal back to earth, and reverses direction. The earth receives the signal from the ship (D) after some time and the ship finally arrives back at earth (E) after some time. D Show all this on a space time diagram to the right. Use ิล different colors for the ship worldlines and the signal worldlines. (Call each box 1 year x 1 light-year.) t=0 is ship leaving earth red = ship green = light According to the earth, when did the signal arrive at b. the ship? t = 66 B According to the earth, when did the ships signal arrive back at earth? 七: 9 ര d. According to the earth, when did the ship arrive back at х earth? α t = 12 The diagram to the right (and below a little) shows a reference frame S' drawn in blue relative to the S reference frame drawn in black. There is also an event labeled A. (Assume the grid is 1 second x 1 light-second.) a. What is the velocity of S' with respect to S? So V= ₩. t' worldline Look @ b. Draw in an event B that is simultaneous to A in S and 4 light seconds further to the right. Thisis D actually the в Draw in an event C that happens at the same worldline c. location as A in S, but 3 seconds later. (X=0) Draw in the time axis lines for events A and B d. for the S' frame. In S', which event happens first? B happens (st (tr < tr) Draw in the position axis lines for events A and B for the S' frame. In the S' frame, e. which event is closer to the origin? X' < X' so C is closer to S'origin
 - f. Draw in an event D that is simultaneous to A and further to the right, but in the S' any point on t'A axis. Notice is after reference frame.

in the S frame

side 2