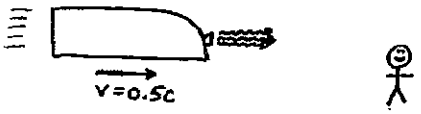
(1)

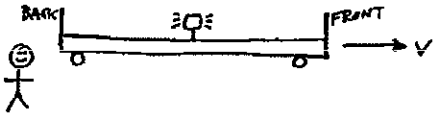


A train moving at 0.5c emits light (at speed c in the train's frame) from its front headlight. What speed does a fixed observer beside the track measure for the light?

Answer: C

ALWAYS C!

(2)



A flash of light is emitted from the center of a moving train. According to a fixed observer near the track, the light

reaches the back of the train

a) at the same time as

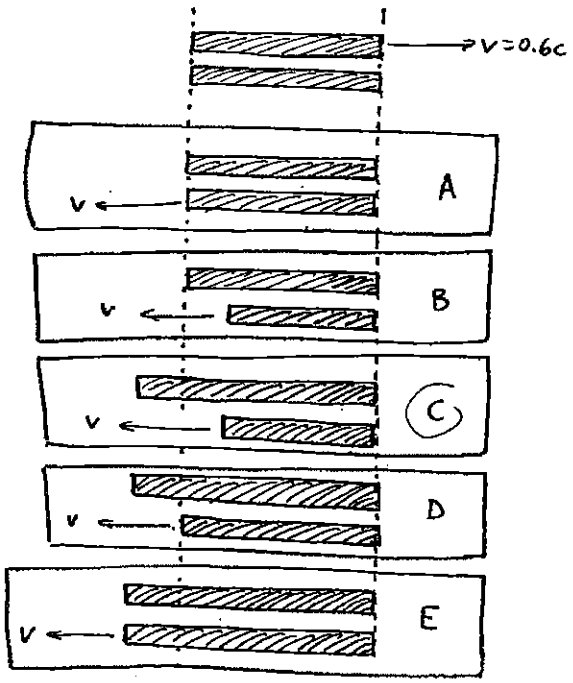
(b) before

c) after

the light reaches the front of the train

Answer: B

(3)



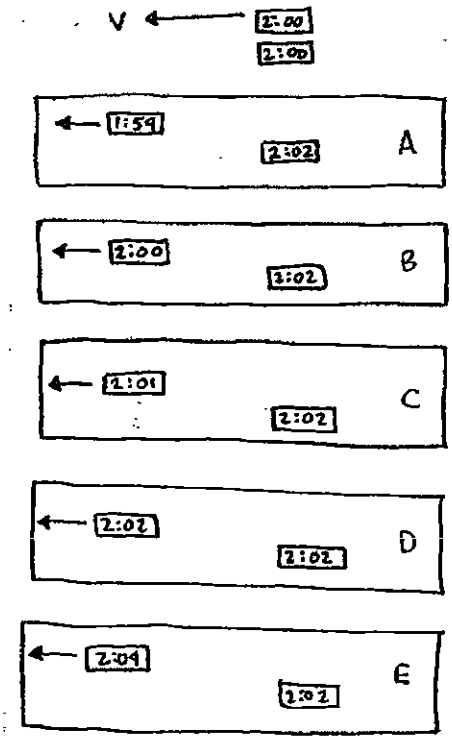
The top picture shows two rods, as observed in the frame of the lower rod. Which of the remaining pictures represents an observation of the same rods in the frame of the upper rod?

Answer: C

TOP HAS LARGER PROPER LENGTH

BOTTOM CONTRACTS

④



Two identical clocks are set to the same time as one passes the other at high velocity (as shown in the top figure). Which of the other figures represents a possible observation of the clocks at some later time in the frame of the fixed clock. (Assume the readings on the clocks are exact).

Answer: C

MOVING CLOCK IS SLOW

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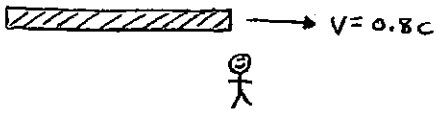
⑤



A meter stick travels at 0.8c relative to some fixed observer. How long does the observer measure for the time it takes the stick to pass?

A) $\frac{1m}{c}$

B) $\frac{0.8m}{c}$

C) $\frac{0.6m}{c}$

D) $\frac{1.25m}{c}$

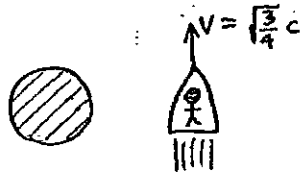
(E) $\frac{0.75m}{c}$

Answer: E

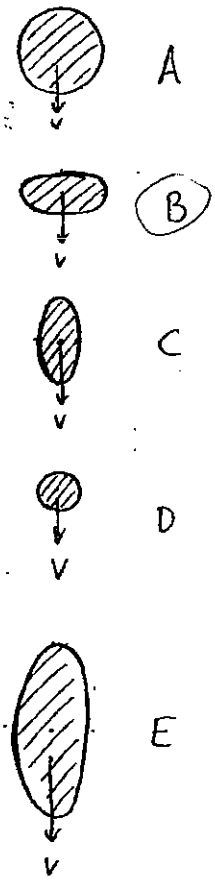
$\gamma = \frac{1}{\sqrt{1-0.64}} = \frac{5}{3}$

$\frac{(1m)/\gamma}{v} = \frac{3/5}{4/5} = 0.75\ m/c$

(6)

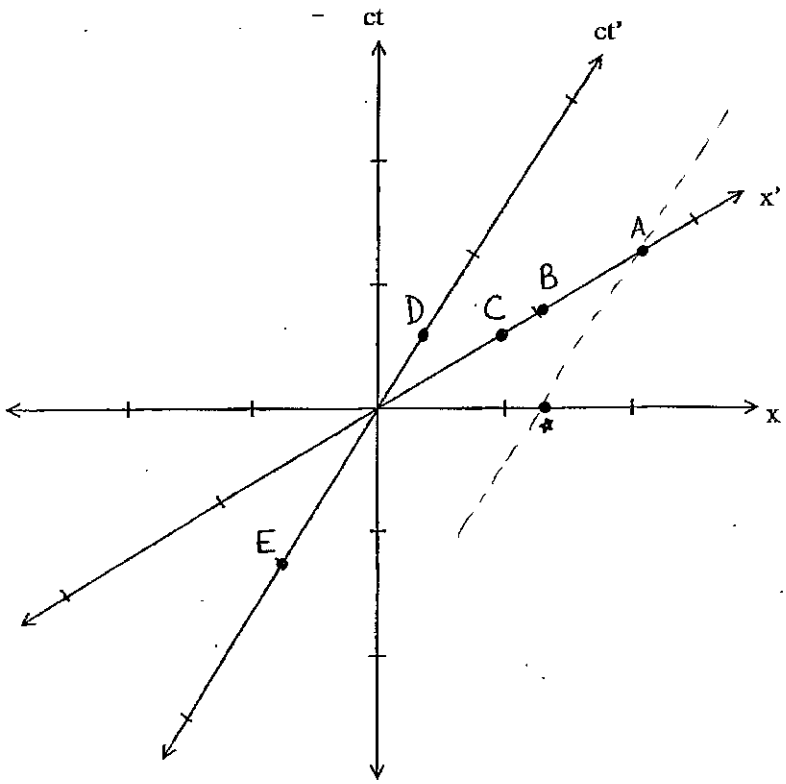


Which of the diagrams below best represent the shape of the shaded object in the top picture, as observed by the person in the rocket in the top picture.



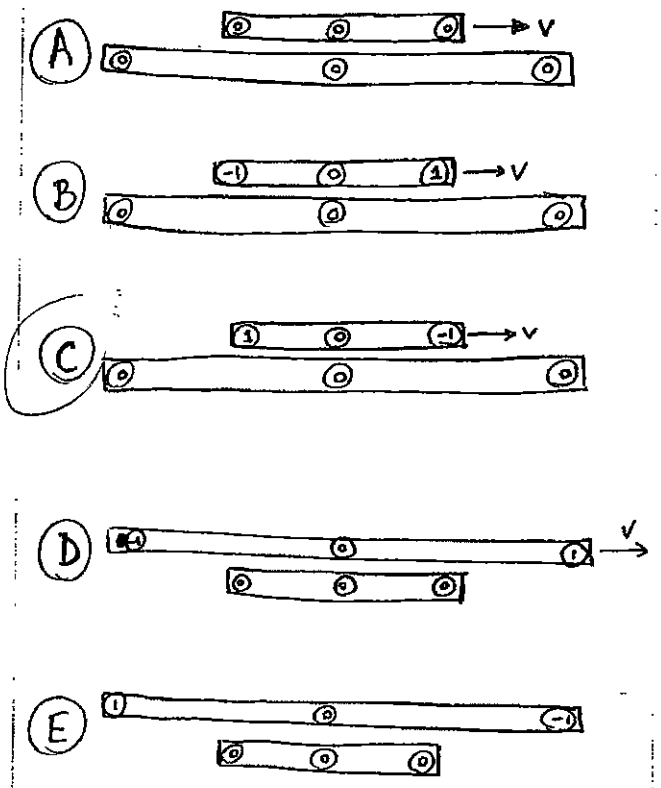
Answer: B

(7) According to an observer in the frame using x′ and t′ coordinates, which event is at the same location as the event marked ★?



Answer: A

(8)

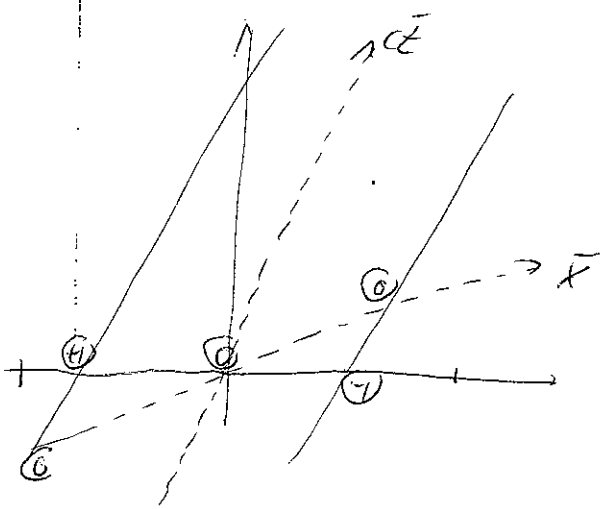


Two identical meter sticks, each with synchronized clocks at the ends and in the middle, pass each other at $v = \sqrt{\frac{3}{4}}c$. Which picture represents a possible observation of the system at some instant in the frame of the lower meter stick. Numbers in the circles represent the clock readings (in some units).

Answer: C

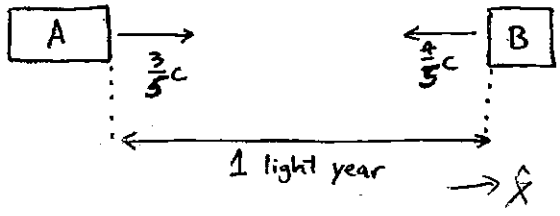
MOVING STICK SHORTER

A, B or C



CLOCK READINGS ON MOVING ROD SHOWN

(9)



Two ships approach each other at high velocity, as shown. The ships are initially 1 light year apart.

a) What is the speed of ship B as measured by ship A? (2 points)

$$\frac{u+v}{1+uv/c^2} : \quad \frac{3/5 + 4/5}{1 + 12/25}\,c = \frac{35}{37}\,c \qquad \text{TO THE LEFT}$$

$$\therefore -\frac{35}{37}\,c\,\hat{x}$$

b) Assuming the clock on ship A reads $t'=0$ in the picture above, what does the clock read when the two ships meet? (3 points)

IT TAKES $\dfrac{1\text{LY}}{(3/5+4/5)c} = \dfrac{5}{7}$ YEAR

IN STATIONARY FRAME FOR SHIPS TO MEET.

$$\gamma_A = \frac{1}{\sqrt{1-9/25}} = \frac{5}{4}$$

$$\frac{5/7}{\gamma_A} = 4/7 \text{ YEARS}$$

c) How far away does A observe B to be when A's clock reads $t'=0$? (2 points)

IN A'S FRAME, B APPROACHES WITH SPEED $\frac{35}{37}c$. IT TAKES $\frac{4}{7}$ YEARS TO GET THERE. SO

$$\text{DISTANCE} = \frac{\cancel{35}\,5}{37}c \cdot \frac{4}{\cancel{7}} y = \frac{\cancel{140}}{\cancel{259}} \text{LIGHT YEARS}$$

$$\frac{20}{37}$$