

Self-test questions

Option A (SL)

1 Which list gives the postulates of special relativity?

	Postulate 1	Postulate 2
A	Moving clocks are slow.	Moving lengths are shorter.
B	The speed of light in vacuum is constant in all inertial reference frames.	The laws of physics are the same in all inertial frames.
C	It takes infinite energy to accelerate a body to the speed of light.	Moving clocks are slow.
D	Moving lengths are shorter.	The speed of light cannot be exceeded.

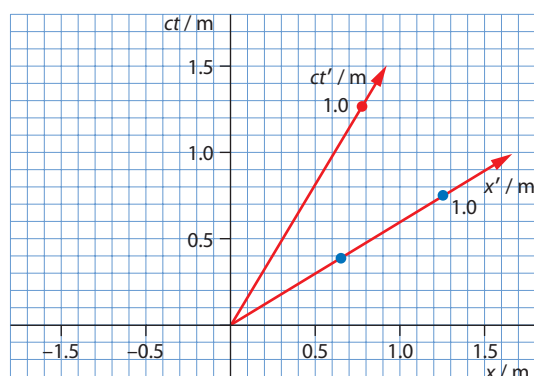
2 A **proper time interval** is the time between two events:

- A in the reference frame that is at rest
- B in the reference frame that moves
- C at the same point in space
- D that is the correct time interval

3 A rod of proper length 60 m moves past an observer with speed $0.80c$. The gamma factor for this speed is $5/3$. What is the length of the rod as measured by this observer?

- A 36 m
- B 48 m
- C 60 m
- D 100 m

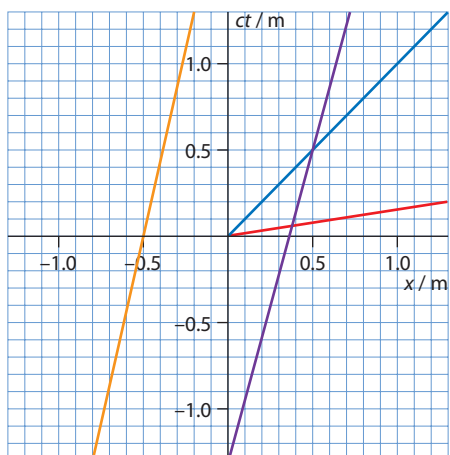
4 The figure below shows a space–time diagram for frame S (black axes) and frame S' (red axes). Two events are marked by blue dots.



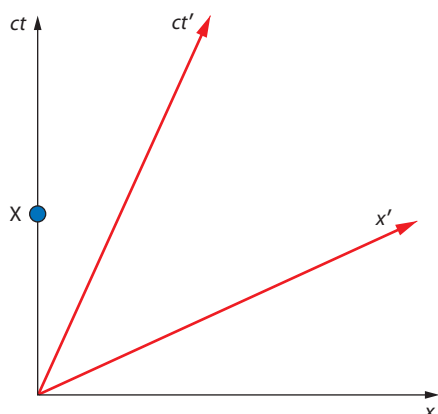
The events are:

- A simultaneous in S
- B simultaneous in S'
- C simultaneous in both S and S'
- D simultaneous in neither S nor S'

- 5 The space–time diagram below shows four world lines. Which one is impossible?



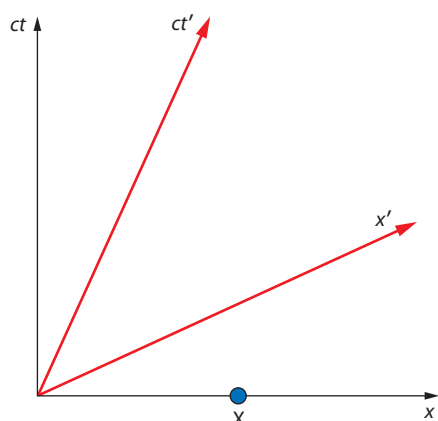
- A Orange
B Blue
C Red
D Purple
- 6 In the space–time diagram below, the red frame moves with velocity v past the black frame. The gamma factor for this speed is γ . In the black frame the coordinates of event X are $(x = 0, ct = 1)$.



What are the coordinates of X in the red frame?

- A $(x' = 0, ct' = \gamma)$
B $(x' = -\gamma v, ct' = \gamma)$
C $(x' = -\frac{\gamma v}{c}, ct' = \gamma)$
D $(x' = -\frac{\gamma v}{c}, ct' = 1)$

- 7 In the space–time diagram below, the red frame moves with velocity v past the black frame. The gamma factor for this speed is γ . In the black frame the coordinates of event X are $(x = 1, ct = 0)$.



What are the coordinates of X in the red frame?

- A $(x' = 0, ct' = \gamma)$
 B $(x' = \gamma, ct' = -\frac{\gamma v}{c})$
 C $(x' = -\frac{\gamma v}{c}, ct' = \gamma)$
 D $(x' = -\frac{\gamma v}{c}, ct' = 1)$
- 8 In frame S event 1 and event 2 happen at the same time and are separated by $\Delta x = x_2 - x_1 = L$. Which statement about the times of these vents in frame S' is correct?
- A Event 1 occurs $\frac{\gamma v L}{c}$ before event 2.
 B Event 1 occurs $\frac{\gamma v L}{c}$ after event 2.
 C Event 1 occurs $\frac{\gamma v L}{c^2}$ before event 2.
 D Event 1 occurs $\frac{\gamma v L}{c^2}$ after event 2.
- 9 A rocket moving at $0.50c$ relative to the ground launches a missile in the direction of motion of the rocket. The speed of the missile relative to the rocket is $0.50c$. What is the speed of the rocket relative to the ground?
- A c
 B $\frac{c}{1.25}$
 C $\frac{c}{0.75}$
 D $0.50c$
- 10 In the figure below, a photon leaves the left-hand wall of the box, arrives at the right-hand wall, reflects and returns to the left-hand wall. The box has proper length L and moves with velocity v to the right relative to the ground.



What is the time for total trip, as measured by an observer inside the box?

- A $\frac{L}{c}$
 B $\frac{L}{c+v} + \frac{L}{c-v}$
 C $2\frac{L}{c}$
 D $2\frac{L}{\gamma c}$