

Self-test questions

Option A (HL)

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

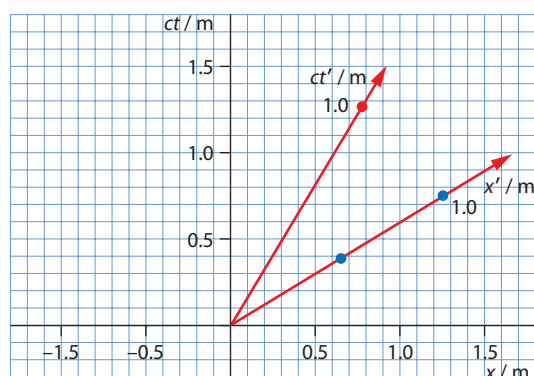
3 A rod of proper length 60 m moves past an observer with speed $0.80c$. The gamma factor for this speed is $\frac{5}{3}$. What is the length of the rod as measured by this observer?

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

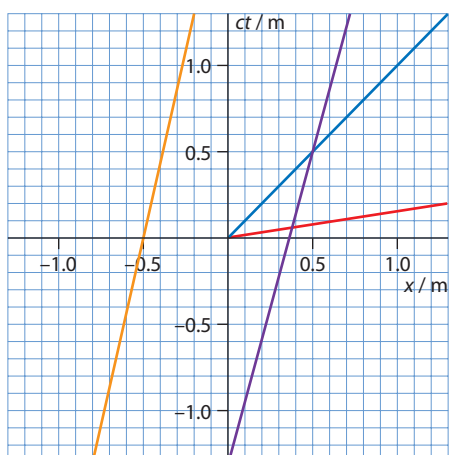
4 The figure below shows a space–time diagram for frame S (black axes) and frame S' (red axes). Two events are marked by blue dots.

The events are:

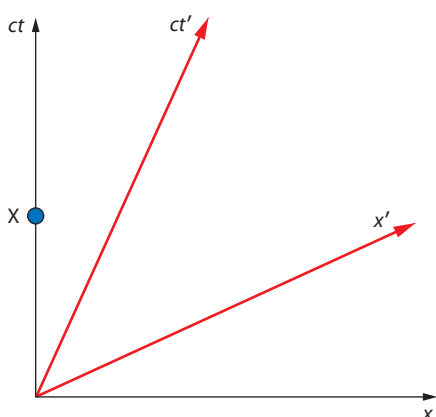
- A simultaneous in S
- B simultaneous in S'
- C simultaneous in both S and S'
- D simultaneous in neither S nor S'



- 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?

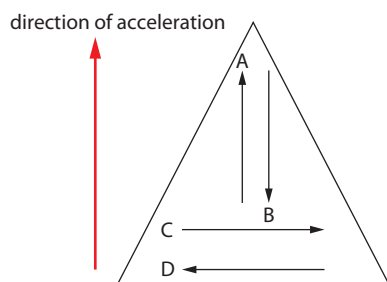


- A $(x' = 0, ct' = \gamma)$
B $(x' = -\gamma v, ct' = \gamma)$
C $(x' = -\frac{\gamma v}{c}, ct' = \gamma)$
D $(x' = -\frac{\gamma v}{c}, ct' = 1)$
- 7 A particle has a total energy that is twice its rest energy. What is the speed of the particle?
- A $\frac{\sqrt{3}c}{2}$
B $\frac{3c}{4}$
C $\frac{1c}{2}$
D $\frac{1c}{4}$

- 8 A particle at rest of mass M decays into two photons. What is the momentum of one of the photons?

A $\frac{Mc}{2}$
 B Mc
 C $\frac{Mc^2}{2}$
 D Mc^2

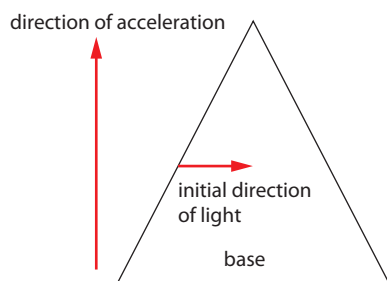
- 9 A frame of reference in outer space moves with constant acceleration as shown in the diagram below. Four photons are emitted. The point of emission is the beginning of the arrow and the point of reception is at the arrowhead.



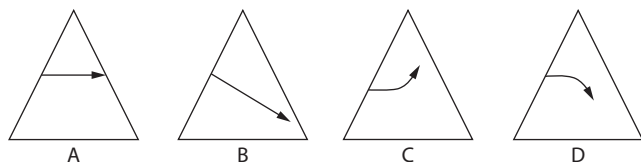
Which photon will have suffered a red-shift when it is received?

A
 B
 C
 D

- 10 A frame of reference in outer space moves with constant acceleration as shown. Light is emitted in a direction that is initially parallel to the base of the frame.



What is the path of the light as observed from within the frame?



A
 B
 C
 D