MCQ on Special Theory of Relativity

(1) The Galilean transformation is applicable when the relative velocity between two frames is

A) Comparable to the speed of light

B) Much smaller than the speed of light

C) Equal to the speed of light

D) Greater than the speed of light

Answer: Much smaller than the speed of light

(2) According to the theory of special relativity, the time interval measured by an observer moving relative to a clock is

A) Shorter than the proper time

B) Equal to the proper time

C) Longer than the proper time

D) Always zero

Answer: Longer than the proper time

(3) The energy-momentum relation for a particle of rest mass m_0 is

A) $E^2 = p^2 + m_0^2$

B) $E^2 = p^2 c^4$

C) $E^2 = p^2 c^2 + m_0^2 c^4$

D) $E = pc^2$

Answer: $E^2 = p^2 c^2 + m_0^2 c^4$

(4) The four-momentum is

A) $P^\mu = m_0 U^\mu$

B) $P^\mu = m_0 v$

C) $P^\mu = mv^2$

D) $P^\mu = F/t$

Answer: $P^\mu = m_0 U^\mu$

(5) The Lorentz force on a charged particle is

A) $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

B) $\vec{F} = q\vec{E}$

C) $\vec{F} = q\vec{B}$

D) $\vec{F} = m\vec{v}$

Answer: $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

(6) The Hamiltonian is defined as

A) $H = L - pv$

B) $H = mv - L$

C) $H = L + pv$

D) $H = \vec{p} \cdot \vec{v} - L$

Answer: $H = \vec{p} \cdot \vec{v} - L$

(7) The Lorentz factor γ is given by

A) $\gamma = \dfrac{1}{\sqrt{1 - v^2/c^2}}$

B) $\gamma = \sqrt{1 - v^2/c^2}$

C) $\gamma = 1 - \dfrac{v}{c}$

D) $\gamma = \dfrac{c}{v}$

Answer: $\gamma = \dfrac{1}{\sqrt{1 - v^2/c^2}}$

(8) For a light ray, the space-time interval is

A) Positive

B) Negative

C) Zero

D) Infinite

Answer: Zero

(9) The length of an object moving with velocity v relative to an observer, along the direction of motion, is

A) Greater than its proper length

B) Equal to its proper length

C) Independent of its velocity

D) Less than its proper length

Answer: Less than its proper length

(10) According to Einstein's postulate of special relativity, the speed of light in vacuum is

A) Dependent on the velocity of the source

B) The same for all inertial observers

C) Dependent on the velocity of the observer

D) Zero in a moving frame

Answer: The same for all inertial observers

(11) The relativistic kinetic energy of a particle of rest mass m_0 and total energy E is

A) $K = E + m_0c^2$

B) $K = m_0c^2$

C) $K = E - m_0c^2$

D) $K = E/c^2$

Answer: $K = E - m_0c^2$

(12) If two events are simultaneous in one inertial frame, they are

A) Simultaneous in every inertial frame

B) Never simultaneous in any other frame

C) Always separated by a time interval of one second

D) Not necessarily simultaneous in another inertial frame

Answer: Not necessarily simultaneous in another inertial frame