

Department of Applied Physics
Applied Physics
Question Bank
Session – 2012-13
UNIT – I -Theory of Relativity

Multiple Choice Questions

- ⌚ A reference frame attached to the earth:
- (a) **is an inertial frame by definition**
 - (b) is an inertial frame because Newton's laws are applicable in the frame
 - (c) Cannot be an inertial frame because the earth is revolving round the sun
 - (d) Cannot be an inertial frame because the earth is rotating about its own axis.
- ⌚ Michelson and Morley experiment showed that
- (a) Newtonian mechanics is correct for all low and high velocities
 - (b) There is an absolute ether frame
 - (c) ***There is no absolute ether frame, but all frames are relative***
 - (d) Velocity of light is relative in all cases.
- ⌚ Two photons approach each other, their relative velocity will be
- (a) $c/2$
 - (b) Zero
 - (c) $c/8$
 - (D) ***c***
- ⌚ An inertial frame is :
- (a) Accelerated
 - (b) Decelerated
 - (c) ***Moving with uniform velocity or at rest.***
 - (d) May be accelerated, decelerated or moving with constant velocity
- ⌚ Michelson-Morley experiment proved that
- (a) speed of light is relative
 - (b) ***there is no preferred frame like ether***
 - (c) earth is an inertial frame.
 - (d) earth is a non-inertial frame.
- ⌚ “All the inertial frames are equivalent” this statement is called the principle of -----
- (a) ***relative motion***
 - (b) equivalence

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- (c) inertia
- (d) Correspondence.
- ⌚ Special theory of relativity deals with the events in the frames of reference which move with constant-----
- ⌚ (a) speed
- (b) ***velocity***
- (c) acceleration
- (d) momentum.

- ⌚ Michelson-Morley experiment to detect the presence of ether is based on the phenomenon of:
 - (a) ***interference***
 - (b) diffraction
 - (c) polarization
 - (d) dispersion

- ⌚ According to relativity, the length of a rod in motion:
 - (a) is same as its rest length
 - (b) is more than its rest length
 - (c) ***is less than its rest length***
 - (d) may be more or less than or equal to rest length depending on the speed of rod.

- ⌚ If $v = c$, the length of a rod in motion is:
 - (a) ***zero***
 - (b) equal to proper length
 - (c) less than proper length
 - (d) more than proper length.

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- ⌚ According to special theory of relativity:
- (a) speed of light is relative
 - (b) *speed of light is same in all inertial frames*
 - (c) time is relative
 - (d) mass is relative.

Short Answer Questions

1. State the fundamental postulates of special theory of relativity.
2. Show that $x^2+y^2+z^2 = c^2t^2$ is invariant under Lorentz transformation.
3. Define an inertial frame of reference. Distinguish between special theory of relativity and general relativity.
4. Show how negative results obtained from Michelson – Morley experiment were interpreted?

Long Answer Questions

1. State the fundamental postulates of special theory of relativity and deduce the Lorentz transformation equations for space and time co-ordinates.
2. What is time dilation in special theory of relativity? Derive an expression for the same where symbols have their usual meanings.
3. Derive the formula for the variation of mass with velocity according to special theory of relativity.
4. What is time dilation in special relativity? Obtain an expression for time dilation in regard to the time interval between two events measured from two different inertial frames.
5. What is Doppler's shift? Explain it.
6. What is Galilean transformation? Deduce the Galilean transformation equations. Show that the laws of mechanics are identical in all inertial frames.
7. State the fundamental postulates of special theory of relativity. Why were they necessary?
8. Obtain Lorentz transformations. How are they superior to Galilean transformations?
9. Discuss some of the achievements of the special theory of relativity and in the light of these discuss that the material objects can never have the velocity greater than the velocity of light.
10. 'The clock in motion ticks less rapidly the stationary clock' Explain this statement
11. Show that the phase difference between two beams in Michelson-Morley experiment can be written as,
12. Show that the mass of the body in motion is given by
13. Discuss Michelson-Morley experiment.

Numerical Problem

1. An electron is moving with speed 0.99 C. What is its total energy? Find the ratio of Newtonian kinetic energy to the relativistic kinetic energy?

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2. Deduce the velocity at which the mass of a particle becomes 1.25 times its rest mass. ()
3. A rocket ship is 100 meters long on the ground. When it is in flight its length is 99 meters to an observer on the ground? What is its speed?