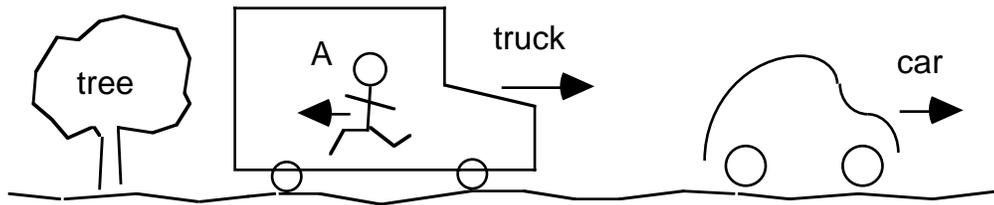# Relativity : Quiz-60

1) In the diagram below, The velocity of the truck is +12 m/s relative to the tree. "A" moves at -3.0 m/s relative to the truck. The car moves at +10. m/s relative to the tree.

a) The velocity of "A" relative to the tree is _____ .

b) The velocity of the car relative to the truck is _____ .

c) The velocity of "A" relative to the car is _____ .

2) Explain why the Michelson-Morley experiment was important.

3) State Einstein's two postulates of relativity.

4) Explain how Einstein showed that no object could travel at, or faster than, the speed of light.

5) A spaceship traveling at 0.85 c passes by an observer. When it is at rest, the length of the ship is 36 m and its mass is 12,000 kg.

a) Find the length of the ship as measured by the observer.

b) If a time of 8.0 hours passes for the observer, how much time has passed on the spaceship?

c) Find the mass of the ship as measured by the observer.

6) At what speed will an object's mass be twice as large as its rest mass?

7) Find the rest energy of a proton. (proton rest mass = 1.67×10^{-27} kg)

8) In a nuclear reaction, matter is converted to energy. For example, a proton can fuse with a deuteron to become a helium-3 nucleus. A gamma ray is released. It is found that the mass of the helium nucleus is 9.8×10^{-30} kg less than the mass of the proton plus deuteron. Find the energy of the gamma ray.

9)a) Find the kinetic energy of an electron that moves with a velocity of 0.90 c. (use the Einstein formula; $E_k = (m-m_o) c^2$) (rest mass for electron = 9.11×10^{-31} kg)

b) Compare with the result found using the old formula for the kinetic energy ($E_k = 1/2\ m_o\ v^2$)

10) A spaceship passes an observer with a velocity of 0.60 c. The astronaut on board fires a missile which travels with a velocity of 0.85 c relative to the spaceship. Find the velocity of the missile relative to the observer. Use the **Velocity Addition Law**.

Answers: 1)a) 9.0 m/s, b) -2.0 m/s, c) -1.0 m/s, 2) The experiment showed that the speed of light is constant., 3) Absolute motion is undetectable., The speed of light is constant., 4) The mass equation; $m = m_o/\sqrt{(1-v^2/c^2)}$ cannot be solved for v greater than or equal to c., 5)a) 19 m, b) 4.2 hr, c) 23,000 kg, 6) 0.87 c, 7) 1.50×10^{-10} J, 8) 8.8×10^{-13} J, 9)a) 1.1×10^{-13} J, b) 3.3×10^{-14} J, 10) 0.96 c.