**Year 12 Physics TEST # 5 – Special Relativity 2022**

NAME:

*Total Marks: 36 Time Allowed: 45 minutes*

(Formula sheet and scientific calculator permitted)

**Question 1 (8 marks)**

1. In a Christmas parade, elves on the back of a float moving at 9.00 ms-1 East are tossing a ball around. Pepper throws the ball at 7.00 ms-1
2. in the direction of the float’s movement,
3. in the opposite direction to the float’s movement.

Determine the velocity of the ball relative to a spectator watching the parade pass by in each case. [2]

1. In a futuristic parade, the float speed is 0.900 c and Pepper throws the ball at 0.700 c. Pepper throws the ball in the same two directions as in part (a).

Determine the velocity of the ball relative to a spectator watching the parade pass by in each case. [6]

**Question 2 (5 marks)**

Answer T (true) or F (false) for each of the following statements.

1. The amount of kinetic energy of an object measured in an inertial frame is the same as in the frame of a stationary observer. [1]
2. The speed of light measured in an inertial frame is the same as in the frame of a stationary observer. [1]

1. The speed of a moving ball measured in an inertial frame is the same as in the frame of a stationary observer. [1]
2. The momentum of a moving ball measured in an inertial frame is the same as in the frame of a stationary observer. [1]
3. The distance to a given destination measured in an inertial frame is the same as in the frame of a stationary observer. [1]

**Question 3 (6 marks)**

A proton is accelerated from rest to a speed of 0.970 c in a linear accelerator by a large voltage. What voltage is required?

**Question 4 (12 marks)**

Two spaceships travelling at the same speed approach each other at a relative speed of 0.860 c, as measured by a stationary observer.

1. Show that the common speed of the two spaceships, as measured by the stationary observer, is approximately 0.569 c. [4]

The length of each spaceship is 28.0 m in its own frame.

1. What is the length of one of the ships, as measured by
2. the stationary observer? [2]
3. the other ship? [4]

A period of 60.0 minutes elapses, as measured on one spaceship.

1. What time has elapsed, as measured by the stationary observer? [2]

**Question 5 (5 marks)**

One of the experimental verifications of Einstein’s Theory of Special Relativity is the momentum change in accelerated high-speed electrons.

To what final speed must an electron initially travelling at 0.600 c be accelerated in order to achieve a 50.0 % increase in momentum?

*- End of Questions -*