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**Special Relativity**

**Question 1 P5886**

The idea of a universal aether was first proposed to explain the transmission of light through space. Michelson and Morley attempted to measure the speed of Earth through the aether. Evaluate the impact of the result of the Michelson and Morley experiment on scientific thinking.

**Question 2 P5609**

Einstein’s 1905 theory of special relativity made several predictions that could not be verified for many years.

(a 1) State ONE such prediction.

(b 2) Describe an experiment to test this prediction.

(c 3) Explain how technological advances since 1905 have made it possible to carry out this experiment. (HSC 2005)

**Question 3 P5950**

Describe an experiment that you could perform in a reference frame to determine whether or not the frame was non-inertial.

**Question 4 P5486**

A spacecraft is travelling at 0.99*c*. An astronaut inside the craft records a time of 1 hour for a certain event to occur. How long would an observer stationary relative to the craft record for this event?

**Question 5 P5606**

A new EFT (extremely fast train) is travelling along the tracks at the speed of light relative to the Earth’s surface. A passenger is walking towards the front of the train at 5 m/s relative to the floor of the train. Clearly, relative to the Earth’s surface, the passenger is moving faster than the speed of light. Analyse this situation from the point of view of Special Relativity.

**Question 1 (P5176)**

Two clocks are synchronized and then one is sent into space at 0.45*c* for one hour of its time. (a) Calculate the time passed for the clock left behind in the stationary frame of reference. (b) Describe and draw the space of the moving clock as observed from the stationary clock. Assume they are circular to start. (c) What shape will the moving clock to an observer moving with the clock? (d) If the moving clock had a mass of 294 g when stationary, calculate the mass when it is moving at 0.45*c*.

**Question 2 (P5410)**

Astronaut Chris travels to Vega, the fifth brightest star in the night sky, leaving his 35 year old twin Pat behind on Earth. Chris travels at a speed of 0.990*c* and Vega is 25.3 light-years from Earth. (a) How long does the trip take from the point of view of Pat. How old is Pat when Chris arrives at Vega? (b) How old is Chris when he arrives at Vega (use the time dilation effect)? (c) What distance did Chris travel from his point of view and how old is he at the end of his journey.

**P5615**

The radius of our galaxy is 3×1020 m, or about 3×104 light years.

Assume the speed of a spacecraft is 0.99­*c.*

(a) From the point of view of an observer on Earth, calculate the time to travel to the edge of our galaxy?

(b) Use the length contraction formula to calculate the time for a person to travel from the centre to the edge of our galaxy.

(c) Use the time dilation effect to calculate the time for a person to travel from the centre to the edge of our galaxy.

(d) How fast would a spaceship have to travel to go from the centre to the edge of our galaxy in 30 yrs as measured from within the spaceship? How much time would elapse on Earth during this journey?

(d) What does this tell us about the future of traveling to edge of our galaxy?

**P5935**

A spacecraft in the shape of a square box with sides 300 mm long moves away from the Earth at a velocity of 0.5*c*. Find the volume of the box as measured from Earth.

**Question 5** (**P5544)**

A particular radioactive isotope loses 5×102 J of energy. Calculate its resultant loss of mass.

**Question 3 (P5456)**

An electron with a rest mass of 9.11×10-31 kg is travelling at 0.999c. Determine the relativistic mass of the electron.

**P5893**

Energy is radiated by the Sun at the rate of about 3.92×1026 W. Find the corresponding decrease in the Sun’s mass for every second that it radiates.

**Answer 1 (A5023)**

**Answer 2 (A5086)**

**Answer 3 (A5117)**

**Answer 4 (A5188)**

**Answer 5 (A5345)**