

EXAM QUESTIONS

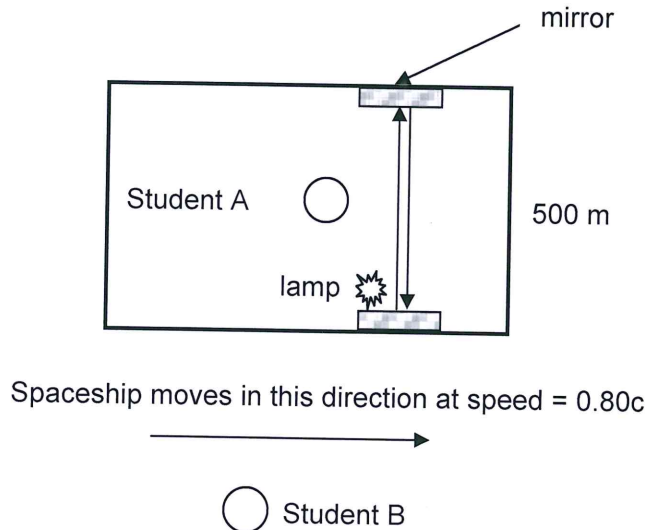
Chapter 6.4 - Einstein's Relativity

Question 1 2010:1:9

(4 marks)

Many hundreds of years in the future, two students are measuring the time it takes for a pulse of light to travel between a lamp and a mirror placed on opposite sides of a spaceship. The spaceship is 500 m wide and can travel at a speed equal to $0.80c$ ($0.80 \times$ the speed of light).

Top down view



Student A is in the spaceship moving at $0.80c$. Student B is stationary outside the spaceship.

The students start stopwatches when a light pulse leaves a lamp closest to Student B and stops them when it returns reflected off the second mirror furthest from B.

Student A measures the time for the pulse of light to travel to the mirror and back to be $3.30 \mu\text{s}$. Student B measures the time for the pulse of light to travel to the mirror and back to be $5.50 \mu\text{s}$. Both students have recorded their times correctly.

Explain why Student B measures a longer time than Student A, using a labelled diagram to aid your explanation. Calculations are not required.

Question 2 2013:1:10

(3 marks)

A geostationary satellite orbits the Earth at an altitude of 35 000 km. It travels at a speed of approximately 3000 m s^{-1} .

Relativistic effects may cause a clock on board the satellite to run a little slower or a little faster than the same clock on the surface of the Earth. Considering the factors that may lead to relativistic effects, complete the table below.

| Factor leading to relativistic effect | Change in factor | Effect on time shown by clock |
|---------------------------------------|------------------|-------------------------------|
| gravitational field | decreased | faster |
| | | |