

EXAM ANSWERS

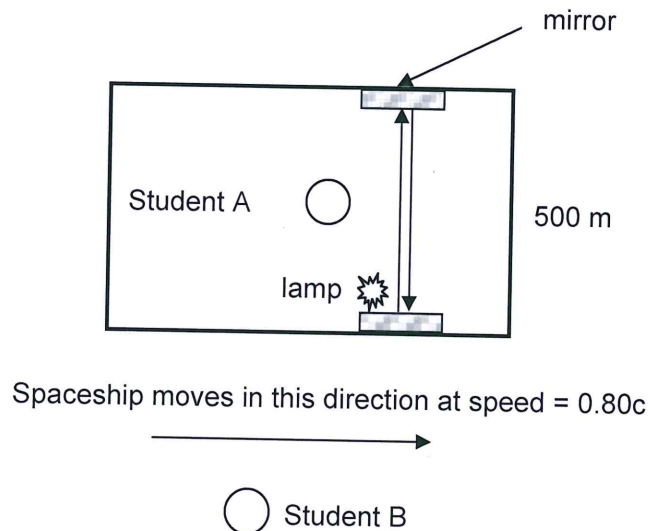
Chapter 6.4 - Einsteins Relativity

Answer 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

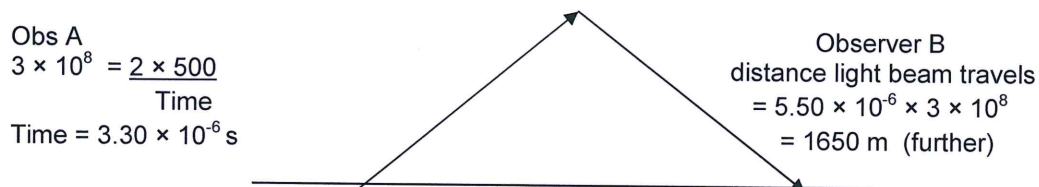


Student A is in the spaceship moving at $0.80c$. Student B is stationary outside the spaceship.

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



Description	Marks
Observer A and Observer B are not in the same reference frame Observer A moves with the pulse of light and mirrors, Observer B watches them move past him. For both observers the speed of light remains constant.	1
Light path drawn correctly and labelled	1-2
Observer B will watch the light trace the path shown on the diagram above. He observes the light trace the path of a right angled triangle, which is longer distance so he measures a longer time.	1

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Chapter 6.4- Einsteins Relativity

Answer 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
velocity	increased	slower

Description	Marks
correct entry in table, 1 mark	1-3
Total	3