Marks

Question 19 (4 marks)

In one of Einstein's famous thought experiments, a passenger travels on a train that passes through a station at 60% of the speed of light. According to the passenger, the length of the train carriage is 22 m from front to rear.

(a) A light in the train carriage is switched on. Compare the velocity of the light beam as seen by the passenger on the train and a rail worker standing on the station platform. **1**

From both observers, light is always seen to travel at $3 \times 10^8 \text{ m s}^{-1}$.

(b) Calculate the length of the carriage as observed by the rail worker on the station platform. **3**

$L = L_0 \sqrt{1 - \frac{v^2}{c^2}}$

$L = 22 \sqrt{1 - \frac{(0.6 \times 3 \times 10^8)^2}{(3 \times 10^8)^2}}$

$L = 22 \times \sqrt{0.64}$

$\therefore L = 17.6 \text{ metres.}$