

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

As light is independent of where the observer is
the passenger and rail worker could
both see it as $3 \times 10^8 \text{ m s}^{-1}$.

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

$$l = 22 \sqrt{1 - \frac{v^2}{c^2}}$$

$$l = 2.77$$

$$22 \times 1.33 = 29.26$$

and the rail worker could observe
it as 29.26 m long.