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   **1**
beam as seen by the passenger on the train and a rail worker standing on the
station platform.

The velocity of light would be the same for the passenger and the rail worker. (light is constant in all reference frames → special relativity) einstein

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

$$l_0 = 22m$$
$$l = l_0\sqrt{1-\frac{v^2}{c^2}}$$
$$\therefore v = 0.6c$$
$$\therefore l = 22\sqrt{1-\frac{(0.6)^2}{c^2}}$$
$$l = 22\sqrt{1-0.36}$$
$$l = 17.6m$$

∴ as seen by the railworker, the length of the train will be 17.6m (3sf)