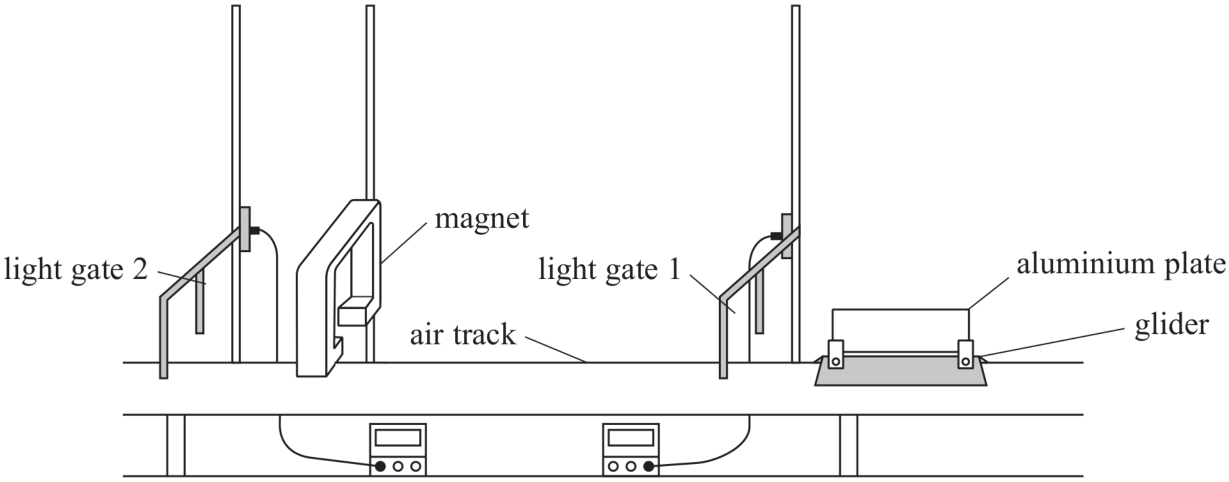
18 A student investigated electromagnetic braking using the apparatus shown.

A vehicle consisting of a glider and aluminium plate was placed on an air track. A powerful magnet was positioned between the two light gates so that the aluminium plate could pass between the poles of the magnet. The air resistance on the vehicle was negligible.



(a) (i) The vehicle was given a push. The aluminium plate took 0.19 s to pass through light gate 1.

Show that the momentum of the vehicle was about 0.3 N s.

length of plate = 15.0 cm
mass of vehicle = 0.40 kg

(3)

....

....

....

....

....

....

(ii) The vehicle then moved between the poles of the magnet before passing through light gate 2.

The magnet caused the kinetic energy of the vehicle to reduce by 10%.

Calculate the velocity of the vehicle at light gate 2.

(3)

....

....

....

....

....

....

Velocity = ...

(b) (i) Explain why a current was produced in the aluminium plate as it passed between the poles of the magnet.

(2)

....

....

....

....

(ii) The kinetic energy of the vehicle decreased as the aluminium plate moved between the poles of the magnet.

Explain why.

(2)

....

....

....

....

(c) The investigation was repeated using different aluminium plates with the same length but different thicknesses. The vehicle was given the same approximate initial velocity each time. The table shows the thickness of each aluminium plate and the corresponding percentage reduction in kinetic energy of the vehicle.

	Thickness / mm	**Percentage reduction in kinetic energy**
Initial plate	0.50	10
Second plate	0.80	16
Third plate	1.1	22

(i) Show that the percentage reduction in kinetic energy is proportional to the thickness of the plate.

(2)

....

....

....

....

(ii) Suggest why the percentage reduction in kinetic energy increases as the thickness of the plate increases.

(3)

....

....

....

....

....

....

(Total for Question 18 = 15 marks)