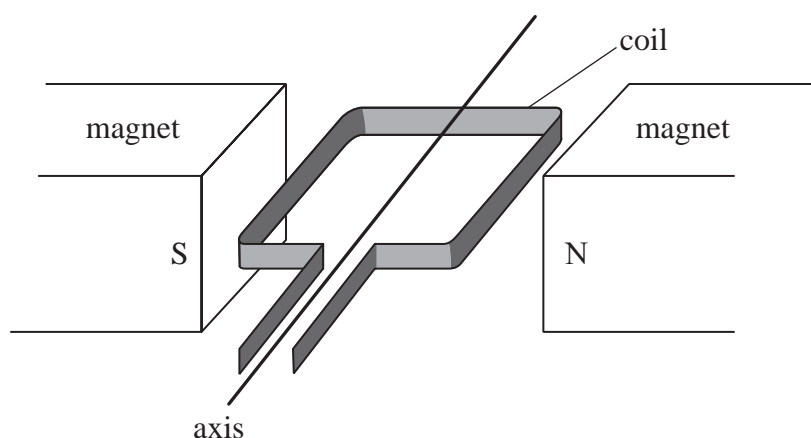


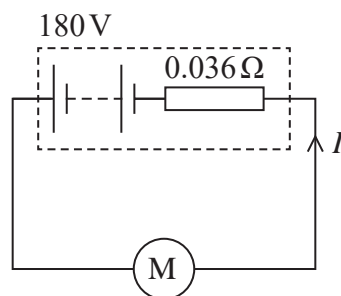
17 Hybrid electric vehicles (HEV) use the same device both as a generator to charge the car battery and as an electric motor to support the propulsion system. A simplified diagram of the device is shown. The coil can rotate freely around the axis.



*(a) Describe how the device can be used as both a generator and an electric motor.

(6)

(b) The circuit diagram shows a car battery connected to an electric motor for a HEV. The battery has an electromotive force (e.m.f.) 180 V and internal resistance $0.036\ \Omega$.



The motor has a maximum power of 88 kW.

(i) Show that the current I drawn by the electric motor when operating at this power would be given by the equation

$$0.036I^2 - 180I + 88\,000 = 0$$

(3)

(ii) Solving the equation above produces an answer of $I = 550\text{ A}$. At maximum power, the car can accelerate from rest to sixty miles per hour in under 7 s.

The maximum charge capacity of the battery within this HEV is 6.1 amp-hour.

Deduce whether the battery could maintain this current for up to 7 s.

(2)