7 **(a)** Consider the electric field created by the charged parallel plates in Fig. 7.1

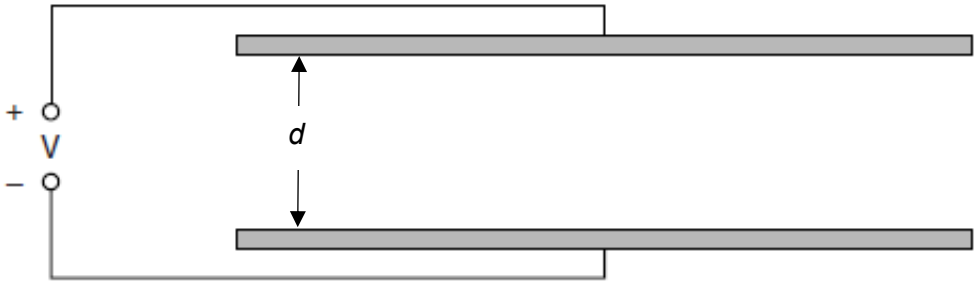

Fig. 7.1

These plates are separated by a distance *d* and there is a potential difference *V* between them. A small charge of +*Q* is moved slowly from the negative plate up to the positive plate by applying a force *F*.

State an expression for the work *W* done on the charge

(i) in terms of *V* and *Q*,

W = ... [1]

(ii) in terms of *F* and *d*.

W = ... [1]

(b) Use your answers to **(a)(i)** and **(a)(ii)** to show that the electric field strength between the plates is equal to the potential gradient.

[2]

(c) Fig. 7.2 shows a side view of a U-shaped permanent magnet of mass 82.0 g resting on an electronic top-pan balance.

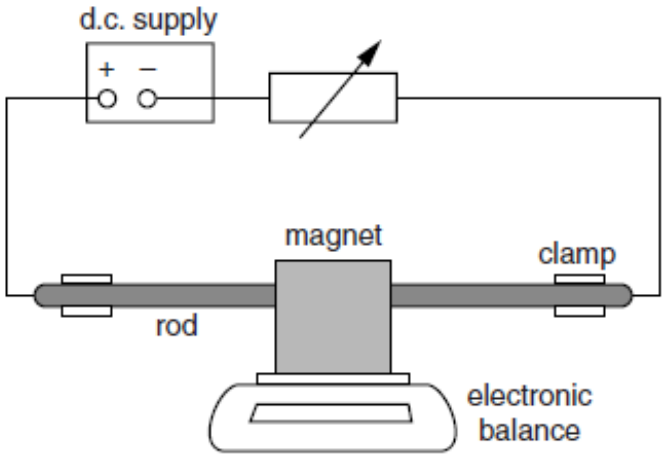

Fig. 7.2

An aluminium rod is clamped between the poles of the magnet so that the rod cannot move. The rod is connected in the circuit shown.

The d.c. supply is switched on. The reading on the balance increases to 82.4 g.

(i) Calculate the additional force exerted on the magnet when there is a current in the circuit.

additional force = …… N [1]

(ii) Explain how this additional force originates.

……...

……...

……...

……...

…….. [2]

(iii) Fig. 7.3 shows a plan view, from above, of the apparatus shown in Fig.7.2. The plan shows the aluminium rod fixed between the poles of the U-shaped magnet. The direction of current in the aluminium rod is from left to right.

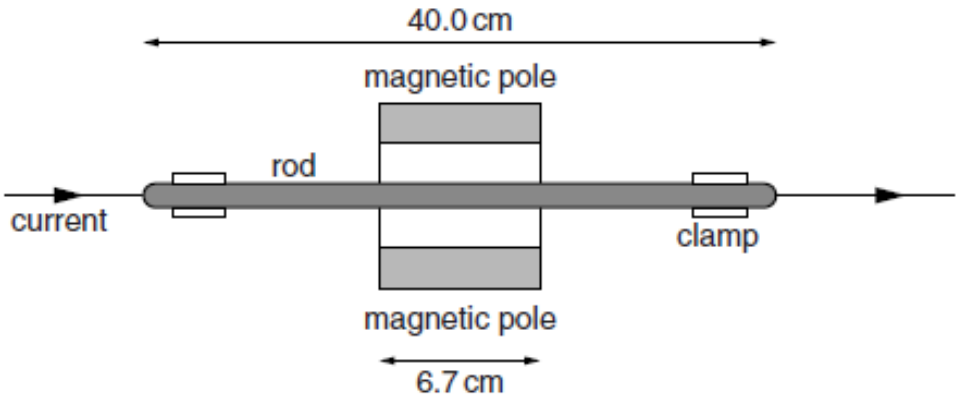

Fig. 7.3

1. On Fig. 7.3, draw an arrow to show the direction of the magnetic field between the poles that resulted in the increase in the balance reading. [1]

2. The aluminium rod is 40.0 cm long and the length of each magnetic pole is 6.7 cm. The magnetic flux density between the poles is 28.6 mT.

Calculate the current in the aluminium rod.

current = …….. A [2]

3. The connections to the d.c. supply are switched over so that the current is reversed. The reading on the electronic balance changes.

Determine the new reading on the electronic balance.

new reading = …….. g [1]

[Total: 11]