OCR
Oxford Cambridge and RSA

AS Level Physics B

H157/02 Physics in depth

Question Set 3

1 **Fig. 1.1** represents a cell of e.m.f. ε and internal resistance r. **A** and **B** are the positive and negative terminals of the cell.

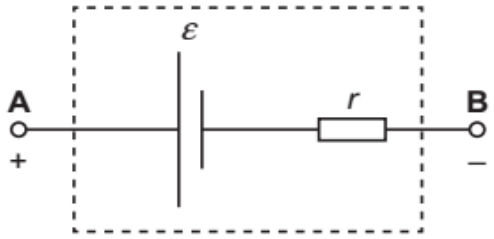

Fig. 1.1

(a)* Complete the circuit diagram of **Fig. 1.1**, adding appropriate meters and a variable resistor, to show how you could determine values of ε and r. Describe and explain the procedure you would use to determine accurate values of ε and r and their uncertainties. **[6]**

(b) A battery-powered appliance has a rechargeable battery consisting of two lithium-ion cells in series. Each cell has an e.m.f. ε = 3.6V and an internal resistance r = 0.32Ω.

The capacity of this battery is 1200 mAh, meaning that a fully-charged battery can deliver an average current of 1200 mA for an hour before it is completely discharged.

A fully-charged battery of this type is connected to an external load of resistance 5.2Ω until it is completely discharged. You can assume that the e.m.f. ε is constant throughout the discharge.

(i) Show that a charge of about 4kC flows during this discharge. **[1]**

(ii) Calculate the time taken for the discharge.

time = …….. s **[3]**

(iii) Show that the percentage efficiency of energy transfer to the load resistance R is given by

$$\text{percentage efficiency} = 100 \times \frac{R}{R + 2r}$$

where r is the internal resistance of one of the battery cells. **[3]**

(c) Lithium-ion rechargeable batteries are used for a large number of charge-discharge cycles.

Fig. 1.2 shows how the energy stored in such a battery changes with the number of charge-discharge cycles. This is shown for two discharge currents: 2A and 15A. In this graph, a relative capacity of 100% refers to the energy stored when the battery is first charged.

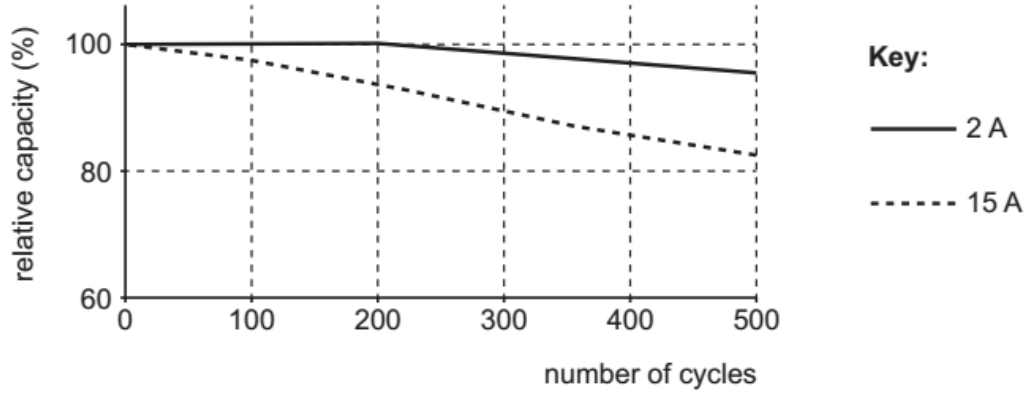

Fig. 1.2

Use the information in **Fig. 1.2** to discuss the suitability of this type of battery for a mobile phone and for an electric car. **[3]**

Total Marks for Question Set 3: 16