

AS Level Physics B
H157/02 Physics in depth

Question Set 3

Fig. 1.1 represents a cell of e.m.f. \mathcal{E} and internal resistance r . **A** and **B** are the positive and negative terminals of the cell.

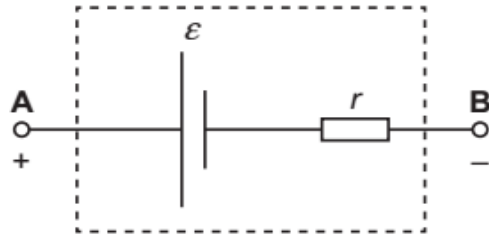


Fig. 1.1

- (a)*** Complete the circuit diagram of **Fig. 1.1**, adding appropriate meters and a variable resistor, to show how you could determine values of \mathcal{E} and r . Describe and explain the procedure you would use to determine accurate values of \mathcal{E} 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. $\mathcal{E} = 3.6\text{V}$ and an internal resistance $r = 0.32\Omega$.

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. \mathcal{E} 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.

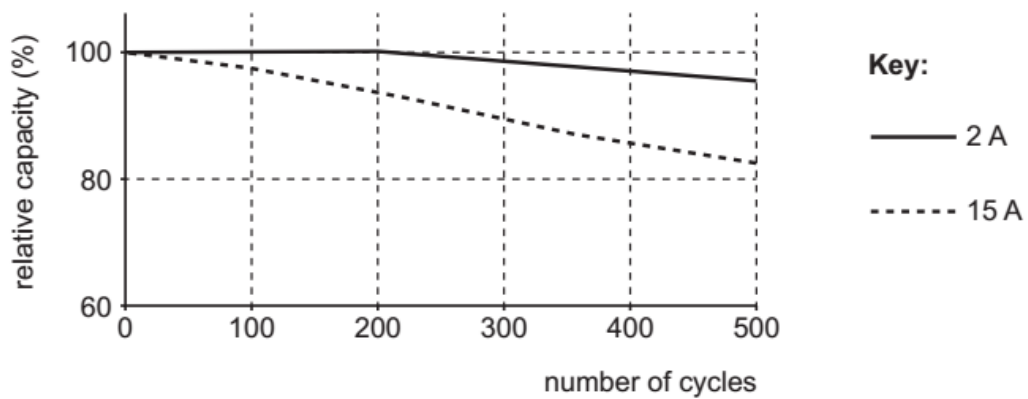


Fig. 1.2

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

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