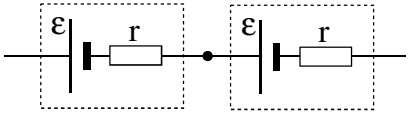
5.4 Cells in Series and Parallel

(i) Cells in series

- When cells are connected in series, the total emf is the sum of the emfs of each cell.
- The current through each cell is the same.

$$cell\ current = \frac{cell\ emf}{total\ circuit\ resistance}$$

- The 'lost volts' $\varepsilon - V = I(sum\ of\ internal\ resistances)$

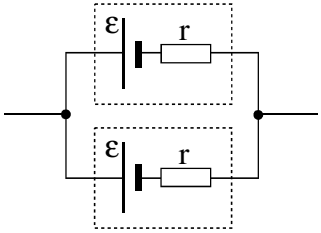


Cells in series

(ii) Cells in parallel

- When identical cells are connected in parallel, the total emf is equal to the emf of each cell.
- The total current supplied is the sum of the currents through each. If there are n cells and the total current is I, the current through each cell is I/n.
- The total 'lost volts' is given by:

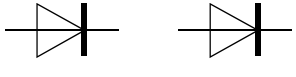
$$\varepsilon - V = \frac{Ir}{n}$$



Cells in parallel

Diodes in circuits

- In forward bias, a p.d. of 0.6 volts exists across a semiconductor diode if it is passing a current.
- In reverse bias, the diode has a near infinite resistance.



current in forward bias | **current in reverse bias**

5.5 The Potential Divider

The potential divider is a combination of two or more resistors in series. A power supply is connected across all the resistors and various p.d.s can be tapped of the combination. The resistors can be fixed or variable, giving a device which can provide a fixed output, a variable pd. output or an output p.d. that changes with some physical condition such as light level or temperature.

For the stepped output in figure 1,

$$V_{out} = \left(\frac{R_3}{R_1 + R_2 + R_3}\right) V_{in}$$

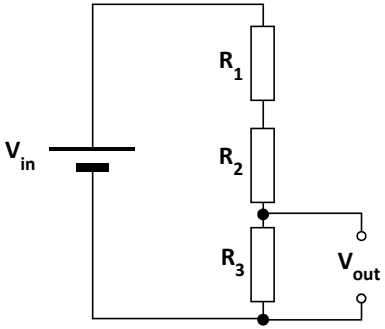


Fig 1

If one of the resistors in a potential divider combination is made variable, a continuously variable output can be achieved, as shown in figure 2.

$$V_{out} = \left(\frac{R_1}{R_1 + R_2}\right) V_{in}$$

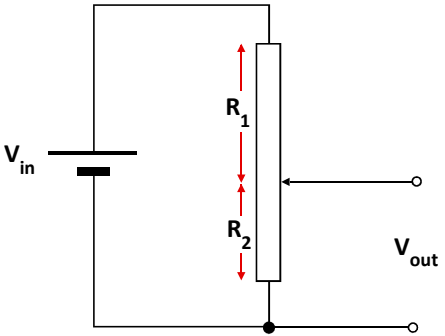


Fig 2

Sensor circuits are often controlled by a potential divider in which the sensor, (a thermistor or light-dependent resistor, for example), is one of the resistors. The other resistor is variable to adjust the temperature or light level at which the sensor circuit switches on.

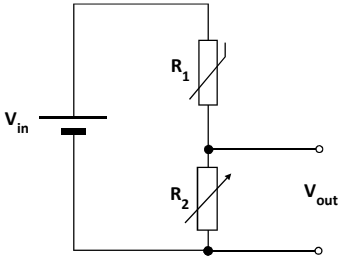


Fig 3