Semiconductors

n-Type and *p*-Type Semiconductors

Read the corresponding paragraphs in section 23.5 of your text book and answer the following questions:

- What are the two commonly used semiconducting materials?

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- Why is pure silicon a poor conductor for electricity?

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- How is the conductivity improved by doping a semiconductor?

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- How can a positively charged hole wander through a semiconductor crystal?

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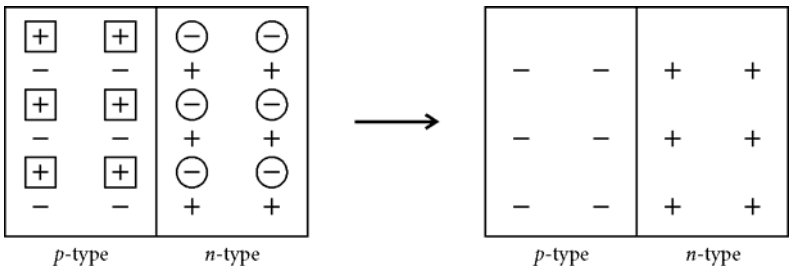
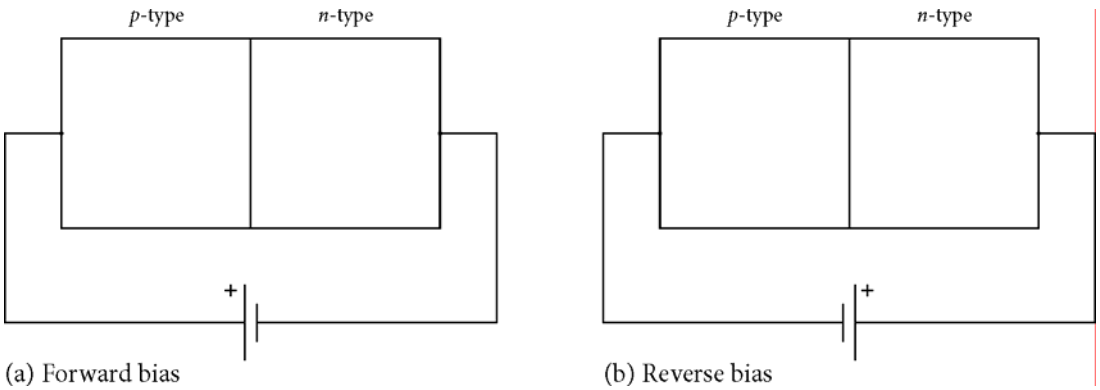
The Semiconductor Diode

A *semiconductor diode* is a device formed from a *p*-type semiconductor and an *n*-type semiconductor. Its operation depends on the *p*-*n* junction between the two materials.

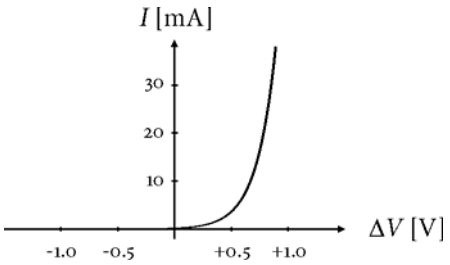


The diode allows the current to flow if it is in *forward bias* (i.e. the positive terminal of the voltage supply is connected to the *p*-type side of the *pn*-junction) and prevents the current from flowing in *reverse bias*.



(a) Forward bias (b) Reverse bias

The diagram below shows the characteristics (current vs. voltage) of a typical diode. In many circuits, the voltage drop across the diode (forward bias) can be considered to be practically constant. For a silicon diode it is about 0.7 V, for a red LED (*light emitting diode*) about 2 V.

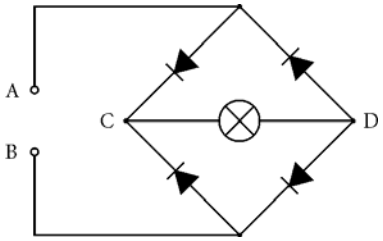


Rectifier Circuits

A *rectifier circuit* is used to convert an ac voltage into a dc voltage. In its simplest form, it consists of a single diode, which allows for a current flow only during the positive voltage cycle (*half wave rectifier*). An improved rectifier circuit is shown below (*full wave rectifier*). In any rectifier, a capacitor connected in parallel to the load can be used to make the dc voltage smooth.

Tasks:

- Draw the path the current follows for the case that A is the positive terminal in a first colour. Draw the path for the other case in a different colour.



- Draw the rectified voltage in the right diagram below. In the same diagram, draw the signal as you expect it after the addition of a smoothing capacitor in a different colour.