values to output a corresponding value. Each input and output usually corresponds to either a high or a low voltage. We shall use the bit 1 to represent a high voltage, or the truth value "1" of a statement; and the bit 0 to represent a low voltage, or the truth value "0" of a statement. Recollect that all contradictions have truth value 0 and all tautologies have truth value 1.

We shall consider three basic gates, corresponding to the logical connectives $\neg$, $\wedge$ and $\vee$. They are called, respectively, the **NOT-gate**, the **AND-gate** and the **OR-gate**. They are usually depicted by block diagrams, as illustrated in Figure 3.8 below.

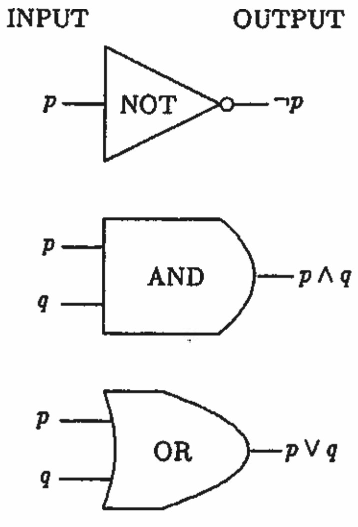

Figure 3.8.

The value of the output (0 or 1) for each value, or combination of values, for the input(s) can be derived from the logic tables for $\neg p$, $p \wedge q$ and $p \vee q$ (see Figures 3.1 and 3.2).

3.4.1 Designing logic networks

The logic gates can also be concatenated to represent more complicated compound statements. The circuits so formed are known as **logic networks**.

Example 3.12 We design a logic network that has two inputs p and q and outputs $p \to q$. To do this, we must use a compound statement that is logically equivalent to $p \to q$, but uses only the connectives $\neg$, $\wedge$ and $\vee$. In Result 3.5, we proved that $p \to q \equiv \neg p \vee q$. Using this fact, we can design a logic network with output $p \to q$, as shown in Figure 3.9. □

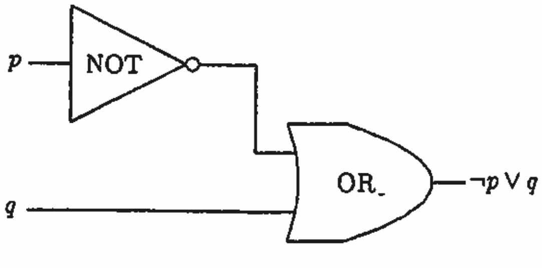

Figure 3.9.

Example 3.13 Suppose we require to devise a logic network with four inputs p, q, r, s and output