III ELECTRICAL MEASUREMENTS

The flow of charge in a wire is called current. It is expressed in terms of the number of coulombs per second going past a given point on a wire. One coulomb/sec equals 1 ampere (symbol A), a unit of electric current named after the French physicist André Marie Ampère. *See* Current Electricity *below*.

When 1 coulomb of charge travels across a potential difference of 1 volt, the work done equals 1 joule, a unit named after the English physicist James Prescott Joule. This definition facilitates transitions from mechanical to electrical quantities.

A widely used unit of energy in atomic physics is the electronvolt (eV). This is the amount of energy gained by an electron that is accelerated by a potential difference of 1 volt. This is a small unit and is frequently multiplied by 1 million or 1 billion, the result being abbreviated to 1 MeV or 1 GeV, respectively.

IV CURRENT ELECTRICITY

If two equally and oppositely charged bodies are connected by a metallic conductor such as a wire, the charges neutralize each other. This neutralization is accomplished by means of a flow of electrons through the conductor from the negatively charged body to the positively charged one. (Electric current is often conventionally assumed to flow in the opposite direction—that is, from positive to negative; nevertheless, a current in a wire consists only of moving negatively charged electrons.) In any continuous system of conductors, electrons will flow from the point of lowest potential to the point of highest potential. A system of this kind is called an electric circuit. The current flowing in a circuit is described as direct current (DC) if it flows continuously in one direction, and as alternating current (AC) if it flows alternately in each direction.

Three interdependent quantities characterize direct current. The first is the potential difference in the circuit, which is sometimes called the electromotive force (emf) or voltage. The second is the rate of current flow. This quantity is usually given in terms of the ampere, which corresponds to a

flow of about 6.24×10^{18} electrons per second past any point of the circuit. The third quantity is the resistance of the circuit. Under ordinary conditions all substances, conductors as well as non-conductors, offer some opposition to the flow of an electric current, and this resistance necessarily limits the current. The unit used for expressing the quantity of resistance is the ohm, which is defined as the amount of resistance that will limit the flow of current to 1 ampere in a circuit with a potential difference of 1 volt. The symbol for the ohm is the Greek letter Ω, omega. The relationship may be stated in the form of the algebraic equation $E = I \times R$, in which E is the electromotive force in volts, I is the current in amperes, and R is the resistance in ohms. From this equation any of the three quantities for a given circuit can be calculated if the other two quantities are known. Another formulation is $I = E/R$. *see* Electric Circuit; Electric Meters.