The wavelength for maximum power (λ_{max}) is inversely proportional to the temperature (T). The following formula was developed by Planck's co-worker at the University of Berlin and is known as Wien's Displacement Law.

$$\lambda_{max} = \frac{c_3}{T}$$

c_3 has a value of 2.90×10^{-3} mK.

The result of the application of this formula is that if an object is heated to a high enough temperature (in excess of 2,000 °C) a reasonable amount of light is produced; this provides the basic operating principle of the incandescent lamp.

In practice many materials when heated radiate energy at slightly different rates to that predicted by Planck. This property can be exploited by light source makers. For example tungsten emits about a third more energy as light than would be predicted by Planck's formula.

3.1.2 Electric discharges

An electric discharge is an electric current that flows through a gas. These discharges generally take a high voltage to initiate but once started they can carry considerable currents with very little voltage drop. A good example of such a discharge is the natural phenomenon of lightning. In an electric discharge the electric current is carried by electrons that have been removed from the gas atoms and ions that are gas atoms with one or more electrons removed. This is shown in Figure 3.2.

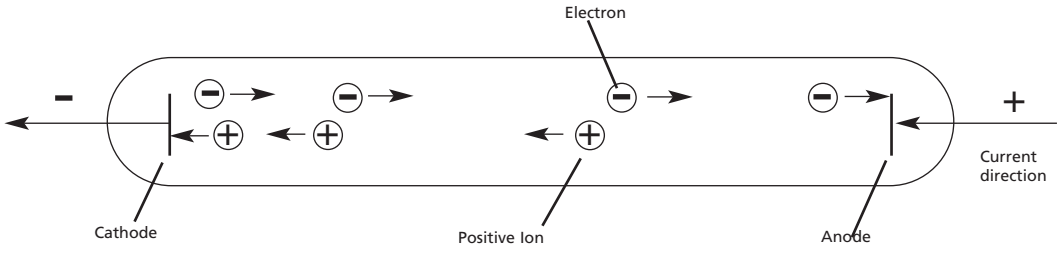

Figure 3.2 Electric discharge through an ionised gas

The negatively charged electrons tend to drift towards the anode whilst the positively charged ions drift towards the cathode. As the ions are several thousand times heavier than the electrons they tend to be less mobile.

When an electron collides with an atom, one of three things may happen:

(*a*) The electron rebounds with only a small change in energy – *elastic collision*
(*b*) The impact excites the atom and the electron loses energy – *excitation*
(*c*) The impact removes an electron from the atom – *ionisation*

Elastic collisions just heat the gas. Excitation raises the energy state of the atom so that it may radiate light. Ionisation generates more free electrons so that the discharge is maintained.