

2 A helium atom may be modelled as a nucleus surrounded by two electrons in diametrically opposite circular orbits, each of radius 170 pm, as shown in Fig. 2.1.

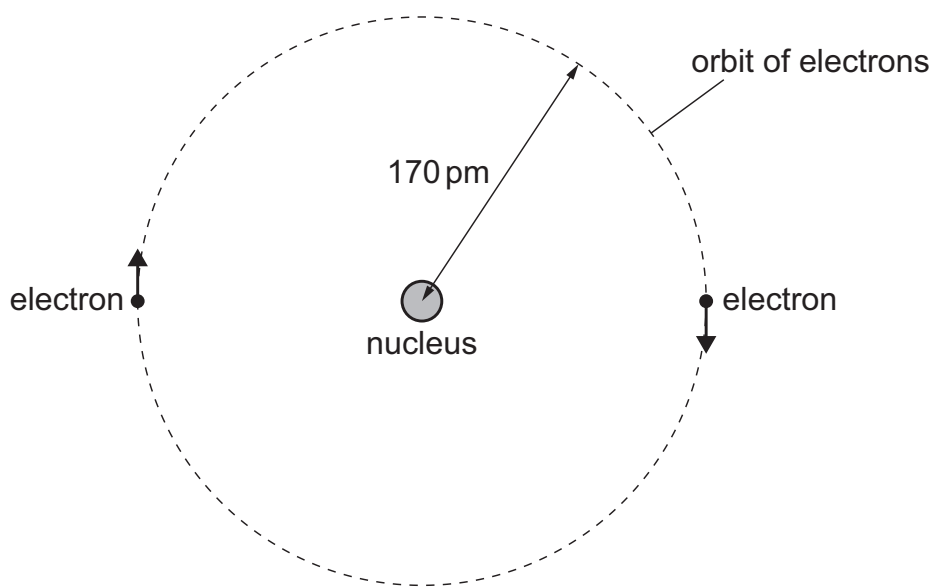


Fig. 2.1

(a) State Coulomb's law.

.....  
 .....  
 ..... [2]

(b) (i) State the charge on the nucleus, in terms of the elementary charge  $e$ .

charge = .....  $e$  [1]

(ii) Show that the electric force between the nucleus and one of the electrons is  $1.6 \times 10^{-8} \text{ N}$ .

[1]

(c) Assume that the force in (b)(ii) is the only force on the electrons.

(i) Calculate the speed of the orbiting electrons.

speed = .....  $\text{ms}^{-1}$  [2]

(ii) Calculate the period of the orbit of the electrons.

period = ..... s [2]

(d) In practice, the orbit of each electron is affected by the presence of the other electron.

(i) For the position of one of the electrons, determine the ratio

$$\frac{\text{electric field strength due to the other electron}}{\text{electric field strength due to the nucleus}}$$

ratio = ..... [2]

(ii) Use your answer in (d)(i) to suggest and explain how the orbit of the electron is affected by the presence of the other electron.

.....  
 ..... [1]