Q- The normal hydrogen atom consists of a proton nucleus and an orbital electron. Assume that the electron orbit is circular and that the constant distance between the proton and electron is 5.3 $\times 10^{-11} \mathrm{~m}$.
(a) What is the force of attraction between the two fundamental particles?

The force is given by the Coulomb's law as

$$
F=\frac{q_{1} q_{2}}{4 \pi \in_{0} r^{2}}
$$

$$
\left[\frac{1}{4 \pi \epsilon_{0}}=9 * 10^{9}\right]
$$

The magnitude of the charge on a proton and the electron both is $1.6 * 10^{-19} \mathrm{C}$. Hence the magnitude of the force between the proton and electron will be

$$
F=\frac{9 * 10^{9} * 1.6 * 10^{-19} * 1.6 * 10^{-19}}{\left(5.3 * 10^{-11}\right)^{2}}=8.2 * 10^{-8} \mathrm{~N}
$$

(b) What is the orbital speed of the orbiting electron?

The force calculated in above question is acting as centripetal force on the electron and hence we have

Centripetal force $=\mathrm{mv}^{2} / \mathrm{r}=\mathrm{F}$
Gives $v=\sqrt{\frac{F R}{m}}=\sqrt{\frac{8.2 * 10^{-8} * 5.3 * 10^{-11}}{9.11 * 10^{-31}}}=2.18 * 10^{6} \mathrm{~m} / \mathrm{s}$

