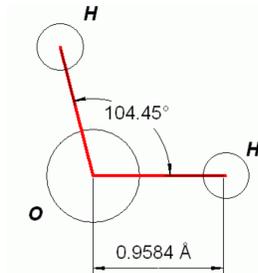


## 25 electric potential energy, electric potential

1. A crude model of the water molecule is given below.



- (a) Calculate the electrostatic energy of this configuration.  
 (b) Is energy required to form this molecule, or is energy released when forming this molecule?

*adapted from Wolfson 23.17*

2. A proton with an initial speed of 800,000 m/s is brought to rest by an electric field.
- (a) Did the proton move into a region of higher potential or lower potential?  
 (b) Did electric potential energy increase or decrease?  
 (c) What potential difference stopped the proton?
3. Repeat the above for an electron with the same initial speed.
4. A beam of protons A is accelerated from rest using a uniform  $\vec{E}$ . Another beam of protons B is accelerated from rest using a non-uniform  $\vec{E}$ . Both are subject to the same potential difference. Compare the final speed of the two beams.
5. Your lab partner wants to make a small particle accelerator using an ordinary AA battery.
- (a) What's the potential of an ordinary AA battery?  
 (b) What speed will an electron have after being accelerated from rest through the potential difference?  
 (c) You connect the battery to a parallel plate capacitor, with 4cm x 4cm plates spaced 1.0mm apart. How much charge does the battery supply to each plate?
6. A uniform 650 N/C electric field is in a space. Consider any two points, 1 and 2 separated by 1.3m, in the field.
- What's the largest potential difference between 1 and 2? The smallest?
7. In an x-ray tube, electrons are accelerated from rest through a potential difference of 30kV. This acceleration occurs over 10cm, after which the electrons hit a target where its abrupt deceleration produces x-rays.

- (a) Calculate the kinetic energy gained by electrons in the acceleration.

Another unit of energy is the electron volt ( $eV$ ). It's the amount of kinetic energy gained by electrons upon accelerating through a 1V potential difference. Here, the electrons have 30keV of energy.

- (b) What's the conversion factor between  $eV$  and J?  
 (c) Compare the speeds of electrons with 60keV of energy to the 30keV. That is, calculate  $v_{60keV}/v_{30keV}$ .

**Due next meeting, beginning of class**

### 25.6 26.7 electric potential of a point charge, many charges

- Identify and write the equation for the electric potential of a point charge. For every term in this equation, provide a name and its units.
- Identify and write the equation for the electric potential of a charged sphere. For every term in this equation, provide a name and its units.
- Write down equation 25.35. What does this equation describe? Use 1-3 full sentences and your own words.

25.29 in the textbook.