7.1 probe

January 23, 2018 11:03 AM

7.1: The Development of Modern Atomic Theory

- Early Greek philosophers began searching for methods of allowing us to see inside an atom, something so small that was invisible to the naked eye
- This same issue continues to baffle scientists today, almost 2400 yrs later!
- These days it is common for scientists to use either conceptual or physical models to study things which are not easily observed, and the effectiveness of these models are tested through experiments

It's all Greek to me...

- Contrary to what Science Probe 9 says, the development of atomic theory as we know it began with the work of Greek philosopher Democritus
- He began the search for a description of matter more than 2400 yrs ago
- He asked: could matter be divided into smaller and smaller pieces forever, or was there a limit to the # of times a piece of matter could be divided?

- His theory: that matter could not be divided into smaller and smaller pieces forever; eventually the smallest possible piece would be obtained. This piece would be indivisible.
- He named the smallest piece of matter atomos, meaning "not to be cut". This is where the word atom originates.

- To Democritus, atoms were hard, small particles that were all made of the same material but were different sizes/shapes. Atoms were infinite in number, always moving and capable of joining together. What a guy!

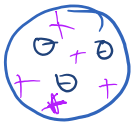
= atomos

The 1st Scientific Atomic Theory (John Dalton!!)

- By the late 1700s most scientists were in agreement that an element was a type of matter that could not be broken into simpler substances
- More than 30 elements had been discovered by this time
- Scientists knew that elements would combine to form compounds during chemical reactions, but they were not really able to explain how this happened
- In 1808 and English chemist named John Dalton proposed an atomic theory of matter that could explain the behaviour of reactions
- John Dalton (1766-1844) was such a smart guy that he became an English teacher at the age of 12 ☺ fun fact ☺
- Dalton envisioned the atom (aka. the smallest piece of elements) as a smooth, solid sphere, without an electrical charge
- His theory included the following points:
  - All matter is made of atoms, which are small particles we can't see
  - Each element has its own kind of atom, with its own specific mass
  - All atoms of any one element are identical
  - compounds are created when atoms of different elements combine in a specific way
  - Atoms cannot be created, destroyed, or divided - during a chemical change
- Dalton's theory envisioned the atom as resembling a billiard ball

New Discoveries: Revisions to Dalton's Atomic Theory

- Dalton's atomic theory was able to explain chemical reactions relatively well, but it did not account for the phenomenon of static electricity and electric charge
- In the 1830s Michael Faraday showed the world that atoms could gain electric charge, and Dalton's theory did not include charged atoms at all. Modifications needed to be made!

- The following modifications were made to Dalton's theory:
  - Matter must contain + and − charges
  - opposite charges attract, and like charges repel
  - Atoms combine to form the particles of a compound because of the electrical attraction between charged atoms
  - Picture: K^+ I^- ⇒ KI
- The revised theory did help explain how atoms formed compounds but scientists had yet to understand how the atoms themselves became charged
- In 1898, an important discovery was made: the electron by JJ Thomson
- Thompson proposed that the atom was mostly made up of positive matter, with a few negative electrons scattered randomly throughout. → 
- In 1904 this became known as Thompson's raisin-bun model (aka. plum pudding), and it was widely accepted among scientists
- Thompson's discovery led to the following revisions to atomic theory:
  - Atoms contain electrons
  - The electrons have a − charge and a very mass
  - The rest of the atom has a + charge
  - The electrons are embedded randomly in the positive part of the atom
  - Electrons can be added or removed to atoms, which creates charged particles
  - Picture:

→ read p. 204-205, half of 206.

→ do Q's p. 208 #1, 2, 3, 5, 6.

BLOCK 1
TUES. Jan 30th
Start Here!

What about the Nucleus?

- The next scientist to make an impact was Ernest Rutherford, who actually had the chance to work underneath JJ Thomson at Cambridge University
- Rutherford won the Nobel Prize for chemistry in 1909, which was two years BEFORE his experimental results would change the structure of the atom (which is pretty cool)
- Rutherford performed an experiment called the Gold foil experiment where he sent a concentrated beam of small, positively charged particles (only a few atoms thick) towards a small piece of gold foil.
- Initially, he had expected that the positive particles would be deflected by the gold atoms in the foil, but he was shocked to discover that most of the particles passed straight through the foil, as if they were carrying on through empty space. Even more shocking, some of the particles bounced right back off of the foil!
- Based on this experimental evidence, Rutherford concluded that almost all the matter in an atom is concentrated in a very small space.
- These results caused a significant change in how scientists viewed the atom
- Rutherford was able to reason, through experimentation, that most of the mass of an atom, as well as all of its positive charge was concentrated in its centre
- This location became known as the nucleus, and it was found to contain 2 types of particles: positively charged protons and neutral or uncharged neutrons
- The remaining mass of an atom, as well as all of its negative charge is made up of electrons that orbit the nucleus.
- Electrons are held in place there by the attractive forces between the charged objects

- Side note: Rutherford DID NOT discover the neutron, a young scientist working under him did! His name was James Chadwick, and he won the Nobel Prize for the discovery of the neutron in 1932

- In 1911 Rutherford proposed his nuclear model of the atom:
  - There is a nucleus. It contains most of the mass of an atom, and all of an atom's positive charge
  - The nucleus contains protons and neutrons
  - Neutrons have the same mass as protons
  - The nucleus is very small relative to the size of an atom
  - Electron orbit the nucleus
  - The mass of an electron is 1/1800th of the mass of one proton
  - The size of an atom is determined by the size of an electron's path of orbit
  - There is only empty space between electrons and the nucleus
  - Picture:

- When this theory was published Rutherford already knew it was not entirely correct...atomic theory would need further modifications! (something for you to look forward to!!!)

↳ we will see this when we study BOHR

DO: CYU's p. 208 #1-13

DO: 7.1 Q's p. 208 # 8, 10, 11, 12, 13

Next week ⟹ QUIZ on ALL atomic theorists! (and atomic structure)

these will help you review
- 1.3 worksheet
- 7.1 notes
- in-class presentations
- checkpoint quizzes