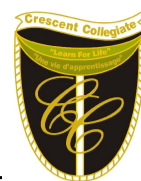


Science 9
Unit 2: Chemical Reactions
Worksheet 4: Atomic Theory



Theory an explanation of an event that has been supported by consistent, repeated experimental results and has therefore been accepted by most scientists.

Law a description of events, patterns, or relationships in science that have been observed over and over again. Laws do not provide explanations—they simply state what happens.

Atomic Theory is a scientific theory of the nature of matter, which states that matter is composed of discrete units called atoms.

History of the Atomic Theory:



1) Empedocles (370 BC)

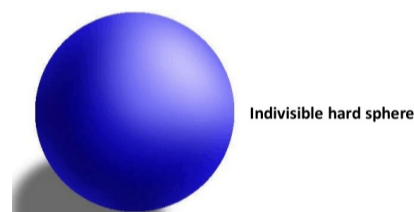
- all matter was composed of four “elements” (earth; air; water; and fire)
- This was later supported by Aristotle

2) Democritus (460 BC)

- proposed that matter cannot be broken down indefinitely. At some point you end up with a piece that can't be divided.
- That smallest piece he called an atom, from the Greek word atomos, which means “indivisible”.

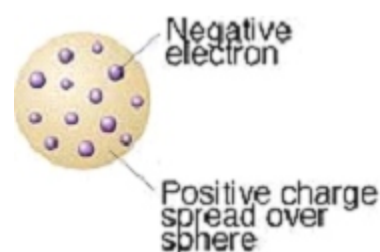
3) John Dalton (1808)

- All matter is made of small particles called atoms.
- Atoms cannot be created, destroyed, or divided into smaller particles
- All atoms of the same element are identical in mass and size, but they are different in mass and size from the atoms of other elements.
- Compounds are created when atoms of different elements link together in definite proportions.
- is often called the billiard ball or cannon ball model because he saw the atom as being the same throughout and being indivisible.



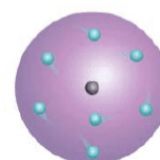
4) Joseph John Thomson (1897)

- discovered that atoms are made of smaller negatively-charged particles called electrons.
- His discovery was the result of doing experiments with “cathode ray tubes
- Thomson proposed a “raisin bun” or “Plum Pudding” model of the atom because he saw the negative electrons as being scattered throughout the positive area of the atom much the same as raisins are dispersed throughout a bun.



5) Ernest Rutherford (1910)

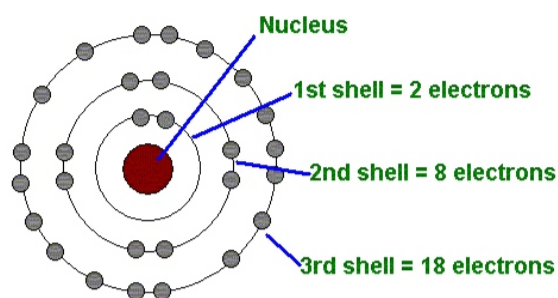
- He used the Gold Foil Experiment to make his observations about the atom.
- Proved that atoms are mostly empty space .
- discovered the nucleus—the tiny, dense, positively charged centre of the atom.
- Electrons move around nucleus
- This model is sometimes called the nuclear model



Rutherford's model:
Electrons move about a nucleus.

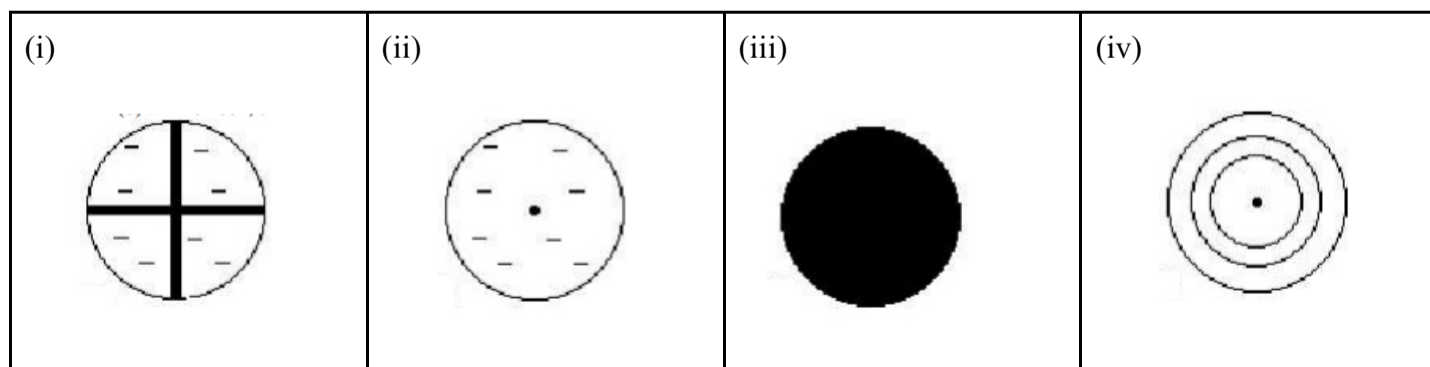
6) **Niels Bohr (1913)**

- proposed that electrons surround the nucleus in specific energy “levels” or “shells.”
- With each orbit only able to contain a set number of electrons.
- Theory is often called the orbital model because he saw the electrons as circling the nucleus at different energy levels away from the nucleus.
- This model is often called the planetary model because he saw the electrons circling the center of the atom in much the same way planets circle the sun.



PART A MULTIPLE CHOICE

- The atomic model has been modified many times over the years. This happened because
 - scientists have become smarter with time.
 - new evidence became available to scientists.
 - the actual nature of the atom has changed with time.
 - more elements were discovered.
- Which model of matter was proposed by Empedocles and supported by Aristotle?
 - the atom as an indivisible particle
 - the raisin bun model
 - the four element model
 - the planetary model
- Several models of the atom have been suggested by scientists since the beginning of the nineteenth century. What is the correct chronological order (earliest to latest) of the models proposed by the scientists listed below?
 - Dalton, Bohr, Thomson, Rutherford
 - Dalton, Thomson, Rutherford, Bohr
 - Thomson, Dalton, Rutherford, Bohr
 - Dalton, Rutherford, Thomson, Bohr
- Which of the answers below correctly identify the diagrams to represent the atomic models proposed by Dalton, Thomson, Rutherford, and Bohr?

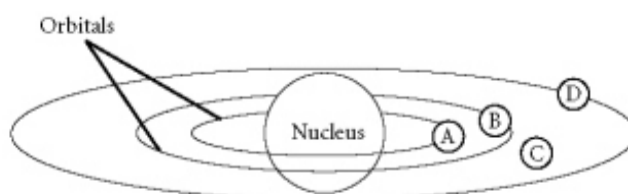


- | | | | | |
|-----|-----------------|------------------|-------------------|--------------|
| (A) | (i)=Rutherford, | (ii)=Bohr, | (iii)=Dalton, | (iv)=Thomson |
| (B) | (i)=Dalton, | (ii)=Rutherford, | (iii)=Thomson, | (iv)=Bohr |
| (C) | (i)=Dalton, | (ii)=Thomson, | (iii)=Rutherford, | (iv)=Bohr |
| (D) | (i)=Thomson, | (ii)=Rutherford, | (iii)=Dalton, | (iv)=Bohr |

5. Who first proposed the atomic theory based on scientific knowledge?
- (A) Democritus
 - (B) John Dalton
 - (C) Joseph John Thomson
 - (D) Neils Bohr
6. Dalton's atomic theory was one of the most important theories in chemistry. In this theory, atoms were considered to be
- (A) tiny solid indivisible spheres.
 - (B) the same for all elements.
 - (C) made up of smaller particles.
 - (D) mostly empty space
7. Which of the following statements is **not** part of Dalton's atomic theory?
- (A) All substances are composed of small, indivisible particles called atoms.
 - (B) The atoms of a given element are identical in every respect.
 - (C) The three main particles in atoms are protons, neutrons, and electrons.
 - (D) In chemical reactions, atoms combine in certain proportions
8. Which of the following statements is NOT part of Dalton's atomic model?
- (A) each element has its own type of atom
 - (B) atoms of the same element are identical
 - (C) all matter is made of tiny particles called atoms
 - (D) atoms can be broken down into sub-atomic particles
9. Who was the first scientist to realized that atoms had sub-atomic particles?
- (A) Dalton
 - (B) Thomson
 - (C) Rutherford
 - (D) Bohr
10. Which researcher first disproved Dalton's atomic model?
- (A) Democritus
 - (B) Thomson
 - (C) Rutherford
 - (D) Bohr
11. Which atomic model was the first one to include electrons?
- (A) Dalton's billiard ball model
 - (B) Thomson's raisin bun model
 - (C) Rutherford's electron cloud model
 - (D) Bohr's planetary model
12. The cathode ray tube was instrumental in the discovery of:
- (A) the electron
 - (B) the proton
 - (C) the neutron
 - (D) the atom, which is mostly empty space
13. The "plum pudding" model of the atom was proposed by
- (A) Dalton
 - (B) Thomson
 - (C) Rutherford
 - (D) Bohr

14. In a model of the atom sometimes referred to as the "raisin bun" model, the raisins represent the
- (A) protons
 - (B) neutrons
 - (C) nucleus
 - (D) electrons
15. Which scientist first proposed the existence of the nucleus in atoms?
- (A) Rutherford
 - (B) Bohr
 - (C) Thomson
 - (D) Dalton
16. In Rutherford's experiments, most of the particles
- (A) were absorbed by the foil.
 - (B) passed through the foil.
 - (C) combined with the foil.
 - (D) bounced back
17. What was discovered as a result of the gold foil experiment?
- (A) electron
 - (B) proton
 - (C) neutron
 - (D) Nucleus
18. Rutherford's gold foil experiment was instrumental in:
- (A) the discovery of the electron
 - (C) the discovery of alpha particles
 - (B) the discovery that an atom is mostly empty space
 - (D) both "a" and "c"
19. Which atomic model was the first one to include a nucleus?
- (A) Dalton's billiard ball model
 - (B) Thomson's raisin bun model
 - (C) Rutherford's electron cloud model
 - (D) Bohr's planetary model
20. What is the key difference between the models of the atom proposed by Bohr and Rutherford?
- (A) Bohr's model includes a nucleus, but Rutherford's does not
 - (B) Bohr's model has the atom made up of mostly empty space, but Rutherford's does not
 - (C) Bohr's model includes neutrons, but Rutherford's does not
 - (D) Bohr's model has the electrons moving in fixed energy levels, while in Rutherford's they do not
21. According to Bohr, electrons cannot reside at ____ in the figure below

- (A)
- (B)
- (C)
- (D)



PART B: WRITTEN RESPONSE

1. Four researchers who contributed to the development of atomic theory were Dalton, Thomson, Rutherford, and Bohr. Which man first proposed each of the following ideas? [8]

(a) Atoms contain electrons.

(b) Atoms contain a nucleus.

(c) All atoms of the same element are identical.

(d) An atom is like a raisin bun, in which electrons are the raisins.

(e) Electrons exist in specific energy levels.

(f) All matter is composed of tiny, indivisible particles.

(g) Atoms contain subatomic particles.

(h) The centre of an atom is positively charged.

2. What was the difference between Dalton's model of the atom and Thomson's model?

3. What did Rutherford discover in his gold foil experiment?

4. What did Bohr discover about how electrons are arranged in atoms?
