

Atomic Theory Notes

OB: Students will examine basic structure of the atom, learn what the numbers on the Periodic table mean, and look at electron orbitals. All atoms are made up of three sub-atomic (smaller than atoms) parts. They are the...

| 1 | Parts of the atom | Charge | Symbol | Mass | Location |
|---|-------------------|--------|--------|------|----------|
| | | | | | |
| | | | | | |
| | | | | | |

2. The mass of an electron is NOT ZERO, but it's so small, only about _____ of a proton or neutron, that we will disregard it's mass. This is an intro class, and we can't measure these masses in our class anyway, but it's not zero in the real world.

3. The nucleus is the _____ center of an atom where the protons and the neutrons live.

4. Electrons _____ outside, relatively far away.

5. _____ is _____

6. In high school a proton is = _____. A neutron is = _____ too.

7. In high school, the mass of an electron is _____ (but it's not really 0)

8. The periodic table of the elements has a KEY, label these.

The diagram shows a box representing an element from the periodic table. Inside the box, the atomic weight '12.011' is at the top left, the atomic number '6' is at the bottom left, and the group number '2-4' is at the bottom center. The element symbol 'C' is in the middle. On the right side of the box, the oxidation states '-4', '+2', and '+4' are listed vertically. Three arrows point from the text 'label these.' to the atomic weight, atomic number, and group number. A fourth arrow points from the right side of the box to the oxidation states.

9. Atomic Mass Numbers will be rounded to the _____
(they are not really whole numbers, we'll get to that later)

10. Mass Number = mass of _____ + _____

11. The mass of sodium is 23 amu, so mercury has a total of 23 protons plus neutrons.
How many of each??? Let's learn how to figure this out

12. How many protons, neutrons, and electrons in the element TIN?

14. All atoms are electrically neutral. The number of _____ = the number of _____

The positives = the negatives. *Always.* Every atom is neutrally charged. The $p^+ = e^-$ always

Determine how many protons, neutrons, and electrons are in these three atoms In, Nb, and Ba.
Write in their NAMES too.

| 15. In | 16. Nb | 17. Ba |
|--------|--------|--------|
| Name | Name | name |
| | | |

There are several ways to “write” symbols that stand for atoms, here’s another, more formal method.

Copy calcium and labels the numbers



18. Write the formal symbols, with the proper numbers, in the RIGHT PLACE, for

| mercury | chlorine | copper |
|---------|----------|--------|
| | | |

19. Electrons do not fly around randomly. They stay in _____ or _____, which are also called _____.

19. The closer to the nucleus, the _____ the energy level is.

The further away from the nucleus, the _____ the energy level that orbital is.

20. The orbitals are only so big, they fit _____

21. The orbitals are sized to hold a _____ number of electrons.

You don’t memorize how many can fit into each orbital, you just look at _____ on the Periodic Table.

| | Noble gases | Electron Configurations |
|----|-------------|-------------------------|
| 22 | Helium He | |
| 23 | Neon Ne | |
| 24 | Argon Ar | |
| 25 | Krypton Kr | |
| 26 | Xenon Xe | |
| 27 | Radon Rn | |

| 28. Orbital | Maximum electrons that fit in this orbital |
|--|--|
| First | |
| Second | |
| Third | |
| Fourth | |
| Fifth | |
| Sixth | |
| <p>“Full” is relative. It is better understood as perfectly stable arrangement. These electron shells, or orbitals, can be stable in different ways. The first two never adjust. The bigger orbitals are fancy, and Group 18 tells us this, just put your finger in the right box and think.</p> | |

29. Find silver, how many electrons does it have? _____

30. Find hafnium, how many electrons, how many neutrons in this element? _____ e⁻ _____ n^o

31. What element has 16 protons and 16 electrons? _____

32. What's the symbol for tungsten? _____ How many electrons are in this element? _____

End here.

Atomic Theory Class #2, Models of the Atom through history.

33. Democritus said: the INDIVISIBLE PARTICLE is called the _____.

In English we say _____.

| | |
|---|-----------------------------|
| 34. | John Dalton's Atomic Theory |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 35. Dalton imagined his atom to look like a _____ | |

36. Around 1837 J. J. Thomson discovers the _____ (and later gets a Nobel Prize).

37. Thomson did experiments, using what's called the _____

This first discovered subatomic particle, which was _____ charged.

38. Thomson describes the model of the atom as _____ !

In 1908, my chemical hero, Ernest J. Rutherford discovers the nucleus! He gets the Nobel Prize as well.

39. Rutherford's _____ Experiment
helps him discover the nucleus, and figure out the basic structure of the atom.

40. Listen first, then draw. This drawing is online, you can add details later if you need to.

41. What does the Gold Foil Experiment prove?

1. Atoms are mostly _____

2. He knew atoms are neutral, so the nucleus must be _____

3. Neutral atoms must therefore have the negatively charged electrons _____

42. The Rutherford Model is named the _____.

He perceives the electrons to be flying around the atom's nucleus like the

_____.

43. Problems with Rutherford's theory...

How can atoms be mostly _____? How can they be mostly "not" there?

How can these negative electrons fly around a positive center, but

_____? Why not?

How do they just keep flying without ever running out of energy?

Why don't they fly off, away from the nucleus?

If they do fly around, do they just fly willy-nilly, or _____ to them?

Rutherford could not provide solid answers to these questions.

44. _____ is able to do some very funky math, and he proves the Rutherford model of the atom is correct. He too wins a Nobel Prize.

45. The Bohr Model - _____.

He expands on the simple planetary model of Rutherford, and put the electrons

into _____, or _____.

46. Bohr proves that for hydrogen, if the electron flies at the right speed, and the right distance, it will mathematically _____, and stay in orbit forever around the nucleus.

47. The math that proves electrons never run out of energy only works for _____ with a single electron.

48. Draw a Bohr Model for the atom of Nitrogen

49. Niels Bohr further determines that electrons could gain a _____ an amount he called a _____.

This enables an electron to “jump” up to a higher than normal energy level called the _____.

Neon in the ground state has an electron configuration of _____

Neon on the excited state has an electron configuration of _____

50. The excited state is _____, and the electron will soon move back to the lower energy, more stable ground state. To do that it must release that exact amount of energy, the same quantum of energy it absorbed to get excited.

51. This amount of energy is released as _____. We can see it with our eyes!

52. This light we call _____. An example is an electric neon light that emits that characteristic orange light. That orange light is its spectra, unique to neon.

The final model of the atom—the “Modern Model”

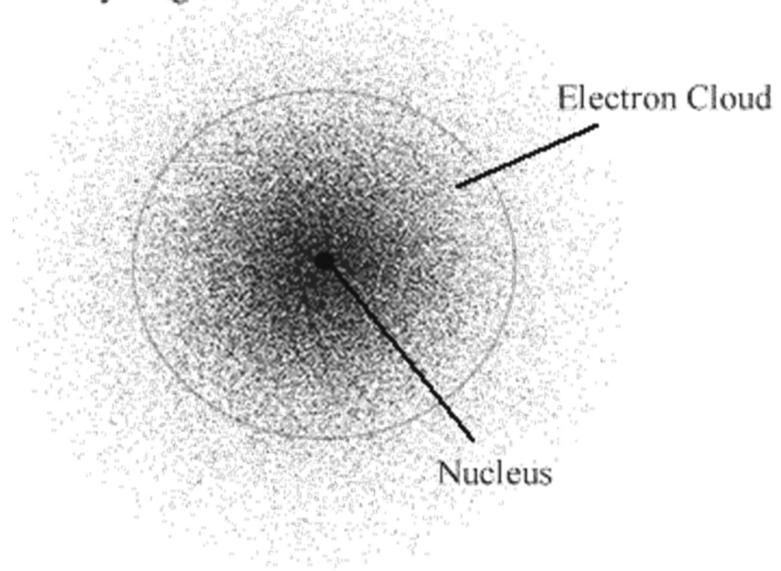
53

54. It's called the _____ Model.
The electrons sometimes act like waves of energy, and sometimes like little bits of mechanical matter with negative charge.

55. This model is more about the _____
of finding an electron's location MOST OF THE TIME, not always.

56. Electrons are like _____, they are where they should be most of the time, but not always.

Hydrogen Atom Electron Cloud Model



| | Symbol | Name | Ground State | |
|----|--------|------|--------------|--|
| 57 | Li | | | |
| 58 | Na | | | |
| 59 | Mg | | | |
| 60 | Ca | | | |
| 61 | He | | | |
| 62 | Ne | | | |
| 63 | Ar | | | |

64. Ground + Excited State electron configurations have the _____ number of electrons,
the electrons are just in _____ places.

65. How do electrons get excited? They absorb _____ amounts of _____,
called a _____. A quantum means a specific amount.

66. Spectra is produced when this unique quantum of energy is ...

67. The color of light, or the SPECTRA that we see, is a _____ of many colors of light that our eyes blur together.

68. A refractive lens can break up this mixture of colors into a unique _____ . This can be measured (even by you, in lab)

In the Neon light tube orange light is the _____

That orange light is many colors, which we can separate with _____ lenses into this spectrograph (like a fingerprint for neon).

69. We can do _____ too, where fire can change color,

The _____ we see when we heat up copper salts is _____.
The spectrograph is much harder to see because the flame is jumping around like mad.

70. _____ once said that all atoms of an element are identical.

71. He should have said that:

72. All atoms of an element are chemically identical. They can have _____
because the _____ in any element is not set.

All iron atoms have 26 protons, all have 26 electrons.

Some iron atoms have the “normal” amount of 30 neutrons. Some iron atoms have less, some more.

73. These different iron atoms are called _____ of iron.

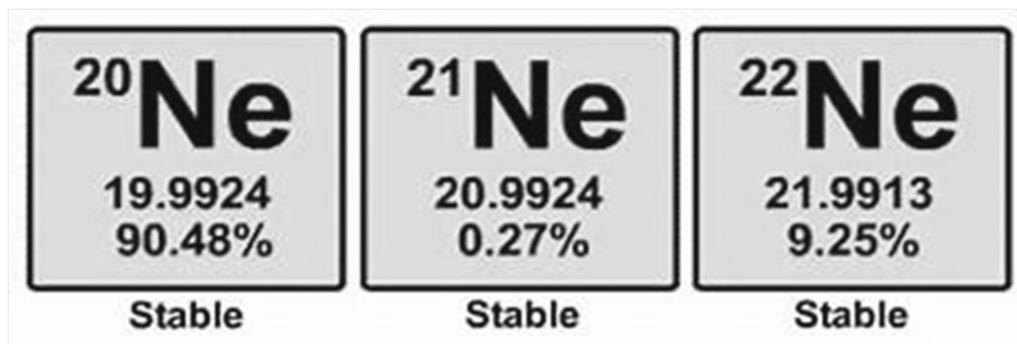
There are 118 elements, but there are about 1500 different isotopes.

74. Each kind of atom comes in a variety of masses, every one of them is an _____ of
that element.

75. Fill in this table.

| | | |
|-----|-----|--|
| H-1 | has | |
| H-2 | has | |
| H-3 | has | |
| | | |

| | | | | |
|----|-------------|---------|--------|---------|
| | ISOTOPE | K-39 | K-40 | K-41 |
| | MASS in amu | 38.9637 | 39.963 | 40.9618 |
| 76 | # protons | | | |
| 77 | # electrons | | | |
| 78 | # neutrons | | | |



79. These 3 different ISOTOPES of neon are all _____ identical. They have the same number of protons and the same number of electrons, but different numbers of _____.

80. Isotopes have different _____ but the same _____.

81. The masses of all the _____
make up 100% of all the average atomic mass of neon

82. Adding $20 + 21 + 22 = 63$ then divide by 3 for an average gives us an average mass of _____.

83. That's wrong! Periodic Table says _____AMU What's up?

84. Average weighted atomic mass has you multiply the exact mass X exact proportion of this isotope, then do that for all isotopes, then add up the totals to get your correct answer. COPY THE MATH...
85. _____ is the mass listed on our periodic tables. These use the mass of each isotope & the proportions that those isotopes make up of all that element.
86. Scientists measure these _____ proportions regularly, sometimes the proportions of an isotope are measured better (and change) which causes a slight adjustment to the mass numbers on the Periodic Table (wow).
87. A new element named Arbuiso is discovered (A). It has two isotopes, A-58 and A-59. 82.08% of all this Arbuiso metal has mass of 57.96 amu, while the rest has mass of 58.98 amu.
What is the weighted average atomic mass of this cool new metallic element? (DO THE MATH)

88. A new element X has 3 isotopes, the details are in this data table.
Calculate the average weighted atomic mass of element X.

| Isotope Symbol | Isotope mass (amu) | Proportion of element X |
|----------------|--------------------|-------------------------|
| X-23 | 22.8995 | 84.25% |
| X-24 | 23.9105 | 8.82% |
| X-26 | 25.9068 | |
| | | |

DO THE MATH...