Chemist: ____________________

Niels Bohr proposed yet another modification to the theory of atomic structure based on a curious phenomenon called *line spectra*. Read the passage below and complete the questions following.

When matter is heated, it gives off light. For example, turning on an ordinary light bulb causes an electric current to flow through a metal filament that heats the filament and produces light. The electrical energy absorbed by the filament excites the atoms' electrons, causing them to "wiggle". This absorbed energy is eventually released from the atoms in the form of light.

When normal white light, such as that from the sun, is passed through a prism, the light separates into a continuous spectrum of colors:

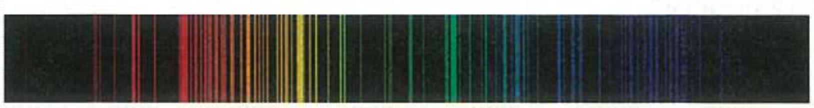
Continuous (white light) spectra

Bohr knew that when pure elements were excited by heat or electricity, they gave off distinct colors rather than white light. This phenomenon is most commonly seen in modern-day neon lights, tubes filled with gaseous elements (most commonly neon). When an electric current is passed through the gas, a distinct color (most commonly red) is given off by the element. When light from an excited element is passed through a prism, only specific lines (or wavelengths) of light can be seen. These lines of light are called **line spectra**. For example, when hydrogen is heated and the light is passed through a prism, the following line spectra can be seen:

Hydrogen line spectra

Each element has its own distinct line spectra. For example:

Helium line spectra



Neon line spectra

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To Bohr, the line spectra phenomenon showed that atoms could not emit energy continuously, but only in very precise quantities (he described the energy emitted as ***quantized***). Because the emitted light was due to the movement of electrons, Bohr suggested that electrons could not move continuously in the atom (as Rutherford had suggested) but only in precise steps. Bohr hypothesized that electrons occupy specific **energy levels**. When an atom is excited, such as during heating, electrons can jump to higher levels. When the electrons fall back to lower energy levels, precise quanta of energy are released as specific wavelengths (lines) of light.

Under Bohr's theory, an electron's energy levels (or electron shells) are described as concentric circles around the nucleus. Normally, electrons exist in the ground state - they occupy the lowest energy level possible (the electron shell closest to the nucleus). When an electron is excited by adding energy to an atom (ex., when it is heated), the electron absorbs energy, "jumps" to a higher energy level, and spins in the higher energy level. This is known as the excited state. After a short time, this electron spontaneously "falls" back to a lower energy level, and gives off a quantum of light energy.

Key to Bohr's theory was the fact that the electron could only "jump" and "fall" to precise energy levels, thus emitting a limited spectrum of light. This animation link simulates this process in a hydrogen atom - Bohr's Atom: Quantum Behavior in Hydrogen -
http://www.visionlearning.com/library/module_viewer.php?mid=51&l=15

Questions:

1. Describe how absorbed energy is released. What form is it in?

2. Define continuous spectrum.

3. What did Bohr know about exciting pure elements by heat or electricity?

4. Define bright line spectrum.

5. What did the line spectra phenomenon show Bohr?

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6. In Bohr's model, where are electrons found?

7. What happens when an atom is excited?

8. What happens when electrons fall back to lower energy levels?

9. Describe (or draw) what Bohr's energy levels look like.

10. Define ground state.

11. Define excited state.

## Counting Particles

(1) Complete the following chart about these atoms...(this type of chart will be on LOTS of your tests so take your time with it)

| Symbol | Atomic # | Charge | Mass # | # of electrons | # of neutrons | # of protons |
|---|---|---|---|---|---|---|
| Cd | | 0 | | | 63 | |
| | 33 | | 74 | 31 | | |
| | | +1 | | | 60 | 47 |
| | | | 81 | 35 | | 35 |
| | 15 | | 30 | 18 | | |
| | | +1 | | | 20 | 19 |
| | | 0 | | 101 | 155 | |

(2) Count the number of protons and neutrons...

a) ${}^{7}_{3}Li^{+1}$ How many protons?______
How many neutrons? ______

b) carbon-13 How many protons?______
How many neutrons? ______

valence e⁻ = ______

c) Fluorine-20 What is the atomic #? ______
What is the mass #? ______
What is the charge? ______

How many protons?______
How many neutrons? ______
valence e⁻ = ______

d) ${}^{9}_{4}Be^{+2}$ What is the atomic #? ______
What is the mass #? ______
What is the charge? ______

How many protons?______
How many neutrons? ______

(3) Count the number of particles

a) ${}^{7}_{3}Li^{+1}$
Protons = ____
Neutrons = ____
Electrons= ____
valence e = ____

b) ${}^{32}P^{-3}$
protons = ______
neutrons = ______
electrons = ______
valence electrons = 