Atomic Theory Unit Review

1. Which of the following are usually found in the nucleus of an atom?
   1. Electrons and neutrons only.
   2. Neutrons only.
   3. Protons, neutrons and electrons.
   4. Protons and neutrons only.
2. The number of neutrons in an atom of  is
   1. 65
   2. 82
   3. 138
   4. 194
3. Identify the following subatomic particles:
   1. The particle that has a much lower mass than the others.

Electrons

* 1. The particle that has no electrical charge.

Neutrons

* 1. The particle that is not found in the nucleus.

Electrons

* 1. The number of these in the nucleus is equal to the atomic number.

Protons

* 1. The particle that is gained or lost when ions are formed.

Electrons

1. Calculate the numbers of protons, neutrons and electrons in the following:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Element | Mass No. | Protons | Neutrons | Electrons |
| Helium | 4 | 2 | 2 | 2 |
| Nitrogen | 14 | 7 | 7 | 7 |
| Aluminum | 27 | 13 | 14 | 13 |
| Manganese | 55 | 25 | 30 | 25 |
| Iodine | 127 | 53 |  |  |

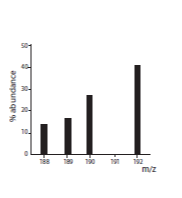
1. Boron has atomic number 5. It comprises two isotopes, one with five neutrons the other with six.
   1. Define the term isotope.
   2. Calculate the mass numbers of the two isotopes and represent them in the form .
   3. In naturally occurring boron, 20% of the atoms contain five neutrons and 80% contain six neutrons. Calculate the relative atomic mass of boron.
2. Naturally occurring copper is a mixture of two isotopes. One of these has 29 protons and 34 neutrons, the other has 2 more neutrons. Complete the following table for both isotopes.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | No. Protons | No. Neutrons | No. Electrons | Atomic No. | Mass No. |
| Isotope 1 | 29 | 34 |  |  |  |
| Isotope 2 |  |  |  |  |  |

If the relative atomic mass of copper is 63.55, calculate the natural abundances of the two isotopes.

1. Give the numbers of protons, neutrons and electrons in the following isotopes.

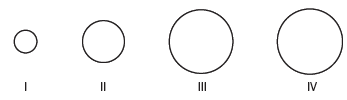
|  |  |  |  |
| --- | --- | --- | --- |
| Isotope | Number of | | |
| Protons | Neutrons | electrons |
|  | 1 | 2 | 1 |
|  | 7 | 8 | 7 |
|  | 26 | 31 | 26 |
|  | 38 | 52 | 38 |
|  | 92 | 143 | 92 |

1. Germanium contains 20% germanium-70, 27% germanium-71, 8% germanium-72, 37% germanium-73 and 8% germanium-74. Draw a graph of the mass spectrum that you would expect germanium to produce. If an atom of germanium 70 lost two electrons to become a doubly charged ion, at what m/z (atomic mass) would it appear? Same place
2. The graph shows the spectrum of the element which contains 76 protons in its nucleus.
   1. Write down, in the form of , the isotopes that it is composed of with their natural abundances (as a %).
   2. Calculate the relative atomic mass of the element.
3. Lead has a molar mass of 207.2g mol-1. Assuming that it is composed entirely of 206Pb, 207Pb and 208Pb, and that the percentages of the two lightest isotopes are equal, calculate the relative percentages of these isotopes in the natural.
4. An atom has an atomic number of 13 and a mass number of 27. How many electrons does it have in its valence level?
   1. 1
   2. 2
   3. 3
   4. 5
5. Which of the following colors corresponds to light of the highest energy?
   1. Yellow
   2. Red
   3. Green
   4. Blue
6. Which one of the following electron transitions in a hydrogen atom would produce light in the visible region of the spectrum?
   1. n=2 to n=1
   2. n=5 to n=4
   3. n=6 to n=2
   4. n=4 to n=1
7. Which of the following transitions in the hydrogen atom would produce light of the shortest wavelength?
   1. n=2 to n=1
   2. n=5 to n=4
   3. n=6 to n=2
   4. n=4 to n=1
8. Given the atomic numbers of the following elements, (a) write their full **and** noble gas abbreviated electron configurations, (b) deduce the number of valence electrons and (c) identify the valence energy level.
   1. Beryllium
   2. Aluminum
   3. Fluorine
   4. Argon
   5. Sulfur
9. Two particles have the following composition:

A: 37 protons, 38 neutrons, 37 electrons

B: 37 protons, 40 neutrons, 37 electrons

1. What is the relationship between these two particles?
2. These two particles have very similar chemical properties. Explain why.
3. Explain why, in the hydrogen atom spectrum
   1. Only light of certain frequencies is observed.
   2. Different series are observed in different spectral regions.
   3. These series all converge at the high frequency end.
4. Sketch and label an energy level diagram to represent the electron transitions for light emitted in the UV, visible and infrafred (IR) regions for a hydrogen atom.
5. The electron configuration 1s22s22p63s23p6 would be found in
   1. Neon atoms
   2. Sodium ions
   3. Sulfide ions
   4. Chlorine atoms
6. For each of the following elements: (a) Write the complete electron configuration (b) sketch an electron energy level diagram and (c) Deduce the number of valence electrons.
7. Mg2+
8. K
9. N3-
10. F-
11. Al3+
12. C
13. (a) Deduce the ionic charge formed by the following elements **and** state whether the atom gains or loses electrons to become an ion. (b) Identify each ion as either an anion or a cation.
    1. Li
    2. P
    3. Cl
    4. Ca
    5. Se
14. Which electrons are lost when an atom becomes a cation?
15. An element has 13 electrons orbiting the nucleus. In which group of the periodic table will it be found?
    1. Group 1
    2. Group 2
    3. Group 3
    4. Group 4
16. Find the element chlorine in the periodic table.
    1. How many valence electrons will it have?
    2. How many fully filled electron energy levels does it have?
    3. Give the symbol of another element in the same period as chlorine.
    4. Give the symbol of another element in the same group as chlorine.
    5. What is the name given to elements in this group? halogen
17. Which one of the following has the lowest electronegativity?
    1. Boron
    2. Beryllium
    3. Magnesium
    4. Carbon
18. Which one of the following has the smallest radius?
    1. K
    2. K+
    3. Ca
    4. Ca2+
19. Arrange the following in order of increasing atomic radius: Al, Mg, Ca, Ba, Cs, and
20. For each of the following properties, state how you would expect it to change in the direction indicated and give reasons for the change based on concepts such as nuclear charge, shielding, electron-electron repulsion and atomic/ionic radius.
    1. The electronegativity going down a group.
    2. The atomic radius going across a period.
    3. The radius of an anion compare to its parent atom.
21. State the general trend for each property as you move from left to right and top to bottom on the periodic table.
    1. Atomic radius
    2. Electronegativity
    3. Ionic radius
22. Explain why atomic radius increases with atomic number as you go down a group, but decreases with atomic number as you go across a period.
23. Define the term electronegativity
24. Given what you know about atoms and subatomic particles, explain why ionic radius increases from left to right across a period and from top to bottom down a group.
25. The circles below represent the relative sizes of the F-, Na+, Mg2+ and K+ ions, but not necessarily in that order. Which one of the following would give them in this order?
    1. II, I, III, IV
    2. III, I, II, IV
    3. I, II, III, IV
    4. III, II, I, IV



1. Which of the following do you think would require the most energy for the removal of one more electron? Explain your answer.
   1. F-
   2. Ne
   3. Na+
   4. Mg2+