Unit II

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1. The explanation of the behavior of matter by describing the smallest part of an element as an atom.
4. A compound is a combination of two or more elements.
5. All matter is composted of very small particles called atoms which cannot be subdivided, created or destroyed. Atoms of a given element are identical in their physical and chemical properties. Atoms of different elements differ in their physical and chemical properties. Atoms of different elements combine in simple, whole number ratios to form compounds. In chemical reactions atoms are combined, separated or rearranged but never created or destroyed.

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1. The mass of an electron is much smaller (about 1/10,000 as much) than the mass of a proton or the mass of a neutron. Protons have a +1 charge, electrons have a -1 charge and neutrons have no charge. Protons and neutrons make up the atomic nucleus (and account for over 99.999% of the mass of the atom), electrons surround the nucleus (and account for over 99.999% of the space of the atom).

2. Isotopes of an element have different number of neutrons but have the same number of protons and electrons.

3. Electrons were discovered with the CRT.

4. $^{44}_{22}\text{Ti}$

5. a) 35 protons, 35 electrons, 45 neutrons
   b) 46 protons, 46 electrons, 60 neutrons
   c) 55 protons, 55 electrons, 78 neutrons

6. atomic number is 56, mass number is 138

7. Because otherwise the like charges multiple protons would repel each other breaking apart the nucleus.

8. No. Hydrogen-3 has only one proton and two neutrons, helium-3 has two protons and one neutron.

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1. Isotopes are atoms of the same element (they have the same number of protons) that have different numbers of neutrons (different mass numbers).

2. Neutrons are particles inside the nucleus of the atom that have no charge but about the same mass as a proton.

4. A cathode is the electrode that attracts cations. It has a negative charge.

5. The mass number is the number of protons plus the number of neutrons. It is the number of particles in the nucleus, the number of particles that make up essentially all of the mass of the atom.

13. This demonstrates the law of definite proportions.

16. The explanation of the behavior of matter by describing the smallest part of an element as an atom.

18. The atomic number is the number of protons and is also the number of electrons if it is a neutral atom. The mass number is the number of protons plus the number of neutrons.

22. The particles were attracted to the cathode. The cathode has a positive charge and since the particles were attracted they must have the opposite charge, negative.

39. 54 neutrons 40. 80 electrons 41. 19 protons

42. 33 electrons

43. a) $^{234}_{92}U$ b) $^{235}_{92}U$ c) $^{238}_{92}U$

44.

isotope	protons	electrons	neutrons
silicon-28	14	14	14
silicon-29	14	14	15
silicon-30	14	14	16

45. $^{12}_{6}C$ and $^{13}_{6}C$

46. $^{130}_{56}Ba$ and $^{137}_{56}Ba$

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5. The mass that is "lost" is converted into nuclear binding energy.

6. The isotopes of oxygen-16 and oxygen-15 differ in the number of neutrons. Oxygen-16 has 8 neutrons and oxygen-15 has 7 neutrons.

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5. a) $^{233}_{92}U \rightarrow {}^{229}_{90}Th + {}^{4}_{2}He$ b) $^{66}_{29}Cu \rightarrow {}^{66}_{30}Zn + {}^{0}_{-1}e$

   c) $^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{13}_{6}C \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$ d) $^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + {}^{0}_{-1}e$

6. $2^{3}_{2}He \rightarrow 2^{1}_{1}H + {}^{4}_{2}He$

9. Eventually a nucleus that is stable is formed.

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1. Half-life is the time required for half of the nuclei to decay.

2. The amount of carbon-12 and carbon-14 are measured. The ratio of carbon-12 to carbon-14 is compared to a sample whose age is known. This indicates the number of half-lives that have elapsed since the carbon became part of the object.

3. Potassium-40 has a long enough half life to be useful in determining ages of even billions of years. Carbon-14 has a relatively short half life so that after about 50,000 years not enough remain to do accurate dating.

4. Many uses – you find at least three.

5. One-eighth or 12.5% of the original sample will remain after 3 half lives.

6. Radon-222 has a half life of 3.82 days so 11.46 days is 3 half lives. The original sample contained 4.16×10^{-7} g of radon-222.

7. $1/16^{th}$, 4 half lives.

8. 37.44 days

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18. An alpha particle is a helium-4 nucleus.

19. Alpha particles have very low penetrating power because of a large mass and low velocity. Beta particle have more penetration power because of low mass (an electron) and more velocity. Gamma rays have great penetration power because of no mass and great velocity (the speed of light).

26. Because the animals are eating either plants that contain both carbon-12 and carbon-14 or they are eating animals that have very recently eaten plants.

30. $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

31. A beta particle is emitted.

32. $^{222}_{86}Rn \rightarrow {}^{218}_{84}Po + {}^{4}_{2}He$

33. $^{235}_{92}U \rightarrow {}^{231}_{90}Th + {}^{4}_{2}He$ $^{231}_{90}Th \rightarrow {}^{231}_{91}Pa + {}^{0}_{-1}e$ $^{231}_{91}Pa \rightarrow {}^{227}_{89}Ac + {}^{4}_{2}He$ $^{227}_{89}Ac \rightarrow {}^{227}_{90}Th + {}^{0}_{2}e$

$^{227}_{90}Th \rightarrow {}^{223}_{88}Ra + {}^{4}_{2}He$ $^{223}_{88}Ra \rightarrow {}^{219}_{86}Rn + {}^{4}_{2}He$ $^{219}_{88}Rn \rightarrow {}^{215}_{84}Po + {}^{4}_{2}He$

$^{215}_{84}Po \rightarrow {}^{211}_{82}Pb + {}^{4}_{2}He$ $^{211}_{82}Pb \rightarrow {}^{211}_{83}Bi + {}^{0}_{-1}e$ $^{211}_{83}Bi \rightarrow {}^{211}_{84}Po + {}^{0}_{-1}e$ $^{211}_{84}Po \rightarrow {}^{207}_{82}Pb + {}^{4}_{2}He$

34. a) $^{239}_{94}Pu$ b) $^{13}_{6}C$ c) $^{1}_{0}n$ d) $^{139}_{36}Ba$

35. a) $^{2}_{1}H$ b) $^{12}_{6}C$ c) $^{0}_{-1}e$

36. $^{117}_{54}Xe \rightarrow {}^{117}_{53}I + {}^{0}_{-1}e$

37. The half life is 12.8 hours. 38. 96.40 days 39. 5715 years 40. 5.83 min

41. 0.274 g 42. 0.625 mg 43. 0.056 g 44. 9.76×10^{-3} g

50. $^{131}_{53}I \rightarrow {}^{131}_{54}Xe + {}^{0}_{-1}e$ 53. 0.200 g 54. 0.937 mg

56. a) beta decay b) alpha decay c) positron emission

57. 3 half lives or 1.34×10^{10} years

58. $^{157}_{70}Yb \rightarrow {}^{153}_{68}Er + {}^{4}_{2}He$ 59. 3% 65. $^{217}_{89}Ac \rightarrow {}^{213}_{87}Fr + {}^{4}_{2}He$

66. a) fusion b) fission c) fusion d) fusion

67. **SKIP** It will be greater. 55.847 amu is the **average mass of all** iron atoms.

68. 20 minutes 69. 29.1 years