Homework Questions – Chapter 2 – Atoms and Elements

1. Iron and oxygen react to produce iron oxide. Using the law of mass conservation, what mass of oxygen must combine with 16.00 g of iron to produce 22.36 g or iron oxide?
2. Sodium hydroxide made in the US has the formula; NaOH. Which of the following is the formula for sodium hydroxide made in Japan?
   (a) Na_2OH (b) $NaOH_2$ (c) $Na(OH)_2$ (d) $Na_2(OH)_2$ (e) NaOH
3. Which law did you use to answer question number 2 (above)?
4. What does the law of multiple proportions tell us about the structure of compounds?
5. (a) What piece of apparatus produces a stream of electrons? (b) How do you know that the electrons produced are found in all different materials?
6. (a) What experiment helped Millikan to find the mass and charge of an electron?
   (b) If you did a similar experiment to find the charge on a new kind of particle, called a flot, what could the charge of a single flot be if the measured charges on 5 oil drops were; 12.87, 42.90, 8.58, 21.45, 30.03?
   (c) Follow up question of the same type as part (b), to be done for practice after working through the solution on Canvas: If you did a similar experiment to find the charge on a new kind of particle, called a drib, what could the charge of a single drib be if the measured charges on 5 oil drops were; -0.329, -0.470, -0.188, -0.752, and -0.423?
7. Using the Rutherford model of an atom, you perform Rutherford's "gold foil experiment" using foil made from a new element called kolk. If the kolk foil deflects about half of the alpha particles fired at it, what might your hypothesis be about the atomic structure of kolk?
8. What are the names, relative masses, relative charges, and locations or the three subatomic particles?
9. How many protons and neutrons do atoms of the following isotopes have?
   a) Radium-226 b) Carbon-15 c) ^{210}Pb d) ^{234}Pa
10. Write the following using atomic notation, and state which are probably not observed experimentally;
    (a) an atom with 39 protons and 20 neutrons
    (b) an atom with 19 protons and 39 neutrons
    (c) an atom with 23 electrons and 27 neutrons
    (d) an atom whose mass number is 40 and whose atomic number is 19
    (e) an atom whose mass number is 39 with 20 neutrons
    (f) an atom with A = 88 and Z = 38
11. Which of the atoms in number 10 (above) are isotopes of potassium?
12. Element X has two isotopes; X-28 has a mass of 27.9463 amu and an abundance of 32.8%, X-30 has a mass of 29.4633 amu. What is the average atomic mass of X?
13. Element Q has three isotopes; 25.3 % of all atoms of Q are ^{58}Q, which have a mass of 57.8882 amu, ^{60}Q has a mass of 59.7211 amu and a fractional abundance of 0.423. If the atomic mass of Q is 59.8877 amu, what is the mass of the other isotope, and its mass number?
14. Element A has two isotopes; A-112 and A-113. You are told that its atomic mass is 58.3 amu. How do you immediately know that this is incorrect?
15. (a) The correct atomic mass for element A is 112.090 amu. If A-112 has a mass of 111.4349 amu, and A-113 has a mass of 112.2844 amu, what is the fractional abundance of A-112?
    (b) Follow up question of the same type as part (a), to be done for practice after working through the solution on Canvas: The correct atomic mass for element Y is 157.780 amu. If Y-156 has a mass of 155.8377 amu, and Y-158 has a mass of 157.9173 amu, what is the fractional abundance of Y-158?
16. Describe the "plum-pudding" atomic model.
17. State the three subatomic particles and give their relative masses and relative charges.
18. Give a definition for each of the following; (a) nucleon, (b) atomic number, (c) atomic mass, (d) isotope.

Answers

1. 6.36 g
2. (e)
3. Law of definite proportions (also known as the law of constant composition)
4. It tells us that compounds are composed of 'chunks' of elements (atoms). Compounds cannot be made from part of a chunk (half a chunk, or 0.38 of a chunk), only from combinations of whole chunks of different elements.
5. (a) Cathode ray tube. (b) Whatever material is used for the cathode, an identical beam of electrons is produced.
6. (a) Oil drop experiment. (b) 4.29 (c) -0.047
7. Very few alpha particles are deflected by gold foil, because gold atoms (like all real atoms) are almost entirely empty space, with a tiny nucleus at the center. If kolk atoms deflected half the alpha particles, it would suggest that the kolk nucleus takes up closer to half the space in each kolk atom – kolk atoms have huge nuclei (note: since this is so uncharacteristic for atoms, a better *initial* hypothesis might be that something is wrong with the experiment…).
8. Electron, ~1/1800 amu, -1, around the nucleus; Proton, 1 amu, +1, part of the nucleus; Neutron, 1 amu, 0, part of the nucleus.
9. (a) 88p 138n (b) 6p 9n (c) 82p 128n (d) 91p 143n
10. (a) $^{59}_{39}\mathrm{Y}$ (b) $^{58}_{19}\mathrm{K}$ (c) $^{50}_{23}\mathrm{V}$ (d) $^{40}_{19}\mathrm{K}$ (e) $^{39}_{19}\mathrm{K}$ (f) $^{88}_{38}\mathrm{Sr}$
    (a) and (b) are probably not observed experimentally.
11. (b), (d), and (e) are isotopes of potassium.
12. 29.0 amu
13. 61.7 amu, mass number = 62
14. The average (or weighted average) of two numbers has to be between the two numbers.
15. (a) 0.229 (b) 0.9340
16. Electrons (tiny, lightweight, negatively charged particles) are uniformly distributed throughout a spherical "cloud" of positive charge. The total charges on the electrons are equal and opposite to the total charge of the positive "cloud".
17. Neutron, relative mass ~ 1, relative charge = 0; Proton, relative mass ~ 1, relative charge = +1; Electron, relative mass ~ 1/1800, relative charge = -1
18. (a) a proton or a neutron (a particle in the nucleus), (b) the number of protons in the nucleus of an atom, (c) the weighted average mass of a single atom, averaged over all it's naturally occurring isotopes, (d) isotopes are atoms that have the same number of protons (atomic number), but different numbers of neutrons (and hence different mass numbers).