

Review questions: unit 2 *Conceptual Physical Science, 4th ed.*, Chapters 12-18

Chapter 12

1. Hydrogen is the oldest element.
3. Nucleus is a the center of every atom.
4. Only one type of atom in a pure sample of an element.
5. Atom is the smallest unit that has properties; element is the substance in any quantity.
6. Co symbol for cobalt.
7. Identification number of the element; number of protons it has.
8. Atomic number is number of protons; mass number is number of nucleons.
9. Mass number is number of nucleons; atomic mass is average mass of isotopic ratio of atoms.
10. Most elements are metallic.
11. Seven periods, eighteen groups organize the periodic table.
12. Gradual change in properties across any period.
21. No, Bohr thought of the planetary model of electrons around atom as a way to explain the behavior; an analogy, if you will.
25. Shell model explains the periodic table. Model is the basis for table's organization.
26. Valence electrons, in the outer shell are most responsible for elemental properties.
27. Same number of elements in period and maximum number of electrons that the shell can hold.

Chapter 13

1. Gamma rays have greater penetrating power than alpha or beta particles.
6. The strong nuclear force holds protons together in the nucleus, over the electrical force of repelling at short distances. Neutrons enhance the strong nuclear force, or counteract the electrical force, or both.
7. Large nuclei have more neutrons than protons. Smaller nuclei have a more equal number.
8. Strong nuclear force is opposite of electrical force. The strong nuclear force acts over very small distances, where the electrical force is effective at much greater distances.
9. Neutrons act as cement to hold the nucleus together.
10. The time it takes for one half of the sample to decay to something else. There is half as much radioactivity also. Half lives are apparently constant for isotopes.
12. Alpha emission reduces atomic number by two. Beta emission increase atomic number by one.
13. Uranium decays to lead.
14. Carbon-14 is radioactive. Carbon-12 is not.
15. Carbon-14 is radioactive, so it decays after metabolic processes no longer replenish it in tissues.
16. Coins were not alive to incorporate atmospheric carbon-14. They also have little to no carbon.
17. Uranium decays to lead.
18. Ratio tells us how many half-lives of uranium have elapsed since formation. This allows calculation of the date of formation of the rock.

Chapter 14

4. Molecules are made of atoms.
5. Solid particles are held in fixed positions with respect to one another. Those in a liquid can slip past one another, although they still stick together.
6. Gas particles move independently, in contrast to other phases, described in question 5.
7. 1 gram of water vapor occupies a larger volume than 1 gram of liquid water or 1 gram of ice.
11. Chemical bond is formed between atoms by electron attraction. It requires input of energy to break chemical bond.
12. Chemical bonds between atoms change in a chemical reaction. The atoms have bonds broken and/or formed in the reaction, resulting in different substances composed of the same atoms in different compounds.
13. Water freezing can be reversed by raising to original temperature. When you get the same properties upon returning to original physical conditions, the change is physical.
14. Chemical changes also result in changes of physical properties. This sometimes makes it difficult to distinguish what type of change has occurred.
15. Iron bonds to oxygen, in a chemical reaction that creates rust from iron and oxygen.
16. Tests for type of change: restore original conditions, test properties of changed substances. If you get the original substances back upon return to original conditions, it is a physical change. If the substances have different properties—volume, color, magnetism, phase, strength etc.—the change has probably been a chemical change
20. Eight atoms in H_3PO_4 : 3 H, 1 P, 4 O
21. No guidelines for knowing properties of products of reactions from properties of reactants. It is likely that the products have vastly different properties as a result of the bonding differences in them compared to the reactants.

Chapter 15

1. 2 electrons in first shell; 8 in second shell.
2. Valence electrons represented in electron dot structure diagram; those in the outermost shell.
3. Same electron dot structure for elements in the same group.
4. 2 each: 2 non-bonding pairs of electrons and 2 unpaired electrons in oxygen atom.
5. Ion has number of electrons not equal to number of protons. Gaining electrons makes negative anion; losing them makes positive cation.
6. Atom gains electrons to become a negative ion.
7. Fluorine has 7 valence electrons. A full valence shell has 8, so fluorine has room for one more. Full shells are more stable than partially full ones, and fluorine holds its 7 valence electrons tightly enough to not lose them.
8. Protons are lost or gained to become polyatomic ions.
9. Metals, halogens and chalcogens (oxygen group elements) tend to form ionic bonds.
12. Ionic crystal is an orderly array of ionic bonds without identifiable ion pairs.
13. Metals hold valence electrons loosely, so they lose and gain them readily.
14. Alloy is a mixture of different types of metal atoms sharing their electrons.
15. Native metal is one found as an element in nature. It is not bonded to non-metals.
16. Halogens, chalcogens tend to form covalent bonds. This is because they have 2 or 3 non-bonding pairs of valence electrons, and 1 or 2 unpaired valence electrons that are tightly held. This leaves 1 or 2 vacancies in valence shell
25. Water is a very polar molecule. It is strongly attracted to itself. It excludes non-polar oil molecules from the water attraction, so the two substances don't readily mix.
29. Hydrogen bond is an unusually strong dipole—dipole attraction.

Chapter 16

1. Mixtures are made of substances that can be separated by physical means: filtering, distillation, etc.
2. Component of mixtures can be separated by physical means: filtering, distillation, etc.
3. Substances that have different boiling points or vaporization pressures can be separated by applying conditions that vaporize one and not the other. The vaporized substance is collected and condensed into liquid. This is the distillation process.
7. Adding sugar to a sugar solution will increase the volume of the solution.
9. Solute is a minor component of the solution. Solvent is the major component.
10. A concentrated solution has a high component of solute, close to the solvent's capacity to dissolve the solute.
11. 1 mole of particles is an extremely large number of particles: 6.02×10^{23} particles.
19. Detergents have greater strength of polar head, and a more complex non-polar tail than soaps. They are also less expensive to manufacture, and more effective because of the properties.
20. Magnesium and calcium ions created hard water.
21. It is the attraction of ionic compounds that attracts soap to calcium and magnesium. The polar head of soaps and detergents bond to the cations Mg^{2+} and Ca^{2+} .
23. Aeration improves the taste of water.
24. Boiling and chemical treatment (usually with iodine) are effective water disinfection methods.
25. Water in Bangladesh is contaminated with arsenic.
26. Two main techniques for desalinating water are distillation and reverse osmosis.
27. Disadvantages of solar distillation include the large area required for distillation, high maintenance cost of the distillers, and need of regular sunlight.

Chapter 17

1. The molar ratio of reactants and products is expressed as the coefficients in a balanced reaction.
2. Four chromium atoms are expressed by the $2Cr_2O_3$. There are six oxygen atoms indicated.
3. Phase of substance is indicated by (s), (l), (g), (aq) subscripts on chemical components. (s) is solid, (l) is liquid, (g) is gas, (aq) is dissolved in water.
4. Molar ratios of reactants and products are expressed by the coefficients of balanced chemical equations. You can calculate amounts of either from known amounts and ratios of coefficients.
5. Subscripts in chemical equations represent the number of atoms of that element in the molecule. If you change the subscript, you have changed the compound into something else with different properties. O_2 is oxygen gas, necessary for metabolic processes. O_3 is ozone, a component of the stratosphere that shields us from ultraviolet radiation. Ozone is harmful to organisms.
6. Golf balls and ping-pong balls have different individual masses. So the same mass of one would not be the same number of the same mass of the other.
7. Carbon and oxygen molecules have different individual masses. So the same mass of one would not be the same number of the same mass of the other.
8. A single atom of sodium has 22.99 atomic mass units: the average of sodium isotopes.
9. NO has a formula mass of 30 amu.
10. A mole of marbles is 6.02×10^{23} marbles (like a mole of any particle).
11. Two moles of pennies is 12.04×10^{23} pennies, or 1.204×10^{24} (proper scientific notation).
12. One mole of water has a mass of 18 grams.
13. A mole of water is 6.02×10^{23} molecules of water.
14. The term 'mole' refers to a consistent number of molecules. The formula mass of a mole is the same in grams as the molecular mass of one molecule is in atomic mass units.

Chapter 17 continued

16. Greater reaction rate with greater temperature.
19. Chlorine is a catalyst in the conversion of ozone to oxygen.
22. No net effect on a catalyst in a chemical reaction: the catalyst is present in the same chemical form before and after the reaction.
23. Catalysts lower manufacturing costs, due to reducing required input of energy to make reaction occur.
24. 436kJ of energy is released when breaking a bond that required 436 kJ to make.
25. Energy of activation is consumed in an exothermic reaction. More energy is released after the reaction is initiated, but some is required to 'jump start' the reaction.
26. Heat is released in an exothermic reaction, from the energy of the chemical bonds.
27. Heat is absorbed in an endothermic reaction, converted to the bonding energy.

Chapter 18 (extra credit)

1. Acids donate protons, bases accept protons in the *Bronsted-Lowry* definition of acids and bases.
2. Hydronium ions are formed when acids dissolve in water.
3. Losing hydrogen is donating hydrogen, so it is behaving as an acid.
7. Water is a weak acid.
9. pH indicates the acidity of a solution. It is the negative of the log of the hydronium concentration of the solution.
11. $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$, carbonic acid.
12. $\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{OH}^-$, hydronium and hydroxyl ions present in water
" $\text{SO}_2 + \text{OH} \cdot \rightarrow \text{HOSO}_2 \cdot$, which is followed by: $\text{HOSO}_2 \cdot + \text{O}_2 \rightarrow \text{HO}_2 \cdot + \text{SO}_3$. In the presence of water, sulfur trioxide (SO_3) is converted rapidly to sulfuric acid: $\text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$ "
(wikipedia: acid rain, 2009-02-20-12:33 pm PST)
13. Burning coal releases SO_2 .
14. Oceans absorb CO_2 , which is precipitated as carbonates of magnesium and calcium.
15. Fluorine and chlorine have the greatest propensity to behave as oxidizing agents: they receive electrons very readily, and are themselves reduced. They oxidize the donator of the electrons.
24. Electrolysis is the application of current to induce the precipitation of metal on the cathode. It is the opposite of what happens in a battery, where different metals are simultaneously reduced and oxidized, creating a flow of electrons—the electricity.
25. Aluminum is produced primarily by electrolysis. Also copper, lithium, sodium, potassium, and magnesium are produced by electrolysis.