

Practice Test A2 (vA pg 1 of 5)

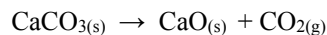
Atoms, Molecules, and Ions

Name _____ Per _____

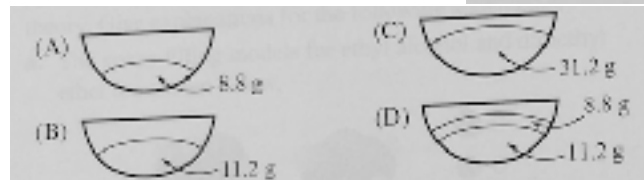
You should NOT use a calculator – use just your periodic table.

- A molecule of water contains hydrogen and oxygen in a 1:8 ratio by mass. This is a statement of _____.
 - the law of multiple proportions
 - the law of constant composition
 - the law of conservation of mass
 - the law of conservation of energy
 - none of the above
- Isotopes are atoms that have the same number of _____ but different number of _____.
 - protons, electrons
 - neutrons, protons
 - protons, neutrons
 - electrons, protons
 - neutrons, electrons
- There are _____ electrons, _____ protons, and _____ neutrons in an atom of $^{132}_{54}\text{Xe}$
 - 54, 54, 78
 - 54, 54, 77
 - 54, 54, 132
 - 78, 78, 54
 - 78, 78, 132

- When 20.0 g of calcium carbonate is placed in a crucible and heated, it will decompose into 11.2 g of solid calcium oxide and carbon dioxide gas. There are several ways to represent this reaction. One of the most common is by chemical equation, shown here:

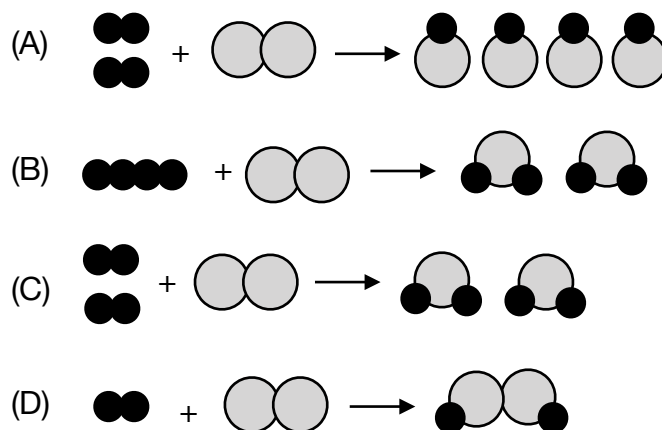


Another way is to draw it. The crucible to the right illustrates the crucible before any reaction takes place. Which diagram best represents the crucible after the reaction has taken place?



- All isotopes of a particular element must have the same
 - mass
 - number of protons
 - number of neutrons
 - number of protons and neutrons
 - number of electrons
- Of the choices below, which one is NOT an ionic compound?
 - PCl_5
 - MoCl_6
 - RbCl_5
 - PbCl_2
 - NaCl
- Consider the reaction between hydrogen (H_2) gas and oxygen (O_2) gas to form water. Write a balanced chemical equation in the space below.

Which of the following particulate diagrams is the best representation of this reaction?

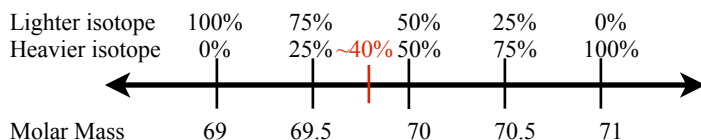


8. Which pair of atoms constitutes a pair of isotopes of the same element?
- ${}^{14}_6\text{X}$ ${}^{14}_7\text{X}$
 - ${}^{14}_6\text{X}$ ${}^{12}_6\text{X}$
 - ${}^{17}_9\text{X}$ ${}^{17}_8\text{X}$
 - ${}^{19}_{10}\text{X}$ ${}^{19}_9\text{X}$
 - ${}^{20}_{10}\text{X}$ ${}^{21}_{11}\text{X}$
9. In the symbol below, x = _____.
- $${}^x_6\text{C}$$
- 12
 - 13
 - 6
 - 7
 - not enough information to determine
10. Silver has two naturally occurring isotopes with the following isotopic masses
 ${}^{107}_{47}\text{Ag} = 106.90509$ ${}^{109}_{47}\text{Ag} = 108.9047$
 The fractional abundance of the lighter of the two isotopes is closest to
- 0.25
 - 0.45
 - 0.55
 - 0.75
 - exactly the same as the heavier isotope
11. The most abundant isotopes of hydrogen and oxygen are ${}^1_1\text{H}$, ${}^2_1\text{H}$, ${}^{16}_8\text{O}$, and ${}^{17}_8\text{O}$, respectively. Using these isotopes only, what is the number of *different* possible values for the molar mass of water in grams?
- 3
 - 4
 - 5
 - 6
 - 8
12. When a metal and a nonmetal react, the _____ tends to lose electrons and the _____ tends to gain electrons.
- metal, metal
 - nonmetal, nonmetal
 - metal, nonmetal
 - nonmetal, metal
 - none of the above, these elements would share electrons
13. Which pair of elements would you expect to exhibit the greatest similarity in their physical and chemical properties?
- C, Pb
 - O, S
 - K, Ca
 - H, He
 - Si, P
14. Elements in group 1A (#1) are known as _____
- transition metals
 - alkaline earth metal
 - halogens
 - alkali metals
 - noble gases
15. Elements in group 7A (#17) are known as _____
- transition metals
 - alkaline earth metal
 - halogens
 - alkali metals
 - noble gases
16. Which one of the following does NOT occur as diatomic molecules in elemental form?
- oxygen
 - sulfur
 - hydrogen
 - nitrogen
 - bromine
17. The molecular formula of a compound is always _____ the empirical formula
- more complex than
 - different from
 - a whole number multiple of
 - the same as
 - simpler than
18. Which pair of atoms contain the same number of neutrons? (Assume the most common isotope.)
- ${}^{35}\text{Cl}$ and ${}^{37}\text{Ar}$
 - ${}^{32}\text{S}$ and ${}^{37}\text{Cl}$
 - ${}^{31}\text{P}$ and ${}^{31}\text{S}$
 - ${}^{31}\text{P}$ and ${}^{30}\text{P}$
 - ${}^{30}\text{Si}$ and ${}^{32}\text{S}$

19. Of the following, which contains the greatest number of electrons?
- P^{3+}
 - P
 - P^{2-}
 - P^{3-}
 - P^{2+}
20. Which particle has 54 electrons?
- ${}^{132}_{54}\text{Xe}^+$
 - ${}^{128}_{52}\text{Te}^{2-}$
 - ${}^{118}_{50}\text{Sn}^{2+}$
 - ${}^{112}_{48}\text{Cd}$
 - ${}^{137}_{56}\text{Ba}^{2-}$
21. Element X reacts with sodium to form an ionic compound with the formula Na_3X . Element X must be a member of which group?
- 1A (1)
 - 3A (3)
 - 5A (5)
 - 6A (6)
 - 7A (7)
22. A certain nonmetallic element forms a compound with gallium having the general formula Ga_2X_3 . Element X is a member of which group?
- 1A (1)
 - 2A (2)
 - 3A (3)
 - 5A (15)
 - 6A (16)
23. The elements of which group are most likely to form ions by losing two electrons?
- 1A (1)
 - 2A (2)
 - 3A (3)
 - 5A (15)
 - 6A (16)
24. Given that there are two naturally occurring isotopes of gallium, ${}^{69}\text{Ga}$ and ${}^{71}\text{Ga}$, the natural abundance of the ${}^{71}\text{Ga}$ isotope must be approximately
- 25 %
 - 40 %
 - 50 %
 - 71 %
 - 90 %
25. Name the following compounds:
- $\text{Ba}(\text{OH})_2$ _____
 - H_2SO_4 _____
 - H_2SO_3 _____
 - NH_4NO_3 _____
 - $\text{Sn}(\text{CO}_3)_2$ _____
 - CCl_4 _____
 - N_2O_5 _____
 - CuBrO_3 _____
 - Au_3N _____
 - HNO_2 _____
 - $(\text{NH}_4)_3\text{PO}_3$ _____
 - PbS_2 _____
26. Write the formula for the following compounds:
- perchloric acid _____
 - chlorous acid _____
 - diphosphorus pentoxide _____
 - chromium (III) phosphite _____
 - zinc cyanide _____
 - magnesium acetate _____
 - lead (II) nitrite _____
 - silver phosphite _____
 - gallium acetate _____
 - cobalt (III) iodate _____
 - acetic acid _____
 - carbonic acid _____

1. b Since water is H₂O, and two hydrogen's (1 g each) weigh 2 g and one oxygen weighs 16 g, the mass ratio 2:16, reduced to 1:8 is true for water, this is the Law of Constant Composition (aka Law of Definite Proportions).
2. c Isotopes are atoms of the same element (all having exactly the same number of protons) with varying numbers of neutrons. The term isotope can refer to an atom or ion, thus the term isotope gives you no information about the number of electrons. You should know the root word *iso* mean *same*. We will also learn the terms isomer, isoelectronic and isothermal. Maybe you remember isotonic from biology?
3. a Recall that the mass number is placed in the top left position, the atomic number is placed at the lower left position. The atomic number tells us the number of protons which is equal to the number of electrons for an atom (not for an ion) and the atomic number subtracted from the mass number will equal the number of neutrons.
4. B Since you are told that 11.2 g of solid CaO remains, that must show in the crucible. The 8.2 g of CO₂ has left the container as a gas.
5. b All atoms of the same element must have the same number of electrons. Isotopes have varying number of neutrons, and ions compared to atoms have a different number of electrons
6. a Metals combined with nonmetals are ionic. Compounds made of groups of nonmetals are molecular compounds
7. C $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
Represent the H₂ gas reactant as separate molecules producing two separate water molecules
8. b Isotopes of the same element must have the same atomic number and thus the same number of protons.
9. e Since the x represents the mass number and that can vary for an element with varying number of neutrons (different isotopes) the x can not be known exactly without more info.
10. c **Practice estimating.** When considering this problem, first round the mass values to whole numbers, 107 and 109. Since the average molar mass of silver is 107.87, closer to the lighter isotope, a and b are not options. If the lighter isotope were 50% the average mass would be 108, 75%, the average mass would be 107.5, thus the best option, without a calculator, must be c, 55%
11. b It's tempting to quickly answer 6, however look closely at the options when adding up the masses of H, H, & O: 1+1+16=18, 1+1+17=19, 1+2+16=19(repeat), 1+2+17=20, 2+2+16=20(repeat), 2+2+17=21, thus a total of only four different molar mass options for H₂O.
12. c Metals have fewer valence electrons than nonmetals, and metals have loose valence electrons and lose them to achieve an octet. Nonmetals have more valence electrons which are held more tightly and therefore nonmetals gain electrons to achieve an octet. It is important to realize that metals and nonmetals produce ionic compounds.
13. b Elements in the same chemical family (vertical group) exhibit similar chemical properties because the elements in the same column have the same number of valence electrons.
14. d Elements in group 1A (or more simply, just named group 1) are called the alkali metals because when dropped into water a reaction occurs producing a basic (alkaline) solution. Thus their ions are called the alkali ions which combine with nonmetals to produce alkali salts.
15. c The elements in group 7A (or named 17) are called the halogens from Swedish for "salt former."
16. b You should know the seven elements that occur naturally as diatomic molecules: H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂. For our purposes, most of the time we will consider all other elements as monatomic, however, sulfur, a solid at room temperature forms 30 different allotropes (more than any other element), the most common of which is S₈.
17. c An empirical formula is the lowest whole number ratio of compound's molecular formula. For instance, glucose with the molecular formula C₆H₁₂O₆, has the empirical formula CH₂O with a whole number multiple of 6. The compound formaldehyde, with the chemical formula CH₂O, has an empirical formula that is the same as its molecular formula, the whole number multiple being 1. Of course the same is true for water, H₂O for which the empirical and molecular formula's are the same.
18. e This question requires that you subtract the mass numbers (given for each isotope) from their atomic numbers (on the periodic table) to determine that both ³⁰Si (30-14) and ³²S (32-16) have 16 neutrons.
19. d Remember that when electrons are gained, a negative ion results, and a loss of electrons causes a positive ion. An atom of phosphorus has 15 protons and 15 electrons, however the ion P³⁻ with its 3- charge must have gained 3 electrons for a total of 18 electrons.
20. b For this question, the mass number is of little consequence, you simply need to consider the atomic number and the charge. For the telluride ion ${}_{52}^{128}\text{Te}^{2-}$, the number of electrons will be 54 since an atom of tellurium would have 52 protons and 52 electrons and the 2- ion would have gained two more electrons for a total of 54.
21. c Since sodium always carries a 1+ charge as an ion, the element that would cause the need for three of the sodium ions to occur in a formula must have a charge of 3-. This of course is the case for the elements in group 5A (aka group 15), the nitrogen group with its 5 valence electrons and its drive to grab three more electrons to achieve the stable valence configuration of 8 valence electrons.

22. e Gallium ions carry the charge $3+$ and there are two of them present for a total charge of $6+$, thus the three ions of element X must produce a total $6-$ charge. Since there are 3 X ions present in the chemical formula, each X ion must carry a $2-$ charge, and group 6A (aka group 16), the oxygen family carries a $2-$ charge.
23. b Group 2A are metallic elements with two valence electrons which are easily given up. This group are called the alkaline earth metals.
24. b For this problem, you must have the good sense to go to the periodic table and look up the average molar mass of gallium and see that it has a value of 69.7, and then go back to view the answers to realize that you do NOT need to do an exact calculation. If there were 50% of each of the two isotopes, the average molar mass would have to be right in the middle at 70, and since the molar mass is lower than 70, you now have narrowed it down to either a) or b). If there were only 25% of the heavier isotope and 75% of the lighter isotope, the molar mass would have to be 69.5, and since the molar mass is greater than 69.5, the remaining choice, between 50% and 25% leaves the option of b) 40%. Perhaps the number line shown below will help.



25. Nomenclature. Pay attention to whether the compound is ionic or molecular as the method of naming is different.
- barium hydroxide
 - sulfuric acid
 - sulfurous acid Need more help with naming acids? The chart below is on your summer sheet (and pg 61-62 in text).
 - ammonium nitrate
 - tin(IV) carbonate
 - carbon tetrachloride
 - dinitrogen pentoxide
 - copper(I) bromate
 - gold(I) nitride
 - nitrous acid
 - ammonium phosphite
 - lead(IV) sulfide
26. Writing formulas
- HClO_4
 - HClO_2
 - P_2O_5
 - CrPO_3
 - $\text{Zn}(\text{CN})_2$
 - $\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2$
 - $\text{Pb}(\text{NO}_2)_2$
 - Ag_3PO_3
 - $\text{Ga}(\text{C}_2\text{H}_3\text{O}_2)_3$
 - $\text{Co}(\text{IO}_3)_3$
 - $\text{HC}_2\text{H}_3\text{O}_2$
 - H_2CO_3

