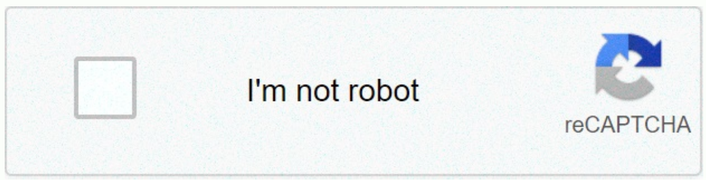

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Ionic and molecular covalent compounds worksheet answers

Navigation bar MAIN General Custom McMurry/Faysta, item 2.10, p. 56-63 and 1411 Lab Manual, p. 27-31. (References) Content: Types of compounds Ion types: Main group metals (groups IA, IIA and IIIA) Transition (Group B) and post-transition (group IVA and VA) Metals Non-metals of the main group (groups IVA, VA, VIA and VIIA) Polyatomic ion Writes Ionic Compounds nomenclature formulae Ionic and Kovalent compounds 1. Binary ion compounds containing metal and non-metallic 2. Ion compounds containing metal and polyatomic ion 3. Acids and acid salts 4. Binary roughener compounds between two non-metals 5. Hydrocarbons Molecular masses of chemical formulae Reference masses Types of compounds Ion compounds are compounds consisting of ion, charged particles formed when an atom (or atomic group, in the case of polyatomic ion) receives or loses electrons. My cation is a positively charged ion Anion is a negatively charged ion. Carbonlent or molecular compounds are formed when the elements divide electrons in a rough bond to form molecules. Molecular compounds are electrically neutral. Ion compounds are formed (usually) when the metal reacts with a non-metaal (or polyatomic ion). Kovalent compounds are formed when two non-meths react with each other. Because hydrogen is non-metric, binary compounds containing hydrogen are usually also rough compounds. Metal + Non-metallic –> ion compound (usually) Metal + Polyatomic ion –> Ion compound (usually) Non-metal + non-methic –> co-pilot compound (usually) Hydrogen + non-metabolic –> co-pilot compound (usually) Ion types: Main group metals (groups IA, IIA and IIIA) Group IA, IIA and IIIA metals usually form cations by losing all their outer (valency) electrons. Kation's charge is the same as the group number. Cation is given the same name as a neutral metal atom. Ions of the Group of Some Main Group Metals (Groups IA-IIIA) Element Cation Ion Name IA H H+ Hydrogen Li Li+ Li+ Liium Ion Na Na+ Sodium IonI K K+ Potassium Ion Cs Cs+ CaesiumIonIIA Mg2+ Magnesium iOni Ca2+ calcium ion Sr Sr2+ strontiumioni Ba Ba2+ bariumion IIIA Al Al3+ aluminium-ion Transition (Group B) and post-transition (group IVA and VA) Metals These elements usually form ion compounds; many of them can form more than one cation. (Payments for the common transition metal must be mesended; Their metallic cations for group IV and V are usually either group number or group number minus two.) Many of these ions are common or insignificant names formed along the name of the element (in some cases the Latin name) and the ending -ic or -ous. (-ic endings go with a higher possible charge, -ous-rest go with a lower possible charge). names (also known as the storage system of these ions) is derived by first naming the metal followed by a charge written in parentheses with Roman numbers. For the metals below, which typically make up only one charge, you usually don't have to specify a download in the name of the compound. For example, iron can form two possible ions, 2+ and 3+. Fe2+ ion is called iron ion (common) or iron (II) ion (systematic); Fe3+ ion is called iron ion (common) or iron (III) ion (systematic). Mercury(I) cation is a specific case; it consists of two Hg+ ions connected together, so it can always be found under the name Hg22+. (Therefore, mercury(I) chloride is Hg2Cl2, not HgCl, while mercury(II) chloride is HgCl2.) Ions of some transition metals and post-transition metals (groups IA and VA) Metal-ion Systematic name Generic name Cadmium Cd2+ cadmium ion Chromium Cr2+ chromium(II) ion chromium-ion Cr3+ chromium(III) ion chromium-ion Cobalt Co2+ cobalt(II) ion Cobalt(II) ion Co3+ cobalt(III) ion cobalt ion Copper Cu+ copper(I) ion cup-ion Cu2+ copper(II) ion cup-ion Gold Au3+ gold(III) ion Iron Fe2+ iron(II) ion iron ion Fe3+ iron(III) ion iron ion Manganani Mn2+ manganese(II) ion manganese(II) ion manganese Mn3+ manganese(III) ion manganese Mercury Hg22+ mercury(I) ion mercurous ionI Nickel Nickel(II) nickel-ion Silver Ag+ silver ion Zinc Zn2+ zinc ————— ——— ————— ————— T Sn2+ tin(II) ion stannous ion Sn4+ tin(IV) ion stannic ion Lead Pb2+ lead(II) ion plumbous ion Pb4+ lead(IV) ion plumbicion Bismuth Bi3+ bismuth(III) ion Bi5+ bismuth(V) ion Main-Group Nonmetals (groups IVA , VA, VIA and VIIA) Group IVA , VA, VIA and VIIA nonmetals usually form animones by obtaining enough electrons to fill the valence shell with eight electrons. Anion's charge is group number minus eight. The anion is named by taking the name of the element stem and adding the ending ide. Ions of some nonmetals (groups IVA - VIIA) Group element AnionIon name IVA C C4-carbide Si Si4 silicioid VA N N N3-nitridi-ion P P3-phosphide-as3-arsenic ion VIA O O2-oxide-ion S S2-sulf Diode-ion VIA Se2 Selenide ion Te Te2-telluridione VIIA F F-fluoride-ion Cl-cl-chlorideioni Br Br bromide-I-iodidian ia H-hydridiioni Polyatomic Ions Polyatomic ions are ions consisting of two or more atoms combined with roughlents but still having a net deficiency or surplus of electrons, resulting in a total loading of the group. Metal and polyatomic ion produce an ion compound. Formulae and names of some polyatomic ions Formula name NH4+ ammonium H3O+ hydronium OH-hydroxide CN-cyanide O22-peroxide N3-azide NO2-nitrite NO3 nitrate ClO-hypochlorite ClO2-chlorite ClO3-chlorate perchlorate MnO4 permanganate C2H3O2 acetate (OAc-) C2O42 oxate CO32-carbonate OCN cyanate SCN thiosyanate S2O32 thiosulphate CrO42 chromatic Cr2O72-didromerate SO42-sulphate So32 sulphite PO43 phosphate PO43 monohydrogen phosphate PO43-dihydrogen phosphate HCO3 hydrogen carbonate (bicarbonate) HSO4 hydrogen sulphate (bisulphate) HSO3 hydrogen sulphite (bisulphite) There are some regular differences in the names of these polyatomisions. Tio-means replacing the oxygen atom with a sulphur atom: OCN cyanate SO42 sulphate SCN-thiosyanate S2O32-thiosulphate Replacing the first element of the formula with another element of the same group gives a polyatomic ion with the same charge, and equivalent name: Group VIIA Group VIA ClO3 chlorate SO42 sulphate BrO3 bromate SeO42 selenate IO3-iodate TeO42 tellurate group VA* Group IVA PO43 phosphate CO32-carbonate AsO43-arsenate SiO32 silicate * But note, that nitrogen does not follow this pattern (i.e. nitrate , NO3-) Some non-metals form a series of polyatomic ions with oxygen (all have the same charge): ClO, hypochlorite; ClO2, chlorite; ClO3, chlorate; CLO4, perchlorate. Ate forms (formula and download) must be mesently taught. In some cases, there are three oxygens in the ate format and in some cases four oxygens. The charge is the same throughout the series. There is one less oxygen in ite form that -ate. The hypo-stem-ite format has two fewer oxygens than ate. Per-stem-ate format has one oxygen in more than athe form. -ide format is a monatomic anion (see Main-Group Nonmetals) The general rules for such series are summarised in the table below: Stencies XOny stem + ate XOn-1y-varsi + -ite XOn-2y-hypo- + varsi + -ite XOn+1y- per- + stem + ate Xy-varsi + -ide Examples of SO42 sulphate SO32 sulphite SO22-hyposulphite SO52-persulphate S2-sulphate Writing Formulas of ion compounds Kation is written first , followed by monatomic or polyatomic anion. Formula subscripts shall be produced by an electro-neutral formula unit. (That is, the total amount of the positive payment must be equal to the total amount of the negative payment.) Subscripts should be the smallest set of integers. If there is only one polyatomic ion in the formula, do not place parentheses around it; for example, NaNO3, not Na(NO3). If the formula has more than one polyatomic ion, place the ion in parentheses and place the subscript after the parentheses. for example Ca(OH)2, Ba3(PO4)2, etc. Remember the prime directive in writing formulae: Ca(OH)2 ¹ CaOH2 ! Examples of Kationi Anion Formula Na+ Cl- NaCl Ca2+ Br-CaBr2 Na+ S2-Na2S Mg2+ O2-Mgo Fe3+ O2-Fe2O3 Na+ SO42-Na2SO4 Mg2 + NO3-Mg(NO3)2 NH4+ SO42

(NH4)2SO4 Nomenclature of ion and co-pilot compounds Binary ion ion compounds containing metal and nonmetal. Binary compound is a compound formed two different elements. There can be more than one element for each element. The diatom compound (or diatom molecule) contains two atoms that may or may not be the same. Cl2 Not binary (only one atomic type), but diatom (two atoms) BrCl Binary (two different elements) and diatom (two atoms) H2O Binary (two different elements), but not diatomatic (CH4 Binary (two different elements) but not diatomical (more than two atoms) CHCl3 Binary or diatomic metals are not combined with non-metaal compounds for theation of ion compounds. When naming binary ion compounds, first name my cation (specifying charging if necessary), then non-metallian (element stem + -ide). DO NOT use the prefix to indicate how many each element there are; This information is included in the name of the compound. Examples of NaCl Sodium chloride AlBr3 Aluminium bromide Ca3P2 Calcium phosphide SrI2 Strontium irid FeCl2 Iron(II) chloride or iron chloride Kation charge should be determined because iron can form more than one charge. Ion compounds containing metal and polyatomic ion. First name the cation (payment if applicable), then the polyatomic ion (or according to the rules) mentioned in the table above. DO NOT use the prefix to indicate how many each element there are; This information is included in the name of the compound. Examples of NaOH Sodium hydroxide Ca(NO3)2 Calcium nitrate K3PO4 Potassium phosphate (NH4)2SO4 Ammonium sulphate NH4F Ammonium fluoride CaCO3 Calcium carbonate Mg(C2H3O2)2 Magnesium acetate Fe(OH))3 Iron(III)hydroxide or ferrous hydroxide Cr3(PO4)2 Chromium(II) phosphate CrPO4 Chromium(III) phosphate NaHCO3 Sodium hydrogen carbonate or sodium bicarbonate acids are compounds containing cation H+. (These aren't really ionic compounds, but we'll get there later.) These can be named compounds, as in previous cases, for example, HCl is a hydrogen chloride, but they are more often given special acid names (especially when dissolved in water, which is most often). The word hydrogen is omitted, the word acid is added to the end; the suffice is amended as follows: Compound name Acid name -ate -ic + acid-ite -ous + acid -ide hydro- -ic + acid Examples Compound name Acid name HClO3 hydrogen chlorate chloric acid H2SO4 hydrogen sulphide HClO2 hydrogen chlorite chlorite HClrid hydrochloride Acid salts are ionic compounds, which still contain acidic hydrogen, such as NaHSO4. When naming these salts, determine the amount of acidic hydrogen in the salt. Examples: Examples of NaHSO4 sodium hydrogen sulphate NaH2PO4 sodium hydrogen phosphate Na2HPO4 sodium hydrogen phosphate NaHCO3 sodium hydrogen carbonate or sodium bicarbonate Prefix bi-confidant sour hydrogen: therefore NaHCO3 is sodium bicarbonate (or sodium hydrogen carbonate); NaHSO3 is sodium bisulphite (or sodium hydrogen sulphite), etc. Binary roughener compounds between two non-metals. The two non-metals form a hardener or molecular compound (i.e. one connected by the rough bonds resulting from the distribution of electrons). In many cases, two elements can merge in several ways to make completely different compounds. (This cannot happen with ion compounds unless metals can form more than one charge.) For example, carbon can share electrons with one oxygen to get CO (carbon monoxide) or two oxygens to get carbon dioxide (carbon dioxide). For this reason, it is necessary to determine how many are in each element of the compound. The formula is first written with a more electropositive element (which is still on the left with a periodic table), then with a more electro-negative element (which is still on the right with a periodic table). [Important exception: when the compound contains oxygen and halogen, the halogen is first set. If both elements are in the same group, the one with a greater period number is first named.] The first element in the formula is given the name of the neutral element, and the second is named by replacing the neutral element name with the End ide. A prefix is used in front of each element name to indicate the initial atom: 1 mono-2 di-3 tri-4 tetra-5 penta-6 hexa-7 hepta-8 octa-9 nona-10 deca- If there is only one of the first elements of the formula, the monoen supplement is dropped. Examples of SO2 sulphur dioxide SO3 sulphur trioxide N2O dinitrogen monoxide NO nitrogen monoxide NO2 nitrogen dioxide N2O4 dinitrogenteroxide N2O5 dinitrogen pentoxide Hydrocarbons contain only carbon and hydrogen and are the simplest type of organic compound (carbon-containing compound). Alkanes contain only individual bonds of carbon carbon and are the simplest hydrocarbons. The simplest beginners are straight-chain beginners, where all carbon atoms are interconnected in a line without branches. (They don't get simpler!) The beginnings have a common formula CnH2n+2 and are ingredients of several important fuels, such as natural gas and gasoline. Organic chemistry has completely different rules for the nomenclature; straight-chain beginners are named with the prefix and the suffical .ane. Note that after C4, the prefixes are the same as the binary co-pilot compounds listed above. CH4 methane C2H6 methane C3H8 propane C4H10 butane C5H12 pentan C6H14 hexane C7H16 heptan C8H18 octane C9H20 nonaani C10H22 decant (Due to a huge range of potential organic compounds [over six million, and further calculation], rules on the more complex structures of the staight chain are much more complex than those we have seen so far, but these rules are discussed when you take organic chemistry.) Molecular masses from chemical formulae Molecular mass of the compound, i.e. molecular weight (measured in atomic mass units, amu), is obtained by adding the atomic masses of all atoms in the unit of the substance. Ion compounds use the term formula mass or formula weight instead, because there are no molecules. The molecular/stencil mass is numerically equal to the mass of one mole of the substance. For example, the molecular weight of water is obtained by the following process: Molecular mass H2O = (2 x atomic mass H) + (atomic mass of 1 x O) = (2 x 1,00797) + (1 x 15,9994) amu = 18,02 amu References John McMurry and Robert C. Fay, chemistry, 4. Ton, Upper Saddle River, NJ: Pearson/Prentice Hall, 2004, 56-63. George E. Shankle & Harold W. Peterson, Chemical Laboratory Manual 1411. University publication at Angelo State University, San Angelo, TX 76909, 27-31. 27-31.