Finding empirical formula from percent composition worksheet

To continue to enjoy our site, please confirm your identity as a human being. Thank you very much for your cooperation. Experiential composition percentage response sheet - display of the 8 best sheets found for this concept. Some sheets for this concept are Work 8 experiential formulas h o n o 4i, formula work, , percentage composition of work ii, percentage of composition and molecular formula work, percentage of composition and molecular formula work, Empirical working formula, empirical formula work 1.Found the sheet you are looking for? To download/print, click the pop-up icon or print icon to print or download the sheet. The worksheet opens in a new window. You can & download or print using the browser's document reader option. Back to the Mole content table Calculate empirical formula when given bulk data Specify the identity of the element from the binary formula and the percentage composition Specify the identity of the element from the binary formulas and mass data Specify the notice hydrate formula below, how to make the first problem with some attention to the use of the corresponding atomic scales, as well as keeping close to the appropriate number of significant numbers. Then, notice how to get away from this (as well as being true compatible with the units) in the following problems. Also note how it doesn't really make much difference. The trick is to know when to do it and it comes only through experience. In general, in empirical formula problems, C=12, H=1, O=16 and S=32 are sufficient. There are times when you will need to use 12.011 or 1.008. If you hit a problem that just doesn't seem to be worked out, come back and recalculate with more precise atomic weights. However, these problems are quite rare. For what it's worth, one advice for rounding: don't round up on piers if you see something like 2.33 or 4.665. The former can be rendered as two and one-thirds (or seven-thirds) and the latter as four and two-thirds (or fourteen-thirds). In such a situation, it could be multiplied by three to achieve the smallest ratio of the rotting number rather than dividing by the smallest. I know it's easy to say, it's harder to demonstrate. Some of the following issues concern the third issue. Look for a problem with citric acid. Just keep in mind that rounding too early and/or too much is a common problem in this type of problem. Example #1: The compound contains 50.05% sulfur and 49.95% oxygen by weight. What is the empirical formula for this compound? The molecular weight of this compound is 64.07 g/mol. What is its molecular formula? Solution: 1) Assume that 100 g of the compound is present. This changes the percentages per gram: S ---> 50.05 g O ---> 49.95 g 2) Conversion of masses to moths: S ---> 50.05 g / 3 2.066 g/mol = 1.5608 mol O ---> 49.95 g / 16.00 g/mol = 3.1212 mol 3) Divide by lowest, search Ratio: S ---> 1.5608 / 1.5608 = 1 O ---> 3.1212 / 1.5608 = 2 4) Enter empirical formula: SO2 5) Calculate the experiential weight of the formula: 32 + 16 + 16 = 16 64 6) Divide the mass of the molecule by EMF: 64.07 / 64 = 1 7) Use the scaling factor calculated just above, to determine the molecular formula: SO2 times 1 gives SO2 for molecular formula Example #2: The compound contains 64,80 % carbon, 13,62 % hydrogen, and 21,58 % oxygen by weight. What is the empirical formula for this compound? The molecular weight of this compound is 74.14 g/mol. What is its molecular formula? Solution: 1) Assume that 100 g of the compound is present. This changes the percents to grams: C ---> 64.80 g H ---> 13.62 g O ---> 21.58 g 2) Convert the masses to moles: C ---> 64.80 g / 12 = 5.4 H ---> 13.62 g / 1 = 13.62 O ---> 21.58 g / 16 = 1.349 3) Divide by the lowest, seeking the whole smallest-number ratio: C ---> 5.4 / 1.349 = 4 H ---> 13.62 / 1.349 = 10 O ---> 1.349 / 1.349 = 1 4) Write the empirical formula: C4H10O 5) Determine the molecular formula: EFW ---> 48 + 10 + 16 = 74 74.14 / 74 = 1 molecular formula = C4H10O Example #3: A compound is found to contain 31.42 % sulfur, 31.35 % oxygen, and 37.23 % fluorine by weight. What is the empirical formula for this compound? The molecular weight of this compound is 102.2 g/mol. What is its molecular formula? Solution: 1) Percents to mass, based on assuming 100 g of compound present: S ---> 31.42 g O ---> 31.35 g F ---> 37.23 g 2) Calculate moles of each: S ---> 0.982 mol O ---> 1.96 mol F ---> 1.96 mol 3) Smallest whole-number ratio: S ---> 1 O ---> 2 F ---> 2 4) Write the empirical and molecular formula formula: SO2F2 EFW ---> 32 + 32 + 38 = 102 g the empir the molecular formula Example #4: Ammonia reacts with phosphoric acid to form a compound that contains 28.2% nitrogen, 20.8% phosphorous, 8.1% hydrogen and 42.9% oxygen. Calculate the empirical formula of this compound. Solution: 1) Weights: N ---> 28.2g P ---> 20.8g O ---> 42.9g H ---> 8.1g 2) Moles: N ---> 2 P ---> 0.67 O ---> 2.68 H ---> 8 3) Lowest ratio 0: N = 32 / 0.67 = 3 P = 0.67 / 0.67 = 1 O = 2.68 / 0.67 = 4 H = 8 / 0.67 = 1 (2) Empirical formula: N3H12PO4 or (NH4)3PO4 Although not asked to do so, the name of this compound is ammonym phosphoate. 5) I would like to discuss my advice (about a third) at the top of the file using moles data from the above problem. N ---> 2 = 6/3 P ---> 0.67 = 2/3 O ---> 2.68 = 8/3 H ---> 8 = 24/3 6) Then, Multiply: N ---> 6/3 times 3 = 6 P ---> 2/3 times 3 = 2 O ---> 8/3 times 3 = 8 H ---> 24/3 times 3 = 24 7) Notice how to do this way introduces an additional factor of 2. We remove the additional factor of two to achieve this ratio: N ---> 3 P ---> 1 O ---> 4 H ---> 12 8) The additional factor of two could be remove thus: N ---> 3/3 P ---> 1/3 O ---> 4/3 H ---> 12/3 12/3 then multiply by 3 gives 3, 1, 4, 12 listed in step 7 8) And we continue. I really don't want you to think that introducing an additional factor two harms this technique. There are times when changing everything to fractions of the third type will make things easier. As in this example. Example #5: The compound contains 57.54% C, 3.45% H, and 39.01% F. What is its empirical formula? Rozwiązanie: 1) Uzyskać masę, następnie moli: C ---> 57,54 / 12,011 = 4,791 H ---> 3,45 / 1,0008 = 3,423 F ---> 39,01 / 19,00 = 2,053 2) Szukaj najniższego współczynnika liczby 00: C ---> 4.01 / 19.00 = 2.053 2) Szukaj najniższego współczynnika liczby 0:42: C ---> 4.01 / 19.00 = 2.053 2) Szukaj najniższego współczynnika liczb 00: C ---> 4.01 / 19.00 = 2.053 2) Szukaj najniższego współczynnika liczby 000: C ---> 4.00 = 2.053 2) Szukaj najniższego współczynnika liczby 00: C ---> 4.00 791 / 2,053 = 2,33 H ---> 3,423 / 2,053 = 1,67 F ---> 2,05 3 / 2.053 = 1 3) Kluczem jest, aby zobaczyć, że 2,33 jest 2 i jedna trzecia lub 7/3 i że 1,67 jest 5/3. Therefore, C ---> (7/3) x 3 = 7 H ---> (5/3) x 3 = 5 F ---> (3/3) x 3 = 3 The empirical formula is C7H5F3 I in this example. Example #6: Vanilla, a vanilla flavouring, has a percentage composition of 63.15%C, 5.30%H and 31.55%O. Determine the experiential formula of vanilla. Solution: 1) Start with assuming that 100 g is present, therefore: C ---> 63.15 g H ---> 5.30 g O ---> 31.55 g 2) Mark moles: C ---> 63.15 g / 12.0011 g/mol = 5.25768 mol H ---> 5.30 g / 1.008 g/mol = 5.25794 mol O ---> 31.55 g / 16.00 g/mol = 1.97188 mol 3) Divide by lowest value: C ---> 5.25768 mol / 1.97 188 mol = 2.67 H ---> 5.0 25794 mol / 1.97188 mol = 2.67 O ---> 1.97188 mol / 1.97188 mol = 1 4) Do not top up 2.67 to 3. Think of 2.67 as 2 and two-thirds, which becomes 8/3. Multiplie the above by 3, to get this: C ---> 2.67 x 3 = 8 H ---> 2.67 x 3 = 8 O ---> 1 x 3 = 3 5) The empirical formula is C8H8O3, not C3H3O, which can be obtained by rounding 2.67 to 3. Example #7: The compound was found to contain 24.74% (by weight) of potassium, 34.76% manganese and 40.50% oxygen. Specify an experiential formula. Solution: I like the titles of each step used by the person who wrote this response on Yahoo Answers. 1) Collect atomic mass: Potassium (K) has 39.1 amu Mnaganese (Mn) has 54.9 amu Oxygen (O) has 16.0 amu 2) Calculate stoichiometric ratio: K ---> 24.74 / 39.1 = 0.63 Mn ---> 34.76 / 54.9 = 0.63 O ---> 40.50 / 16.0 = 2.53 3) Find integer numbers on the basis of ratios: K : Mn : O = 0.63 : 0.63 : 2.3 53 = 1 : 1 : 4 4) Write empirical formula: KMnO4 Example #8: A mass spectrometer analysis finds that a molecule has a composition of 48% Cd, 20.8% C, 2.62% H, 27.8% O. Determine the empirical formula. Solution: 1) Suppose 100 g of the compound is present. This means: 48 g Cd, 20.8 g C, 2.62 g 27.8 g O 2) Let us determine moles present: Cd ---> 48 g / 112.4 g/mol = 0.427 mol C ---> 20.8 g / 12.011 g/mol = 1.732 mol H ---> 2.62 g / 1.008 g/mol = 2.5992 mol O ---> 27.8 g / 16.00 g/mol = 1.7375 mol 3) Divide through by lowest value: Cd ---> 0.427 mol / 0.427 mol = 1 C ---> 1.732 mol / 0.427 mol = 4.06 H ---> 2.5992 mol / 0.427 mol = 6.09 O ---> 1.7375 mol mol 0.427 mol = 4.07 4) Ignore the cd and see ratio 4: 6:4 for C:H: O. Reduce it to 2:3:2. Therefore: C2H3O2 C2H3O2$^-$is ion acetate 5) Cadmium is divalent, so we can see the empirical formula as: Cd(C2H3O2)2 Notice how the molar ratio in the full cadium acetate formula is 1: 4 : 6 : 4 Example #9: Bromoalkane contains 35% carbon and 6.57% hydrogen by weight. Calculate the empirical formula of this bromoalkane. Solution: 1) Assumption that 100 g mixture is available: C ---> 35 g H ---> 6,57 g Br ---> 58,43 g (from 100 minus 41,57) 2) Determine moles: C ---> 35 g / 12 gmol = 2,917 H ---> 6,57 g / 1 g/mol = 6,57 Br ---> 58,43 g / 80 g/mol = 0,730375 3) Divide the smallest, for the lowest ratio of 000: C ---> 2.917 / 0.730375 = 4 H ---> 6.057 / 0.730375 = 9 Br ---> 0.730375 / 0.730375 = 1 C4H9Br Example #10: A compound containing sodium, chlorine, and oxygen has a mass of 25.42% sodium. A sample of 3.25 g gives 4.33 x 1022 oxygen atoms. What is an experiential formula? Solution: 1) Oxygen percentage in sample: 4,33 x 1022 atoms divided by 6,022 x 1023 atoms/mol = 0,071903 mol 0,071903 mol times 16,00 g/mol = 1,15045 g 1.15045 g / 3.25 g = 0.3540 = 35.40% 2) Chlorine percentage: 100 minus (25.42 + 35.40) = 39.18% 3) We assume that 100 g of compound is present. This will convert percentages to grams. Mark moles: On ---> 25.42 g / 23.0 g/mol = 1,105 Cl ---> 39,18 g / 35,453 g/mol = 1,105 O ---> 35.40 g / 16.00 g/mol = 2.2125 4) Finish with the lowest numerical ratio: Divide by 1,105 to get the lowest ratio of 1: 1 : 2 $NaClO_2$ Although not required, this is a formula for sodium chlorinate. Example #11: An analysis of a compound containing only C and Br showed that it contains 33.33% C atoms by number and has a molar mass of 515.46 g/mol. What is the molecular formula of this compound? Solution: 1) . . . 33.33% C of atoms by number . . . Since mole is a measure of number (one mole = 6.022 x 1023 chemical units), we know this: C ---> 0.3333 mol Br ---> 0.6667 mol 2) Let's determine the smallest ratio of 0: C ---> 0.3333 / 0.3333 = 1 Br ---> 0.6667 / 0.3333 = 2 3) Empirical formula is CBr_2. Mark molecular formula: 515.46 / 171.819 = 3 C_3Br_6 Example #12: Chemical analysis shows that citric acid contains 37.51% C, 4.20% H, and 58.29% O. What is an empirical formula? Solution: 1) We start with the adoption of 100 g of the compound. This turns the above percentages into masses. 2) Calculate moles: C ---> 37.51 / 12.011 = 3.123 H ---> 4.20 / 1.008 = 4.167 O ---> 58.29 / 15.999 = 3.643 3) Look for the lowest y---> C 3.123 / 3.123 = 1 H ---> 4.167 / 3.123 = 1.334 O ---> 3.643 / 3.123 = 1.166 See to 1.334. That's one and a third or 4/3. I'm going to multiply all three values by 3: C ---> 1 x 3 = 3 H ---> 1.334 x 3 = 4 O ---> 1.166 x 3 = 3.5 See that 3.5? Let's multiply now by 2. C = H = 8 O = 7 4) Empirical Formula: $C_6H_8O_7$ When I found this question on Yahoo Answers, the wrong answer was given: C ---> 37.51/12 = 3.1258 H ---> 4.2/1 = 4.20 O ---> 58.29/16 = ratio 3.6431 moles = CHO = experiential formula. Too much rounding. Be very careful on rounding off or have a problem like this citric acid one will trip you over. Learn to recognize that something like 1,334 should be treated as 4/3, which leads to multiplying by three. Don't round 1,334 off to 1 or round out something like 2,667 to three. I certainly don't round up how bad a person's response is. No no no! Example #13: The compound is 19.3% Na, 26.9% S and 53.8% O. Its formula weight is 238 g/mol. What is the molecular formula? Solution: 1) We start with the adoption of 100 g of the compound. This turns the above percentages into masses. 2) Calculate moths: On ---> 19.3 / 23.00 = 0.84 S ---> 26.9 / 32.1 = 0.84 O ---> 53.8 / 16.00 = 3.36 3) Look for the lowest ratio of numbers y 0: 3.36 / 0.84 = 4 (I made only this one for oxygen. You should be able to find out the other two values!) 4) Empirical formula: $NaSO_4$ 4) Molecular formula: 238 / 119 = 2 $Na_2S_2O_8$ Example #14: In which I present a problem and a solution stripped down to their basic. I hope you enjoy it! C = 48.38%, H = 8.12%, O = 53.5% Solution: 4.028 8.06 3.34375 1.2 2.4 1 12 24 10 $C_6H_{12}O_5$ Interesting how you multiply by 10 and then divide by 2. You might ask: why not just multiply by 5? Well, you can if you saw it. If you haven't done so, moving the decimal point to get the full numbers, then seeing the common factor gets to the same place in a slightly more educational way. That being said, if you've seen that multiply by five runs, then treat yourself to ice cream! Example #15: Nitroglycerin has the following percentage composition: carbon: 15.87%, hydrogen: 2.22%, nitrogen: 18.50%, oxygen: 63.41% Determine its empirical formula. Solution: The assumption that 100 g of the compound is present turns the above percentages into grams. 1) Calculate moths (I will ignore units): ---> carbon 15.87 / 12.01 = 1,321 hydrogen ---> 2.22/1.01 = 2.198 ---> nitrogen 18.50/14.01 = 1,320 ---> oxygen 63.41/16.0 = 3,963 2) Looking for the lowest ratio of 000: C ---> 1,321 / 1,32 = 1 H ---> 2.198 / 1.32 = 1.66 N ---> ---> 1.32 / 1.32 = 1 O ---> 3.963 / 1.32 = 3 The key is 1.66, which you do not complete to two. Think of it as 5/3. 3) Multiplie everything by 3: C ---> 1 x 3 = 3 H ---> 5/3 x 3 = 5 N ---> 1 x 3 = 3 O ---> 3 x 3 = 9 4) The empirical formula is: $C_3H_5N_3O_9$ Example #16: Insulin contains 3.4% sulfur. Calculate the minimum molecular weight of insulin. Solution: 1) We assume that 100 g of insulin is present. 3.4% of these 100 grams are sulphur. Therefore, 3.4 g of sulphur is present. 2) Determine how many sulphur moths are found in 3.4 g of sulphur: 3.4 g / 32.065 g/mol 0.106035 mol 3) Suppose one mole of insulin contains one mole of sulfur: 0.106035 100 100 ——— = ——— 1 x 0.106035x = 100 g x = 943 g Example #17: Two metal oxides contain 27.6% and 30% oxygen respectively. If the formula of the first oxide is M_3O_4, then what will be the formula of the second? Solution: I will play the answer given on Yahoo Answers: Here you express everything based on 100 g. The first oxide contains 27.6 g O or 27.6/16 = 1.725 moles O and metal will be 100 - 27.6 = 72.4 g. Now the given formula is M_3O_4, so calculate 4 moles O will react to how much g of metal that will be 72.4 * 4 / 1.725 = 167.9 g of metal, which corresponds to 3 moles of metal, so its atomic tide will be 167.9/3 = 55.97 or 56. Perform similar calculations for the second, 30 g O = 30/16 = 1,875 moles reacting from 100-30 = 70 g of metal. So metal moths will be 70/56 = 1.25 moles, so the metal-oxygen ratio is 1.25:1.875, divided by a smaller number that is 1.25, you have 1:1.5, you need to get to whole numbers, so it will be 2:3, so the formula will be M_2O_3 Example #18: What formula gives 36.8% nitrogen in nitric oxide? Roztwór: 1) Napisz tak: 14N 0.368 = —————— 14N + 16O Gdzie N = liczba atomów azotu i O = liczba atomów tlenu 2) Krzyż mnożenie: 5.152N + 5.888O = 14N 3) Zbierz podobne terminy: 5.888O = 8.848N 4) Podziel przez najmniejsze: O = 1.1.45N Kiedy N = 2, O = 3 5) Wzór: N_2O_3 6) Inny sposób myślenia: 1.5N = O 3N = 2O 3N 2O ——— = —————— (2) (2) (2) (3) N O ——— = ——— 2 3 N musi być równe 2, a O musi być równe 3 dla stosunku i proporcji, aby były równe. Example #19: A 150. (g) the sample of the compound is 44,1 % C, 8,9 % H and the remainder oxygen. What is the empirical formula of the compound? Solution: 1) Since percentages are given, we can assume that 100 g (not 150 g) of the compound is present: C ---> 44.1 g H ---> 8.9 g O ---> 47.0 g (from 100 − 44.1 − 8.9) Since percentages are given, the fact that the sample has a mass of 150 g is superfluous. 2) Conversion of mass to moths: C ---> 44.1 / 12.011 = 3.6716 H ---> 8.9/ 1.008 = 8.8294 O ---> 47.0 / 15.9994 = 2.9376 3) Use the smallest answer above. Divide it into each answer: C ---> 3.6716 / 2.9376 = 1.24986 mol = 1.25 H ---> 8.8294 / 2.9376 = 3.0056 = 3.00 O ---> 2.9376 / 2.9376 = 1.00 4) Think of the answers in step 3 as invalid fractions: C ---> 1.25 = 5/4 H ---> 12/4 O ---> 1 4/4 5) Multiply by 4: C ---> 5 H ---> 12 O ---> 4 Experiential formula is $C_5H_{12}O_4$ 6) If the teacher was to insist on you with 150 g, start this way: C ---> (150) (0.441) = H ---> (1 (0.089) = O ---> (150) (0.470) = and then convert the masses to moles, and then perform calculations to get to the lowest set of subscripts of the entire number. Example #20: Nitrogen forms nitrogen oxides than any other element. The percentage of nitrogen in one of the oxides is 36.85%. a) Determine the empirical formula of the compound b) Determine the molecular formula for this compound, taking into account that its molecular weight is 152,0 g mol1 Solution: a typical method . . . . 1) Assume that 100 g of the compound is present. 2) Convert %N and 100 g to N mass and O N ---> 36.85 g O ---> 100 − 36.85 = 63.15 g 3) Conversion of masses to moths N ---> 36.03 85 g / 14.007 g/mol = 2.631 mol O ---> 63.15 g / 15.9994 g/mol = 3.947 mol 4) Simplify the mole ratio to get the empirical formula. N ---> 2.631 mol / 2.631 mol = 1 O ---> 3,947 mol / 2,631 = 1,5 Multiplie by 2 to N = 2 and O = 3 N_2O_3 is an empirical formula 5) Compare the molecular weight with the empirical mass to obtain the number of empirical units per molecule and molecular formula. N_2O_3 weighs 76.0 152.0 / 76.0 = 2 N_2O_3 times 2 = N_4O_6 Solution: another way . . . . This method depends on knowing the molecular weight. if this value is not given, we need to use the method we assume that 100 g of the compound is present. 1) Determine the mass of N and O resent in one mole of nitric oxide: N ---> (0,3685) (152,0 g) = 56,012 g O ---> 152.0 − 56.012 = 95.988 g Oxygen value can also be reached by: (0.6315) (152.0 g) 2) Determine the moles of each: N ---> 56.012 g / 14.007 g/mol = 3.9988577 O ---> 95.988 g / 15.9988 g/mol = 5.99969998 I think you can safely round these answers to 4 and 6. 3) Write formulas: molecular ---> experiential N_4O_6 ---> N_3O_3 Bonus Example #1: The chemist observed the gas evolved in the chemical reaction and collected some of it for analysis. It was found to contain 80% carbon and 20% hydrogen. It has also been observed that 500 mL of gas in the STP weighed 0.6695 g. What is the empirical formula for a relationship? What is its molecular formula? Solution: 1) Determine the empirical formula: Suppose 100 g of the compound is present. This means 80 g C and 20 g H. This means 6.67 moles C and 20 moles H. The above molar ratio is 1:3, which means that the empirical formula is CH_3 2) Determine the molar mass of the compound: Since everything is in the STP, I can use molar volume. 22.414 L 0.500 L ——— = ——— 1.00 mol x = 0.0223075 mol mol mol mass ---> 0.0 6695 g / 0.0223075 mol = 30.0 g/mol 3) Determine the molecular formula: the empirical weight of the formula (not a standard term in chemistry) CH_3 is 15. 30 / 15 = 2 The molecular formula is C_2H_6. An additional #2 example: Halothane is an anesthetic of 12.17% C, 0.51% H, 40.48% br, 17.96% Cl and 28.87% F of mass. What is the molar mass of a compound if each molecule contains exactly one hydrogen atom? (Note: Try doing this without a calculator.) Solution: Guess the pattern as $C_2HBrClF_3$ How would I do it? Divide each percentage by atomic mass of the element and you will get this: C = 1 H = 0.5 Br = 0.5 Cl = 0.5 F = Multiply by 2. I think the key #1 in this problem is to see that 12.17% of coal will go to 12.17g and that 12.17/12.011 is essentially equal to 1. The key #2 is to see that hydrogen will be 0.51 g / 1.0 g / mol = 0.5 moles and that it would have to be multiplied by 2 to get to one H atom. Other items are attacked in the same way. Back to mole content table Calculate empirical formula when given mass data Specifies the identity of the element from the binary formula and the percentage composition Specify the identity of the element from the binary formula and the mass data Specify the hydrate hydrate formula