What is a limiting reactant

When there is not enough reacting in a chemical reaction, the reaction stops abruptly. To understand the amount of product produced, it will limit the chemical reaction (limiting reactive) from the reactive, and it must be determined which reactive (extremely reactive) is excessive. One way to find the limiting reagent is to calculate the amount of products that can be created by each reactive; Is a limiting reactive that produces fewer products. The following scenario shows the importance of limiting reagents. To assemble a car, 4 tires and 2 headlights (among other things) are required. In this example, consider that tires and headlights are from the reacter, while the car is a product consisting of 4 tires and 2 farreactions. If there are 20 tires and 14 headlights, how many cars can be made? With 20 tires, 5 cars can be produced because there are 4 tires for a car. With 14 headlights, 7 cars (each car needs 2 headlights) can be built. No more cars can be made than existing headlights, but only 5 full cars are possible due to the limited number of available tires. In this case, the headlights are excessive. Since the number of cars formed by 20 tires is less than the number of cars produced from 14 headlights, the tires are limiting reactive (limiting the full completion of the reaction using all reactives). This scenario is shown below: 4 Tires + 2 Headlights = 1 Car + = Figure 1: Synthesis reaction of making a car. Images that are used with permission from Wikipedia. The first case is that there should be 4 tires for 2 headlights. Reactaktans should occur at this rate; otherwise, it will limit a reaction. There are 20 tires and 14 headlights, so there are two way to look at this problem. 10 headlights are required for 20 tires, while 28 tires are required for 14 headlights. Since there are not enough tires (20 tires are less than 28 required), the tires are from the limiting reactive. The limiting reactive is from the reactive, which is fully used in a reaction, thereby determining when the reaction stops. From reaction stoiometry, the exact amount of reacting with another element can be calculated from the necessary react. If reacters are not mixed at the right stokiometric proportions (as indicated in the balanced chemical equation), one of the reacters is completely consumed, while the other is left. Limiting reagent is one that is fully consumed; since there is no more loathing to the reaction with excess reacting, it limits the ongoing response. There are two way to determine the limiting reagent. One method is to find and compare the mole ratio of reacters used in the reaction (approach 1). Another way is to calculate the grams of products produced in the given quantities of reaktans; producing reacting the smallest amount of products is limiting reactive (approach 2). How to find a Limiting Reagent: Approach 1 Find the bounding reactive by looking at the bensate of each reaktan. Set the balanced chemical equation for the chemical reaction. Convert all given information into mes (most likely, through the use of less security as a conversion factor). Calculate the ratio of moles from the given information. Compare the calculated rate with the actual rate. Use the amount of limiting reactive to calculate the quantity of products produced. If necessary, calculate how much remains that exceed the non-limiting reagent. How to find Limiting Reagent: Approach 2 Find the bounding reagent by calculating and comparing the amount of products to produce from each reagent. Balance the chemical equation for a chemical reaction. Convert the information provided into me. Use stoiometry for each reaktan to find the mass of the manufactured product. It is reactive, limiting from reaktan, which produces a smaller amount of products. It is more reactive than reactive, producing a larger amount of products. To find the amount of excess reactive left, remove the excess reactive in mass consumed from the total mass of the given excess reagent. Example \(\PageIndex{1}\): Photosynthesis Consider respiration, one of the most common chemical reactions on Earth. \[\ce{ C6H_{12}O6 + 6 O_2 \rightarrow 6 CO2 + 6 H2O} + \rm{energy}\] What carbon dioxide mass occurs in the reaction of 25 grams of glucose with 40 grams of oxygen? Solution As I approach this problem, observe that glucose requires 1 mole (\(C_6H_{12}O_6\)) 6 carbon dioxide and 6 moles of oxygen to obtain 6 moles of water. Step 1: Set the balanced chemical equation for the chemical reaction. The balanced chemical equation has already been given. Step 2: Convert all given information into mes (most likely, with the use of a mass of few zrveneks as the conversion factor). \(\mathrm{25\:g \times \dfrac{1\: mol}{180.06\:g} = 0.1388\: mol\: C_6H_{12}O_6}\) \(\mathrm{40\):g \times \dfrac{1\: mol}32\:g} = 1.25\: mole\: O_2\) Step 3: Mole from the given information=: mol\: O_2\\ step 3: Calculate the rate of information provided. Compare the calculated rate with the actual rate. A. If all 1.25 oxygen m moles are to be used, there must be \(\mathrm{1.25 \times \dfrac{1}{6}}\) or 0.208 glucose muffins. Only 0.1388 mole glucose is available, which makes it limiting reactive. \[1.25 \; \rm{mol} \; O_2 \times \dfrac{ 1 \; \rm{mol} \; C_6H_{12}O_6}{6\; \rm{mol} \; O_2}= 0.208 \; \rm{mol} \; C_6H_{12}O_6 onumber\] b. If all 0.1388 glucose m moles have been used, there must be 0.1388 x 6 or 0.8328 oxygen cells. Since there is an oversping of oxygen, the amount of glucose is used to calculate the amount of products in the reaction. \[0.1388\; \rm{ mol}\; C_6H_{12}O_6 \times \dfrac{6 \; \rm{mol} \; \rm{mol} \; C_6H_{12}O_6} = 0.8328 \; \rm{mol}\; O_2 onumber\] If C6H12O6 has more than 6 O2 lugs per mole, oxygen is high and glucose is limiting from the reactant. If glucose has less than 6 moles of oxygen per mol, the oxygen limiter is from the reactive. The ratio is 1 mol oxygen per 6 moles of oxygen per glucose, 1/6 mole is 1 mol oxygen per glucose. This means: 6 moles O2 / 1 mol C6H12O6 . Therefore, the ratio of moles: (0.8328 mol O2)/(0.208 mol C6H12O6) This gives the rate of C6H12O6 O2 4.004. Step 4: Use the amount of limiting reactive to calculate the amount of CO2 or H2O produced. For carbon dioxide produced: \(\mathrm{0.1388\: mems\: glucose \times \dfrac{6}{1} = 0.8328\: mems\: carbon\: dioxide}\). Step 5: If necessary, calculate how much is left. 1.25 mol - 0.8328 mol = 0.4172 oksijen molleri Örnek \(\PageIndex{2}\): Magnezyumun oksidasyonu 2.40 g \(Mg \) 10.0 g \(O_2\) \[\ce{ Mg O_2 \\\\} ile reaksiyona girerse magnezyum oksit kütlesini hesaplayın} onumber\] Solution Step 1: Bakiye denklemi \[\ce{2 Mg + O_2 \rightarrow 2 MgO} onumber\] Adım 2 ve Adım 3: Kütleyi benlere ve stokiyometriye dönüştürme \(\mathrm{2.40\:g\: Mg \times \dfrac{1.00\: mol\: Mg}{24.31\:g\: Mg} \kez \dfrac{2.00\: mol\: MgO}{2.00\: mol\: mol\: Mol\: Mg\: Mol\: MgRac{40.31\:g\: MgO}{1.00\: mol\: MgO} = 3.98\:g\: MgO}\) \(\mathrm{10.0\:g\: O_2\kez \dfrac{1\: mol\: O_2}{32.0\:g\: O_2} \kez \dfrac{2\: mol\: MgO}{1\: mol\: O_2} \times \dfrac{40.31\ :g\: MgO}{1\: mol\: MgO} = 25.2\ : g\: MgO}\) Step 4: Mg produces less MgO than O2 (3.98 g MgO vs. 25.2 g MgO), so Mg is limiting reactive in this reaction. Step 5: From reactive, which produces a larger amount of products, the overactive O2 produces more MgO (25.2g MgO vs. 3.98 MgO) than Mg, so O2 is overly reactive in this reaction. Step 6: Find the amount of over-reactive left by removing the mass of the over-reactive consumed from the total mass of the given over-reagent. Overactive mass calculated using bounding reagent: \(\mathrm{2.40\:g\: Mg \times \dfrac{1.00\: mol\: Mg}{24.31\:g\: Mg} \times \dfrac{1.00\: mol\: O_2}{{2.00\: mole\: Mg} \times \dfrac{32.0\:g\: O_2}{1.00\: mol\: O_2} = 1.58\:g\: O_2}\) OR overactive mass calculated using the mass of the product: \(\mathrm{3.. 98\:g\: MgO \times \dfrac{1.00\: mol\: MgO}{40.31\:g\: MgO} \times \dfrac{1.00\: mol\: O_2}{2.00\: mol\: MgO} \times \dfrac{3 2.0\:g\: O_2}{1.00\: mole\: O_2} = 1.58\:g\: O_2}\) The total more reactive mass given – the more reactive mass consumed in the reaction is 10.0g – 1.58g = 8.42g O2. Example \(\PageIndex{3}\): What is a bounding reactive if the bounding reagent is counted as a reaction with 76.4 grams \(C_2H_3Br_3\) 49.1 grams \(O_2\)? \[\ce{4 C_2H_3Br_3 + O_2 \rightarrow 8 CO_2 + 6 H_2O + 6 Br_2} onumber\] Solution Approach 1: A. \(\mathrm{76.4\:g \times \dfrac{1\: mol}{266.72\:g} = 0.286\: mole\: of\: C_2H_3Br_3}\) \(\mathrm{49.1\: g \times \dfrac{1\: mol}{32\:g} = 1.53\: moller:\O_2\\ Assuming all oxygen is used, \(\mathrm{1.53 \times \dfrac{4}{11}}\) or 0.556 mol C2H3Br3 is required. Since C2H3Br3 is only available at 0.286 moles, C2H3Br3 is limiting reactive. Using Approach 2: \(\mathrm{76.4\:g\: C_2H_3Br_3 \times \dfrac{1\: mole\: C_2H_3Br_3}{266.72\:g\: C_2H_3Br_3} \times \dfrac{8\: mole\: CO_2}{4\: mole\: C_2H_3Br_3 <8>} \times times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \times \\ dfrac{44.01\:g\: CO_2}{1\: mol\: CO_2} = 25.2\:g\: CO_2}\) \(\mathrm{49.1\:g\: O_2 \times \times \times dfrac{1\: mol\: O_2}{32\ :g\: O_2} \times \dfrac{8\: mol\: CO_2}{11\: mole\: O_2} \times \dfrac{44.01\:g\: CO_2}{1\: mole\: CO_2} = 49.1\ :g\: CO_2}\) Therefore, either way, C2H3Br3is is limiting reactive. Example \(\PageIndex{4}\): What is a limiting reactive if the bounding reagent is counted as a reaction with 78 grams of Na2O2 29.4 grams of H2O? Approach 1: A. \(\mathrm{78\:g \times \dfrac{1\: mol}{77.96\:g} = 1,001\: mols\: mols\: \: \: \: \: \: : \: Na_2O_2}\) \(\mathrm{29.4\:g \times \dfrac{1\: mol}{18\\\ mol}\: mol}\: mols\: H_2O\\) Assume that all water is consumed. \(\mathrm{1.633 \times \dfrac{2}{2}}\) or Na2O2 1,633 moles are required. Since Na2O2 is only 1,001 moles, it is from the limiting reactive. Using Approach 2: \(\mathrm{78\:g\: Na_2O_2 \times \dfrac{1\: mole\: Na_2O_2}{77.96\:g\: Na_2O_2} \times \dfrac{4\: mol\: NaOH}{2\\: mol\: Na_2O_2} \times \dfrac{40\:g\: NaOH}{1\: mol\: NaOH} = 80.04\:g\) Reactively supplies na2O2 with bounding reagent using both approaches. Example \(\PageIndex{5}\): How much more reactive does overly reactive 24.5 grams of CoO remain if it is counted as a reaction with 2.58 grams of O2? \[4 CoO + O_2 \rightarrow 2 Co_2O_3\] Resolution A. \(\mathrm{24.5\:g \times \dfrac{1\: mol}{74.9\:g}= 0.327\: moller\: of\: CoO}\) \(\mathrm{2.58\:g \times \dfrac{1\: mol}{32\:g}= 0.0806\: mol\: \: O_2}\) B. Assuming all oxygen is used, \(\mathrm{0.0806 \times \dfrac{4}{1}}\) or 0.3225 mol \(CoO\) is required. Since coo is 0.327 moles, coo is excessive and thus O2 is limiting reactive. A. 0.327mol - 0.3224mol = 0.0046 moles are left more. Example \(\PageIndex{6}\): 28.7 grams \(SiO_2\) 22.6 grams \(H_2F_2\)? If not, identify the bounding reagent. \[SiO_2+ 2 H_2F_2 \rightarrow SiF_4+ 2 H_2O\] Solution A. \(\mathrm{28.7\:g \times \dfrac{1\: = 0.478\: moller\: mole\: mole\:: \: SiO_2}\) \(\mathrm{22.6\:g \times \dfrac{1\: mol}{39.8\:g} = 0.568\: mole\: of\: H_2F_2}\) B. Every 2 Moles Consumed must be 1 mol SiO2 for H2F2. Since the ratio is between 0.478 and 0.568, it reacts with 28.7 grams of SiO2 H2F2. C.C. all silicon dioxide, \(\mathrm{0.478 \times \dfrac{2}{1}}\) or H2F2 0.956 moles are required. Since H2F2 is only 0.568 bens, this is limiting reactive. Reactive.