SHS LEARNING ACTIVITY

CHEM1-06-05

Name: _____ **Score/Mark:** _____
Grade and Section: _____ **Date:** _____
Strand: ☐ **STEM** ☐ **ABM** ☐ **HUMSS** ☐ **ICT (*TVL Track*)**
Type of Activity : ☐ Concept Notes ☐ Skills: Exercise/Drill ☐ Illustration
☐ Laboratory Report ☐ Essay/Task Report ☐ Other: _____
Activity Title: 06-05.Limiting reagent and excess reagent v01
Learning Target: To determine the limiting reagent. Further calculations.
Authors | References: Victor Sojo | Wikipedia: Limiting reagent.

What happens when we know the amounts of both reagents? Normally, we will have too little of one of them, so the other will remain as an excess.

The reaction of tetraphosphorous decaoxide with perchloric acid produces phosphoric acid and dichlorine heptoxide. Let's say we start with 0.1 mol of P_4H_{10} and 0.6 mol of $HClO_4$. We would have, in mol:

	P_4O_{10}	+	**12** $HClO_4$	⟶	**4** H_3PO_4	+	**6** Cl_2O_7
i)	0.10		0.60		0.00		0.00
r)							
f)							

To fill in the table the equation tells us that <u>for every molecule of P_4O_{10} that react, 12 molecules of $HClO_4$ must react with it</u>. If we have 0.10 mol of P_4O_{10}, we would need 12 times that to react it completely, that is, we would need 1.2 mol $HClO_4$. We only have 0.6 mol $HClO_4$, so now we know that $HClO_4$ is the **<u>limiting reagent</u>** (since it limits how long the reaction can go on for), and P_4O_{10} is an **<u>excess reagent</u>**. Note that the limiting reagent can actually start out with larger quantities: we had a lot more $HClO_4$ than P_4O_{10}, but since the relation is 1:12, the $HClO_4$ runs out much more quickly. **<u>The limiting reagent reacts completely</u>**, nothing is left of it, so we can fill in our first two missing boxes, the "r" and "f" for $HClO_4$.

So, we know that $HClO_4$ reacted completely; now it would be good to know how much of the P_4O_{10} reacted, and how much is left. That's easy: the amount of P_4O_{10} that reacted is 1/12 of the 0.06 mol of $HClO_4$ that reacted.

Next we have the products. Their quantities are also determined by the limiting reagent. We know that their respective relations to $HClO_4$ are 12:4 and 12:6. That's the same as 3:1 and 2:1, or more convenient in this case, 6:2 and 6:3! So, we must have formed 0.2 mol H_3PO_4 and 0.3 mol Cl_2O_7. Note that the stoichiometric relations also remain if you use the "r" numbers for any reagent or product. **<u>Exercise:</u>** go on and fill in the whole table =)