

Lab: Preparation and Reactions of Acetylene (Ethyne)

In this experiment, you will prepare acetylene, (C₂H₂), and ignite mixture of acetylene and air to observe combustion. You will also observe the reaction of an unsaturated hydrocarbon with bromine (in an inert solvent, TTE) and potassium permanganate.

Procedure

1. Half fill a 250mL beaker with water, and into it, invert a test-tube filled with water. Using a spatula, drop a small lump of calcium carbide, CaC₂, into the water in the beaker. Observe all changes that occur.
2. Place the second inverted test-tube, filled with water over the calcium carbide, and collect the tube **full** of gas. Stopper the test-tube.
-Collect a second test tube **half full** of gas
-Collect a third test tube **one-twelfth** full of gas
Keeping the mouths of these partially filled test tubes down, lift them slowly out of the beaker, allowing air to replace the water, then stopper the tubes.
3. Hold each of the test tubes, one at a time, in a horizontal position, and bring a lighted splint to the mouth of the tube. Record all observations carefully.
4. Collect a **new** test tube **full** of acetylene, and add a few drops of bromine (in TTE). Stopper and shake. Record all observations.
5. Prepare **another** test tube **full** of acetylene, add a few drops of 1.00mol dm⁻³ KmnO_{4(aq)}. Observe any colour changes.
6. Test the water in the beaker with red litmus paper.

Questions

1. Write the equation for the laboratory preparation of acetylene.
2. **Incomplete Combustion:** Many balanced equations are possible, balance the following three:
$$\text{C}_2\text{H}_2(\text{g}) + 3 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) + \text{C}(\text{s})$$
$$\text{C}_2\text{H}_2(\text{g}) + 4 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) + \text{C}(\text{s})$$
$$\text{C}_2\text{H}_2(\text{g}) + 6 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) + \text{C}(\text{s})$$
3. **Complete Combustion:** Balance the following equation:
$$\text{C}_2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$$
4. What observation from the lab would indicate that the combustion of acetylene was incomplete?
5. Write the equation for the reaction of bromine with acetylene and give the IUPAC name of the intermediate product and the final product.
6. What is the physical evidence that the bromine has disappeared in the reaction?
7. What is the evidence that the KMnO₄ has been changed in reacting with acetylene? Name the product of the reaction. KMnO₄ is acting as an _____ agent. Explain why.(What is the oxidation number?)
8. Name two reactions that may be used as identification tests for unsaturated compounds.
9. Explain the observed pH of the resultant water in the beaker.
10. Why are pi bonds, π-bonds, of acetylene more reactive than the sigma, σ- bond?
11. Draw the structures of the products of each of the following reactions, and clearly explain the mechanism of each reaction ...
 - a) 2-butyne + bromine
 - b) propyne + hydrogen bromide