

2012 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS

2. A sample of a pure, gaseous hydrocarbon is introduced into a previously evacuated rigid 1.00 L vessel. The pressure of the gas is 0.200 atm at a temperature of 127°C.
- (a) Calculate the number of moles of the hydrocarbon in the vessel.
 - (b) $\text{O}_2(g)$ is introduced into the same vessel containing the hydrocarbon. After the addition of the $\text{O}_2(g)$, the total pressure of the gas mixture in the vessel is 1.40 atm at 127°C. Calculate the partial pressure of $\text{O}_2(g)$ in the vessel.
- The mixture of the hydrocarbon and oxygen is sparked so that a complete combustion reaction occurs, producing $\text{CO}_2(g)$ and $\text{H}_2\text{O}(g)$. The partial pressures of these gases at 127°C are 0.600 atm for $\text{CO}_2(g)$ and 0.800 atm for $\text{H}_2\text{O}(g)$. There is $\text{O}_2(g)$ remaining in the container after the reaction is complete.
- (c) Use the partial pressures of $\text{CO}_2(g)$ and $\text{H}_2\text{O}(g)$ to calculate the partial pressure of the $\text{O}_2(g)$ consumed in the combustion.
 - (d) On the basis of your answers above, write the balanced chemical equation for the combustion reaction and determine the formula of the hydrocarbon.
 - (e) Calculate the mass of the hydrocarbon that was combusted.
 - (f) As the vessel cools to room temperature, droplets of liquid water form on the inside walls of the container. Predict whether the pH of the water in the vessel is less than 7, equal to 7, or greater than 7. Explain your prediction.