

Refinery Products Math Student Guide

Background

Shell Deer Park is an oil refinery located near Houston, Texas, on the Buffalo Bayou, leading to Burnet Bay and ultimately to the Gulf of Mexico. Most of the oil that comes into Deer Park is sour crude oil from Mexico. Nearly 3,000 people work at the refinery, and it is operating all day, every day. The refinery handles about 100,000,000 (100 million) barrels of crude oil every year.

Crude oil is a mixture of different sized molecules that are almost entirely made of hydrogen and carbon. These molecules are called hydrocarbons. The number of carbon atoms in each molecule determines what its end use will be. For example, propane has only three carbons, and it is used primarily as a fuel for cooking and heating. The black, tarry substance found in asphalt that paves your neighborhood street is made from molecules with 20 or more carbon atoms.

Crude oil is separated by a process called distillation. The crude oil is heated until it boils, and the hydrocarbons rise in a tower, cooling as they rise. The tiniest molecules will stay as a gas and go out the top. The medium-sized molecules condense into liquids and are collected. The very large molecules collect near the bottom of the tower. After the molecules are sorted and separated, they may be processed some more before being sent to factories to be made into products, or sent to gas stations for cars.

Procedure

Answer the following questions using your math skills. Some of the information you need will be found in the paragraphs above.

1. How many barrels of oil come into Deer Park every day, on average?

2. One barrel of oil is equal to 42 gallons. Using your answer from #1 above, calculate how many gallons of oil are brought into Deer Park every day.

3. On average in the United States, one barrel of oil will produce 20 gallons of gasoline. Using your answer from #1 above, calculate how many gallons of gasoline are probably produced at Deer Park every day.



4. One barrel of oil will produce six gallons of materials that are used to make other products like medicine, carpet, paint, plastics, insecticides, fertilizers, adhesives, and plastic and rubber coatings. Using your answer from #1 above, calculate how many gallons of materials are sent from Deer Park to factories that make these products each day.

5. The United States uses 19,687,000 barrels of oil in one day. What percentage of U.S. oil is processed by Deer Park? Use your answer from #1 in your calculation.

6. One gallon of Mexico sour crude oil weighs about 7.8 pounds. How much does one barrel of this oil weigh?

7. Bitumen is one compound found in crude oil. It is very thick, often sticky and black. The molecules in bitumen are quite large, usually around 24 carbons in size. Gasoline is made of molecules that have 5-10 carbon atoms each. Cracking is a chemical process that breaks big hydrocarbon molecules into smaller molecules. If you have a big vat of bitumen, and need more gasoline, what size(s) of molecules would you break each bitumen molecule into? You do not want to have tiny molecules (1-4 carbons) breaking off and floating away. Draw a picture or use math to solve this problem.

