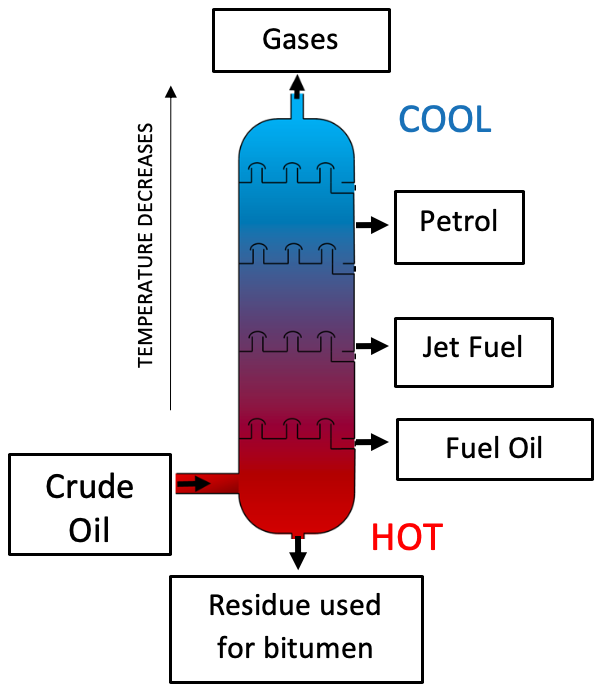
**Fractional distillation of fizzy drinks**

**Crude oil contains molecules of many different shapes and sizes. Using fractional distillation, we can separate out all of these different components to get more useful products. This is an important industry in the UK.**

**Heating up crude oil can be used to separate out its different components. This uses a fractionating column, which is a giant vertical tank that is hot at the bottom, and cool at the top.**

**Crude oil is vaporised and added to the fractionating column. The molecules that condense at the bottom of the column, where it is hottest, are the heaviest molecules as these have high boiling points.**

**All of the other gases rise up the column, and as they cool, these gases with different boiling points condense and the liquids are separated. At the very top of the column, the lightest molecules with the lowest boiling points are removed as gases.**

**Exercise**

Using the boiling point ranges,

arrange the following products

on the column

Fuel oil (370 – 600 °C)

Gases (<40 °C)

Jet fuel (175 – 325 °C)

Petrol (60 – 100 °C)

Residue (>600 °C)

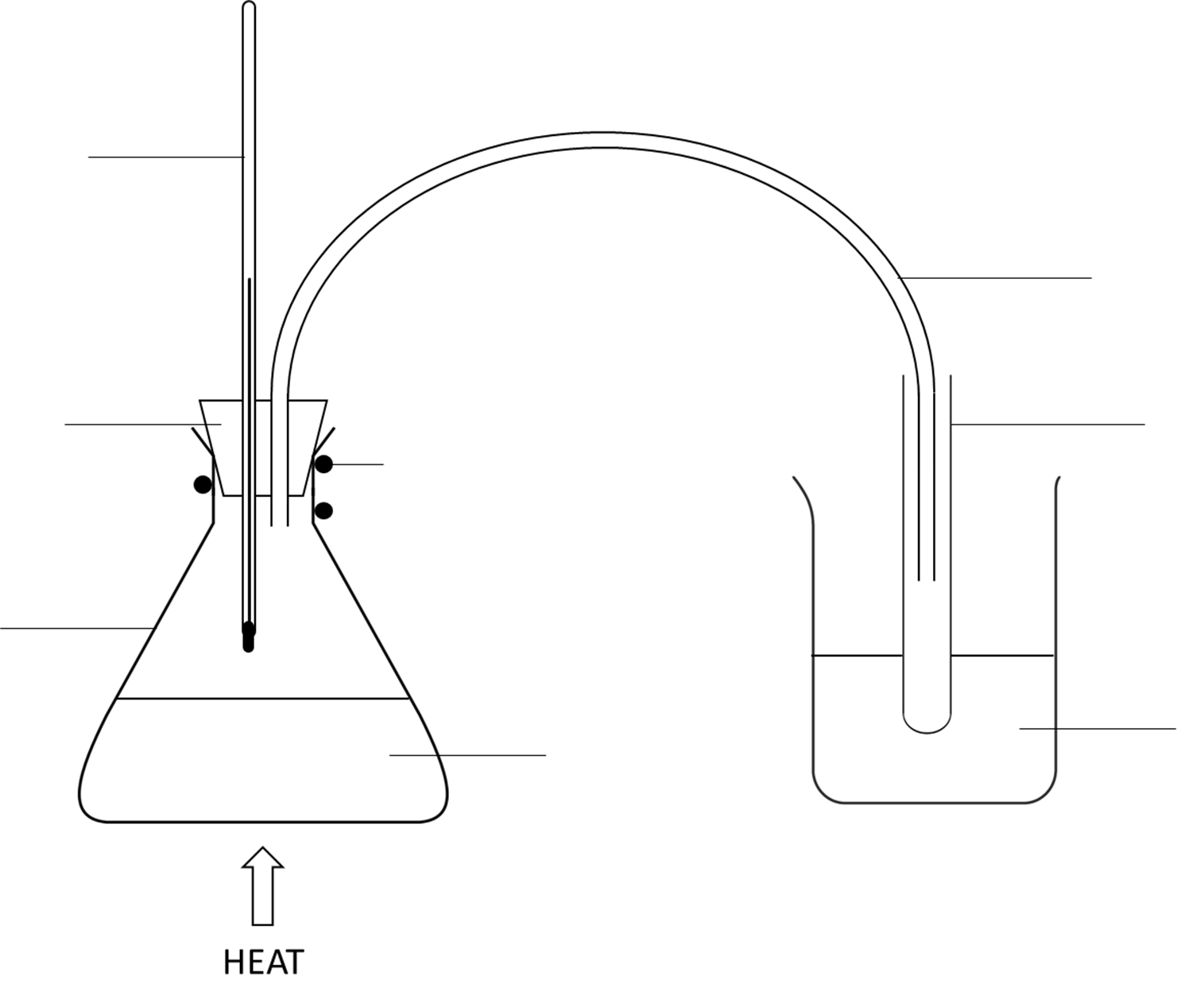
**Try building your own fractional distillation column using a lemonade bottle and straws – instructions at (**<https://chembam.com/online-resources/gcse-resources/fractional-distillation/>**)**

**Aim**

To separate a fizzy drink into its ingredients by fractional distillation.

**Method**

Start by assembling your apparatus and labelling this diagram.



NOTE: do not use a bunsen burner for this experiment as it is too difficult to control heating. Use a hot plate or a tea light. For an image of the apparatus, check out **(**<https://chembam.com/online-resources/gcse-resources/fractional-distillation/>**).**

**Part 1: release of CO­2**

Measure out 25 mL of the soft drink into a conical flask and weigh. Fill a test tube ¾ of the way full with tap water. Add 1 mL of universal indicator and note the colour and pH of the tap water. Place the conical flask on top of the tripod or clamp it securely. Push the thermometer through one of the holes in the bung and the tubing through the other. If there is an issue with getting the thermometer or tubing through the bung add a bit of washing up liquid to the end that you want through the bung. The thermometer should rest above the liquid and measure the temperature of the vapour. Carefully fit the bung on top of the conical flask making sure that there is a tight seal, and put the other end of the tube in the universal indicator solution. Place the heat source under the conical flask.  Gently heat until the thermometer reads around thirty degrees, or there is a consistent release of gas. As the gas passes through the universal indicator solution in the test tube note the colour change and the pH.

**Part 2: distillation of flavour compounds**

Fill a beaker or container with ice, and place a second test tube in the ice. Swap the tube that is running into the first test tube and place it in the second test tube. Gently increase the heat of the soft drink until it begins to boil and produce a [distillate](http://chembam.com/definitions/distillate/). Collect the distillate up to about 5 mL then remove the test tube from the beaker/container. If you want to increase the rate of distillation, you can wrap the flask and tubing with aluminium foil cladding.

**Part 3: distillation of the water**

Place a third test tube in the beaker/container of ice, and swap the tubing from the second test tube to the third test tube. Maintain the heat on the soft drink and collect the remaining distillate. Observe what remains in the conical flask. Compare the smell of test tube 2 and test tube 3. Keep collecting fractions until all the liquid has boiled away

This reaction can take a very long time to run until completion. If you do not have time to allow all of the liquid to boil off and leave a solid, collect whatever liquid you may have and weigh it.

**Questions**

1. What happened to the pH of the water after the CO2 from part 1 of the distillation was run through it and why?

The solution became more acidic. This is because the CO2 dissolves in the water to produce carbonic acid.

1. Which fractions had the highest and lowest boiling points? Write a list of the different fractions that came off the mixture in order of their boiling point from lowest to highest.

Highest CO2

Flavour compounds

Lowest Water

1. What remains in the conical flask after the distillation was over? What difference would you expect to see in a “diet” version of this drink?

Sugar or a sugar solution. In a diet drink you’d expect only a tiny residue of artificial sweetener.

1. What was the initial density of the fizzy drink? What is the final density of the fizzy drink? Can you give an explanation for any changes? Think about what you have collected in your fractions and what is left in the conical flask.

The liquid left at the end is more dense as it is a more concentrated sugar solution

1. What did fractions 2 and 3 smell like? Why is it important that these molecules have relatively low boiling points?

Flavour molecules have a low boiling point. As well as providing taste, they provide a nice smell to the drink. Because they are volatile, they can travel up the nose.

1. Below is a diagram of a distillation column. Fill in the boxes for where you think that your fractions from your fizzy drinks would be removed.

