THE CASE OF THE DRUNK DRIVER; GC APPROACH

From *Science in Motion, Juniata College*

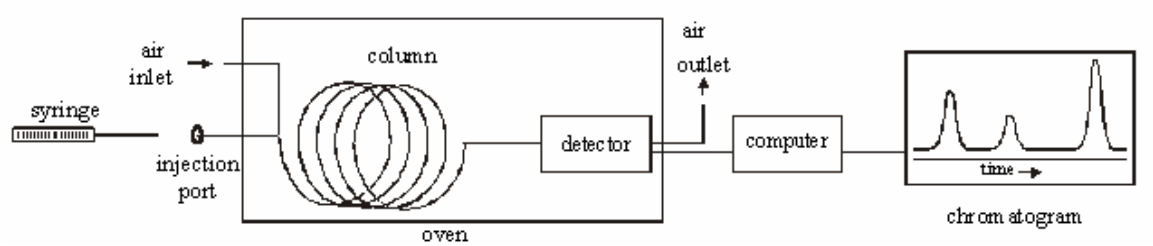
Westminster College

STANDARDS ADDRESSED

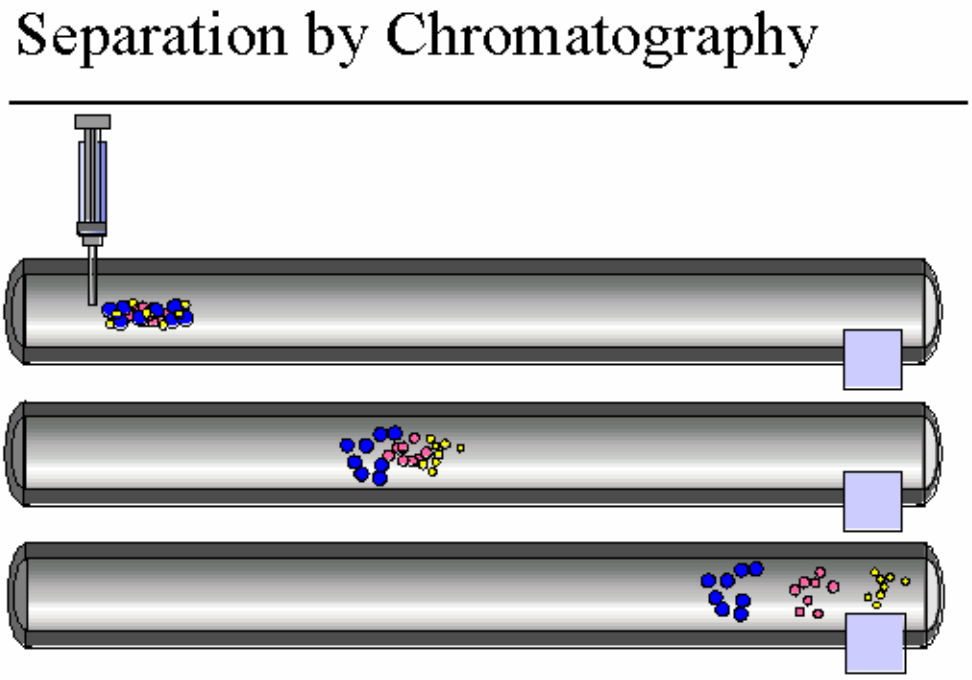
1.2.11.A, 2.4.11.E
3.4.10.A, 3.7.10.A
3.7.12.A

INTRODUCTION ON GAS CHROMATOGRAPH

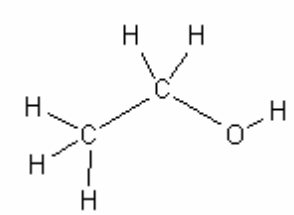
Chromatography is a separation technique utilizing a stationary phase and a mobile phase. In gas chromatography, the stationary phase is a solid material packed in a coiled column, and the mobile phase is air.



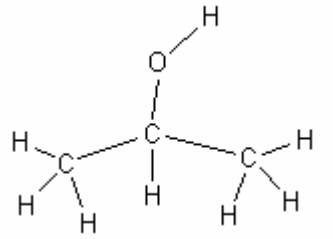
The gas chromatograph is an instrument that allows a chemist to separate a mixture of gases or volatile liquids. Separation is based on the size, structure, polarity of the molecules.



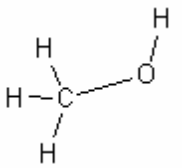
Retention time is used to identify the components, and the area under the curve is used to determine the relative quantities of the components. In this experiment, a HAYSEP-D column is used to separate ethanol, isopropyl alcohol, and methanol.



Ethanol
Boiling Point 78 °C



Isopropyl alcohol
Boiling Point 82°C



Methanol
Boiling Point 65°C

SCENARIO

You are a forensic scientist at a local police station. You are presented with a case that involved a drunk driver. A police officer pulled the driver over for erratic driving. As the police officer approached the vehicle, the driver was chugging an unknown substance from an ice tea bottle. The police officer smelled alcohol and quickly took the ice tea bottle from the driver. There was still a small amount of substance left in it. The driver's blood alcohol level was 0.15; the legal limit in Pennsylvania is 0.08. He is being charged with a DUI and an open container of alcohol in the vehicle. You need to determine whether or not the driver was telling the truth. Does the ice tea have any alcohol mixed into it? To test this you will compare your results for running the following samples on a gas chromatograph; ethanol, ice tea, and the unknown mixture taken from the suspect.

GUIDING QUESTIONS

Please answer the following questions before beginning the lab.

1. Which will have the shortest retention time, alcohol or ice tea?

2. What information do you know about the following alcohols; methanol, ethanol, and isopropyl alcohol; that would help you determine which would have the shortest retention time?

EQUIPMENT/MATERIALS

Mini Gas Chromatograph
LabQuest or Computer
10 microliter syringe
vial of methanol (optional)
Acetone (for clean syringe)
vial of Unknown Drink
vial of ethanol
vial of ethanol/ice tea mix
vial of isopropyl alcohol (optional)

SAFETY

1. Always wear safety glasses in the lab.

2. Handle the syringes carefully. The syringes are very dangerous, especially when filled with hazardous chemicals. They also break easily.

3. Do not allow the syringe to roll off of the lab bench. When injecting the sample, push the plunger straight so that it does not bend.

4. The gas chromatograph is like an oven, so the port may be hot. Use caution.

PROCEDURE

1. Obtain and wear goggles.

2. Obtain a glass syringe and a set of vials of ethanol, methanol, isopropyl alcohol, and tea.

3. Prepare the Mini GC for data collection.
   a. Turn on the GC
   b. Connect the USB cable of the GC to the USB port on the LabQuest
   c. Choose '**New**' from the File menu
   d. Tap on ▶ the LabQuest to bring up the **Temperature-Pressure profile**
   e. Set the Temperature-Pressure values to:

Start Temperature	120°C
Hold Time	10 Min.
Ramp Rate	0 Min.
Final Temperature	120°C
Hold Time	10 Min.
Total Length	10 Min.
Pressure	4 kPa

   f. Select '**Done**' to initiate the Mini GC warm up. Note: A new message will appear, "**Do not inject until GC is ready**", and the LED on the Mini GC is red. The Mini GC will take a few minutes to warm up and stabilize. When the Mini GC is ready for injection, the message will read, "**Inject and select Collect simultaneously**", and the LED will turn to **green**. While the mini GC is warming up, complete Steps 4 and 5.

4. Clean the syringe by rinsing it at least 7 times with the alcohol sample you will be injecting into the GC. With the plunger fully depressed, place the needle into the alcohol sample. Slowly draw up the plunger to obtain a sample of alcohol in the syringe. ***(Caution: Do not pull the plunger out too far or the plunger will come out the syringe.)*** Remove the syringe from the alcohol sample. Discharge this sample into a waste container. Depress the plunger, and put the syringe needle back into the alcohol sample. Draw up a second sample and discharge it into a waste container. Repeat.

5. Place the syringe needle back into the alcohol sample, and obtain 2 microliter of the standard alcohol. Wipe the needle with a Kimwipe to prevent any excess sample from being vaporized prior to injection.

6. Prepare for injection and the start of data collection. It is important for you and your lab partner to divide the task in this step. One person will operate the syringe and the other person will operate the LabQuest.
    a. When the GC has reached the correct start temperature and pressure, the message reads, "**Ready to inject**," and the LED on the GC is **green**.
    b. To insert the needle of the syringe into the injection port of the GC, hold the syringe with one hand and steady the needle with your other hand. Insert the needle into the injection port until the needle stop is fully seated. If the needle sticks, rotate it slightly while inserting. Do not move the plunger yet. Simultaneously, depress the syringe plunger and select Collect to begin data collection.
    c. Leave the needle in the injection port until data collection has finished.

7. When the sample peak of a standard returns to the baseline, the run may be stopped by p  ssing the end button on the LabQuest.

8. To print the graph:
    a. Disconnect the GC from the LabQuest
    b. Connect the USB of your printer into the USB port on the LabQuest
    c. Select Print from the FILE menu
    d. Tap Graph
    e. On the Print Options screen, tap Print
    f. The LabQuest will prepare for printing

9. Repeat steps 4-8 for the other 2 known alcohols, the tea and the unknown alcohol. **When running an unknown sample, be certain to let the data collect long enough to get all possible peaks.**

DATA TABLE Standard	Retention Time
Ethanol	
Ice tea	
Methanol (optional)	
Isopropyl alcohol (optional)	

QUESTIONS

1. What is a control? What purpose do they serve? What sample(s) are serving as controls? Why is it important to run known samples of possible components in the unknown mixture?

2. If a supposedly pure sample was properly injected into the gas chromatograph and several peaks were observed, what can be concluded about the sample?

3. Why is it important to clean the syringe between samples?

4. Why is it important to wipe the needle before injecting the sample into the instrument?

5. Ethanol

    a. Chemical Formula

    b. Structural Formula

6. What does the area under the peak represent?

7. Did the suspect have any alcohol in his ice tea? How do you know? If so, how much alcohol was in the tea? Show all work.

8. Explain why we analyzed the ice tea with the Gas Chromatograph?

9. What questions do you still have?