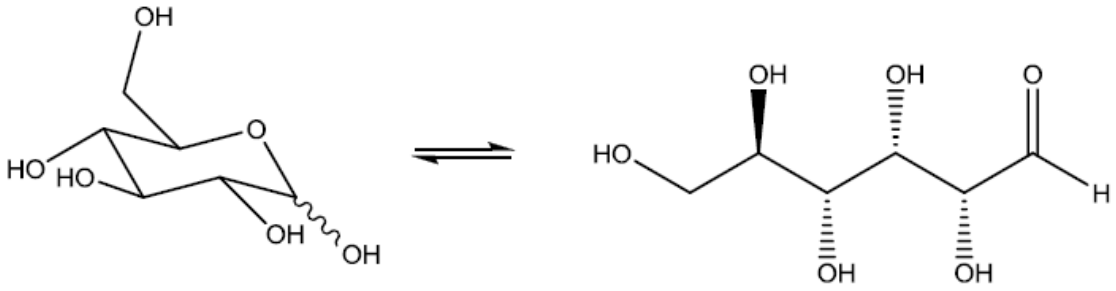
Problem 10: Patient prognosis

Pre-Lab answers

1.

a)

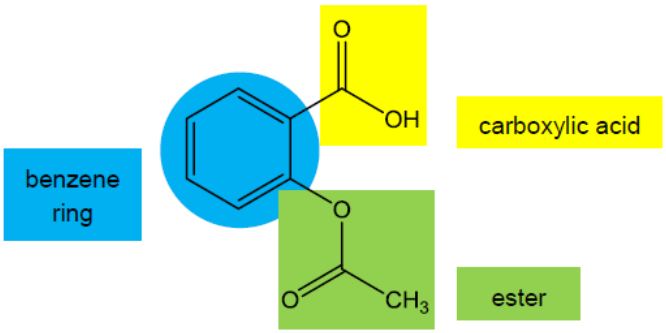


b) Any test for an aldehyde will indicate the presence of a reducing sugar. The most common test is Benedict's or Fehling's test where heating a small amount of the sample with either Benedict's or Fehling's solution brings about a change in colour from blue to brick red.

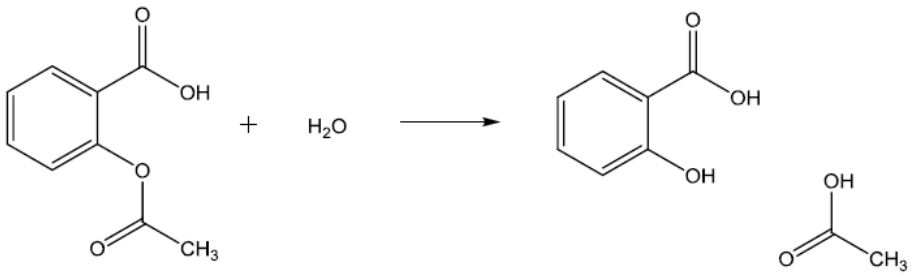
c) The presence of glucose in a patient's urine is a concern as it can be a sign of diabetes. Normally, urine contains no glucose because the kidneys are able to reclaim all of the filtered glucose back into the bloodstream. Presence of glucose in the urine indicates high blood glucose levels which may be caused by diabetes.

2.

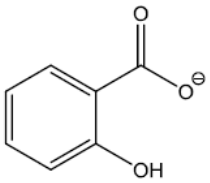
a)



b)



c)



3.

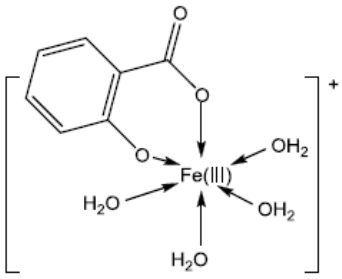
In gas chromatography, the sample is vaporized in the presence of a gaseous solvent (the mobile phase) and passed through a long capillary tube packed with a powder coated with oil (the stationary phase). Each substance moves along in the gas / oil mixture differently and stays in the gas phase for a unique, specific time, called the retention time, before exiting the end of the column and being detected. The retention time can be used to identify the compound present in the sample by comparison with the retention times of known drugs.

The results are presented on a graph or chromatogram consisting of one or more peaks for each of the different components in the sample. The technique is quantitative because the area under the peak is proportional to the amount of that component present. Thus by comparison with calibrated samples containing known quantities of the identified drug, the quantity of that drug in the sample can be determined.

4.

a. The filter is chosen such that the light it transmits is absorbed by the sample. It selects the wavelength of visible light which is transmitted e.g. a blue-green filter allows blue-green light (wavelength 500-590 nm) only through. So if a sample appears red this means that it absorbs light of the complimentary colour to red i.e. blue-green. Hence a blue-green filter must be chosen.

b.



Complex colour: pink-purple

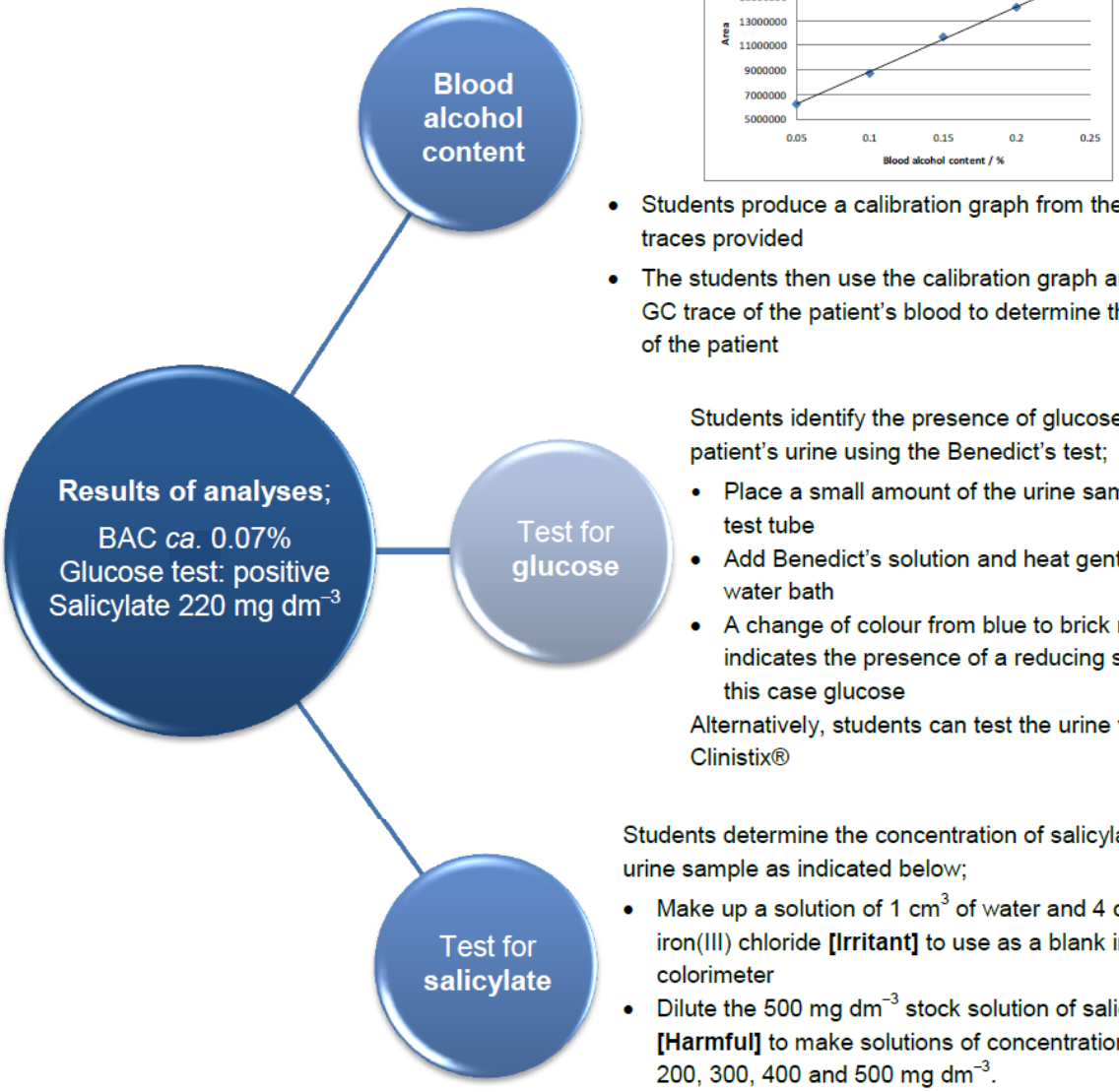
Filter colour chosen: blue-green

(If the students ask the equation for the formation of the complex is;

$[Fe(H_2O)_6]^{3+}$ + salicylate$^-$ → $[Fe(H_2O)_4(salicylate)]^+$ + 2 H_2O + H^+

The iron(III) ion is sufficiently polarising as a result of its large charge to size ratio for the phenolic OH to be deprotonated)

Proposed method



- Students produce a calibration graph from the GC traces provided
- The students then use the calibration graph and the GC trace of the patient's blood to determine the BAC of the patient

Students identify the presence of glucose in the patient's urine using the Benedict's test;

- Place a small amount of the urine sample in a test tube
- Add Benedict's solution and heat gently in a water bath
- A change of colour from blue to brick red indicates the presence of a reducing sugar, in this case glucose

Alternatively, students can test the urine with Clinistix®

Students determine the concentration of salicylate in the urine sample as indicated below;

- Make up a solution of 1 cm^3 of water and 4 cm^3 of 5% iron(III) chloride **[Irritant]** to use as a blank in the colorimeter
- Dilute the 500 mg dm^{-3} stock solution of salicylate **[Harmful]** to make solutions of concentration 100, 200, 300, 400 and 500 mg dm^{-3}.
- Place 1 cm^3 of each solution into a test tube and add 4 cm^3 of 5% iron(III) chloride solution.
- Transfer each new solution to a cuvette and measure the absorbance in the visible region from 400-600 nm.
- Repeat steps 2 and 3 above with the urine sample
- Use the absorbance to determine the concentration of salicylate in the patient's urine.

Recommendation: The patient's BMI falls into the overweight category. His blood pressure is normal. The blood alcohol level (approx. 0.067%) indicates that the patient was mildly inebriated on the night. The levels of salicylate (220 mg dm^{-3}) indicate that the patient had administered a therapeutic level of aspirin consistent with taking two aspirin for a headache. The presence of glucose in the urine is a concern and suggests the possibility of diabetes. Further investigations should be carried out in this area.

Equipment list

Each group will need;

A urine sample made up of;

- 12 mg sodium salicylate [Harmful; Irritant]
- 100 mg glucose [Low hazard]
- 5 drops of ethanol [Highly flammable]
- Made up to 50 cm^3 with dilute cold tea (to create a “urine” look)

For the glucose test;

- Test tube
- Test tube holder
- Disposable pipettes
- Access to Benedict’s solution
- 250 cm^3 beaker, Bunsen, tripod and gauze for a hot water bath
- Or Access to Clinistix®

For the colorimetry;

- Access to a colorimeter
- 6 × plastic cuvettes
- 50 cm^3 of a 5% by mass solution of iron(III) chloride [Irritant] (made by dissolving 4.16 g of
- $FeCl_3 \cdot 6H_2O$ in WATER† and making up to 50 cm^3)
- An accurate method of measuring 1 cm^3 and 4 cm^3 (either 2 × 5 cm3 plastic syringe or 2 × 10 cm^3 measuring cylinder)
- Disposable pipettes
- A 500 mg dm^{-3} stock solution of salicylate [Harmful] (made by dissolving 584 mg of sodium
- salicylate in 1 dm^3 of water). 50 cm^3 per group should be sufficient. This can be placed in a burette to facilitate the dispensing of small quantities.
- Equipment for accurate dilution of the stock solution (e.g. a burette of distilled water and small test tubes and bungs)
- Distilled water
- Test tube rack

† **NOTE** If the iron (III) chloride solution is made up in acid as recommended by CLEAPSS it protonates the sodium salicylate and no complex forms. It must therefore be made up IN WATER.