

Uganda Advanced Certificate of Education
S.5 END OF YEAR ASSESSMENT
CHEMISTRY PAPER 1
DURATION: 2 hours 30 minutes

Instructions

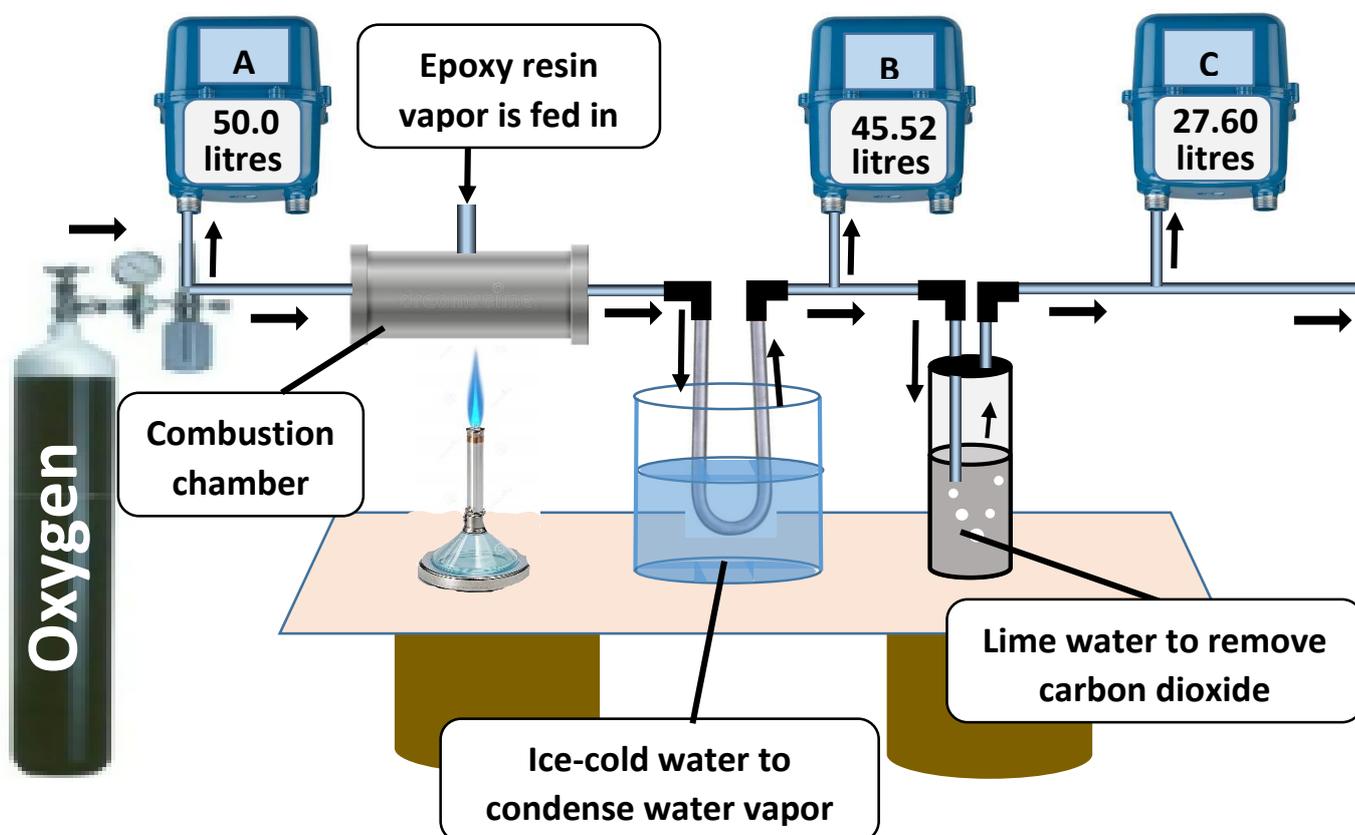
Answer all items

Attached at the end paper is a periodic table.

Item 1

After visiting a certain factory in Kampala, senior fives were inspired to use their chemistry knowledge to manufacture epoxy resin (a chemical used in decorating furniture). They learnt that the factory manufactures the resin from hexane in petroleum. Due to petroleum being expensive for the students, they decided to use phenol from lignin of plants after doing some research. They also discovered that the resin is a hydro carbon, an aromatic compound with molecular mass of 104g. Before the manufacture could start, they had to first determine the formula of the epoxy resin so as to know how to synthesize it.

They therefore used combustion analysis method to determine the molecular of the resin. According this method, they obtained excess oxygen from a cylinder, then evaporated 10.4 g of epoxy resin liquid into vapor at s.t.p. The vapor was then mixed with the excess oxygen in a combustion chamber where the resin vapor was burnt in oxygen forming different products. The volumes of the gases were then read by meters as shown below.



Task

(a) (i) Identify the gases represented by letters A,B and C.

(ii) Write the equation of reaction between the resin and the oxygen.

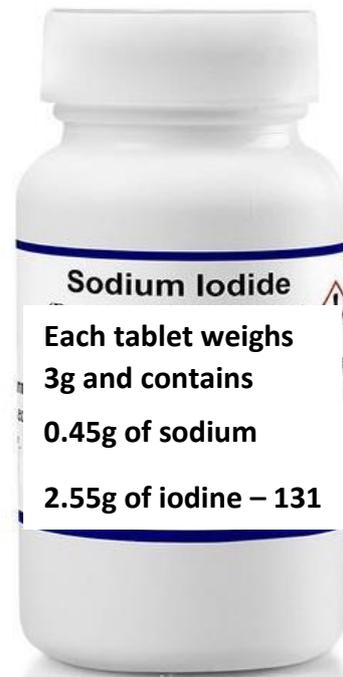
(b) (i) Calculate the volume of vapor formed from liquid resin.

(ii) Using the volumes of gases represented by the meters, determine the molecular formula of the resin

Item 2

Christine a 35 year old lady weighing 60kg moved to the hospital after developing a swollen neck. The doctors immediately recognized it was goiter though never knew the cause, they therefore sent her for a CT-scan in the same hospital. The radiographer at the CT-scan usually gives patients a radioactive drug (sodium iodide/Nal) depending on their body weight. After the patient has swallowed the drug, it radioactively decays releasing gamma rays that move out of the body to the CT-scan screen showing the medical status of the tissues. The drug must have a very short half-life so as it easily vanishes from the body. Each sodium iodide tablet weighs 3g and the radioactive iodine in the drug (I-131) has a half-life of 8 days. The drug must be administered to the patient based on body weight, since different people with different body weights have different volumes of blood according to the chart below

Weight	Total blood volume*
50kg	5000mls
55kg	5500mls
60kg	6000mls
65kg	6500mls
70kg	7000mls



The concentration of sodium iodide that must be in blood for safety and efficiency is 0.0035M

Iodine-131 has a decay constant of 0.086 day⁻¹

*1ml is equal to 1cm³

Task

(a) By calculating the mass of drug Christine needs depending on her body weight, describe the dosage in terms of the number of tablets the radiographer will give her.

Item 3

When S.5 students were asked to design a science project, they came up with an idea of making a battery in figure 1 that will power school projector in figure 2, to solve a problem of black outs when projecting in class in case power goes. The projector however operates at high internal temperatures, so the battery must remain stable and safe while the device is projecting. After intensive research in the library and on the internet, students realized that:

- Their battery design needed an anode metal that is hard and can easily lose electrons to the cathode so as to release power of a high voltage sufficient for the projector as shown in figure 3.

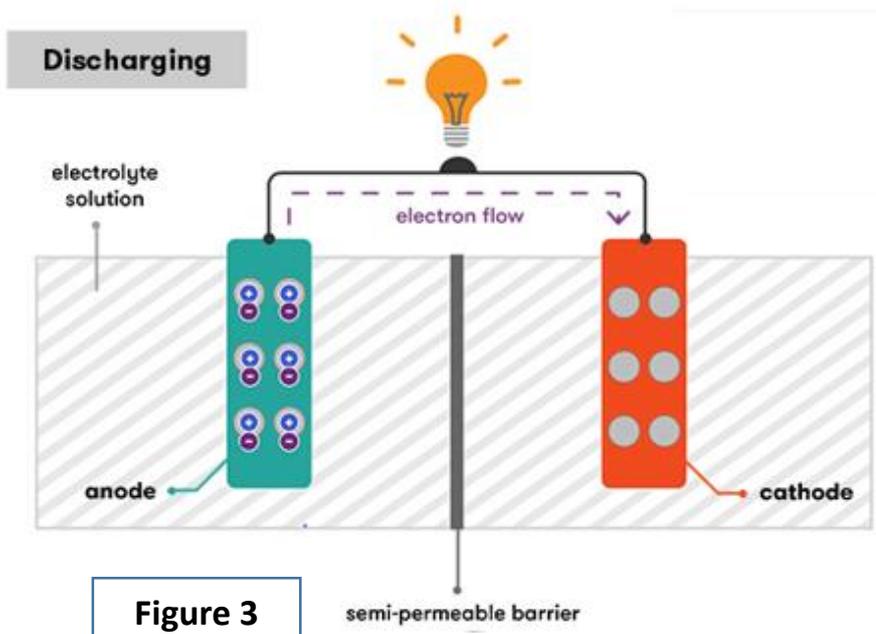


Figure 3



Figure 1



Figure 2

- The battery also needed an electrolyte, an ionic compound that could resist very high temperatures of the projector.
- To avoid damage of the battery due to high temperatures of the projector, they needed a casing with a very high melting point that can shield it.

The students therefore visited a certain shop to buy the equipment they needed. The shop had substances like silicon sheets, lithium metal, sodium metal, beryllium metals, sodium chloride, and potassium chloride.

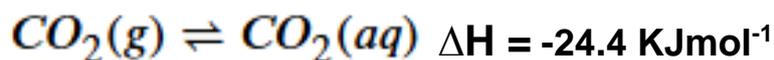
TASK

(a) Explain the type of bonding in the substances at the shop

(b) With reasons, identify the substances they should use for each of the three requirements

Item 5

Sarah owns a small beverage shop in Kampala that sells freshly made juices from fruits. To improve her brand, she started packaging juice in bottles and preserving it by flushing carbon dioxide into each bottle before sealing it according to figure 1. Some of the carbon dioxide dissolves in the juice according to the equilibrium:



Usually, when more carbon dioxide dissolves in the juice, more can be flushed into the juice but when less carbon dioxide dissolves in the juice, less is flushed into the juice. When more carbon dioxide is flushed into the bottle, the drinks are preserved for a longer time, but when less carbon dioxide is flushed into the bottle, the drinks are preserved for a short time and thus easily get spoilt.



Carbon dioxide being flushed into the juice

Figure 1

There's a time Sarah flushed the carbon dioxide into the juice without refrigerating it. The juice was not preserved for a long time and thus got spoilt easily and the customers complained. The customers also gave in a complaint that the juice worsened ulcers due to too much acid. She realized that the acid was carbonic acid that came from carbon dioxide dissolving in the juice. After analysis, she realized the juice contained 0.01M of H₂CO₃ (carbonic acid). She now does not know the mass of soda ash (Na₂CO₃) that must be added to make the pH of the juice neutral.

Task

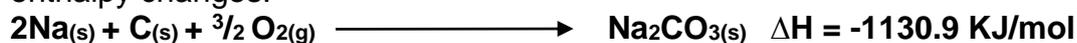
- (a) Explain what happened when Sarah flushed the carbon dioxide in the juice without refrigerating it.



But she is unaware of the temperature at which the decomposition happens. The temperature depends on the amount of energy involved in the decomposition according to the table below

Amount of energy (KJ/mol)	Temperature of oven
1000-1500	20°C
1501-2000	25°C
2001-2500	30°C
2501-3000	35°C
3001-3500	40°C
3501-4000	45°C

She searched on internet to get the necessary enthalpy changes that would help her calculate the amount of energy for the decomposition. Below are the various enthalpy changes.



Task

- (a) Explain the enthalpy change represented by equations she obtained from internet.

- (b) Determine the amount of energy and hence the temperature the oven should be adjusted to for the decomposition.
