**Name…….combination……**

**BAPTIST HIGH SCHOOL**

**END OF TERM 2 EXAMINATIONS**

**S.5 CHEMISTRY**

**2 hours 30 minutes**

## INSTRUCTIONS

- Answer all items.
- All answers are to be written in the spaces provided
- At s.t.p, 1 mole of a gas occupies 22.4 litres
- The following are relative atomic masses of elements. (C=12, H=1, O=16, Na=23, Cl=35.5)

## Item 1

Nile post newspaper recently posted that “Nile breweries launches a campaign for smart drinking.” This campaign involves the industry reducing its alcohol production capacity to minimize the alcohol in public. To avoid reduction in revenue, the company proposed supplying the excess 200kg of ethanol as a fuel for cooking by burning it. An industrial chemist though, advised that converting the ethanol to LPG used in gas cylinders is better since LPG contains propane which produces more energy when burnt.

Below are the equations showing how energy is produced from the fuels.

Ethanol: $CH_3CH_2OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$

Propane: $CH_3CH_2CH_{3\,(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$


**TASK**

(a) Explain the category of energy change involved.

(b) Determine the volume of carbon dioxide at s.t.p produced when the fuel the company proposed is used.

(c) By using equations, describe how the conversion which the industrial chemist advised can be effected.

**Item 2**

Google Nest, a company that makes smoke detectors has inspired investors in Uganda to start up one. Engineers in Google Nest explained that ionization smoke detectors contain a radioactive material that decays releasing rays with a very high ionizing power but a very low penetrating power incapable of penetrating most metals. These rays then hit the oxygen molecules in air into atoms. The atoms are then stripped off of their electrons by the rays forming unipositively cat ions which ensure a flow of current in the detector. When the current is disrupted by smoke, an alarm goes off. Engineers said that the radioactive substance they use is americium. The Ugandan investors want to use francium since it is cheaper. Below are the decay constants of the elements.

| **Element** | **Decay constant** |
|---|---|
| Americium | 0.001604 $year^{-1}$ |
| Francium | 0.0315 $min^{-1}$ |

**TASK**

(a) Explain the category of the rays released from the detector.

(b) Identify the enthalpy changes involved in forming the cat ions and write equation(s) showing them.

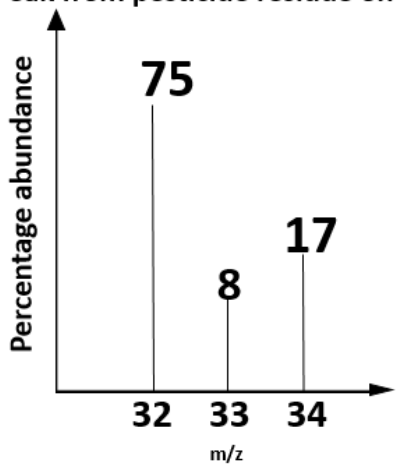
(c) If 0.29mg of an element is used in the detector, what mass will be present in the detector after 1 year for the two elements.

(d) Advise the investors on the choice of element to use with reasons.

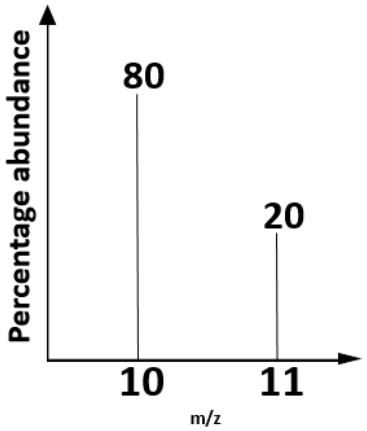
**ITEM 3**

Alex a restaurant owner bought tomatoes and cabbages. He noticed some pesticide residues on the two vegetables. On washing both the vegetables with very hot water, the residues on the cabbage melted away hence removed while those on the tomatoes remained. Alex took the vegetables to a lab with a mass spectrometer for analysis of the residues. The solid samples of the residues in the mass spectrometer were converted into atoms. The atoms were then ionised to form unipostively charged cations. Alex noticed that the technician increased the energy going through the device when ionising the sample from cabbage. The screen of the mass spectrometer showed the peaks below.

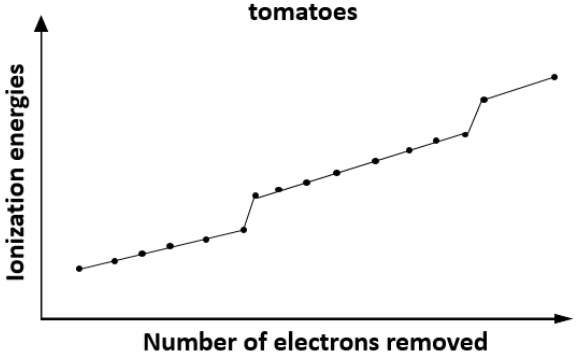
**Peak from pesticide residue on tomatoes**



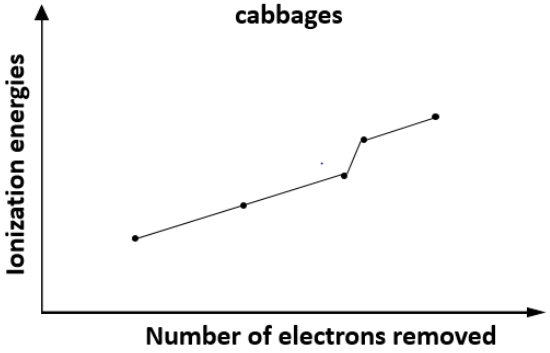

**Peak from pesticide residue on cabbage**

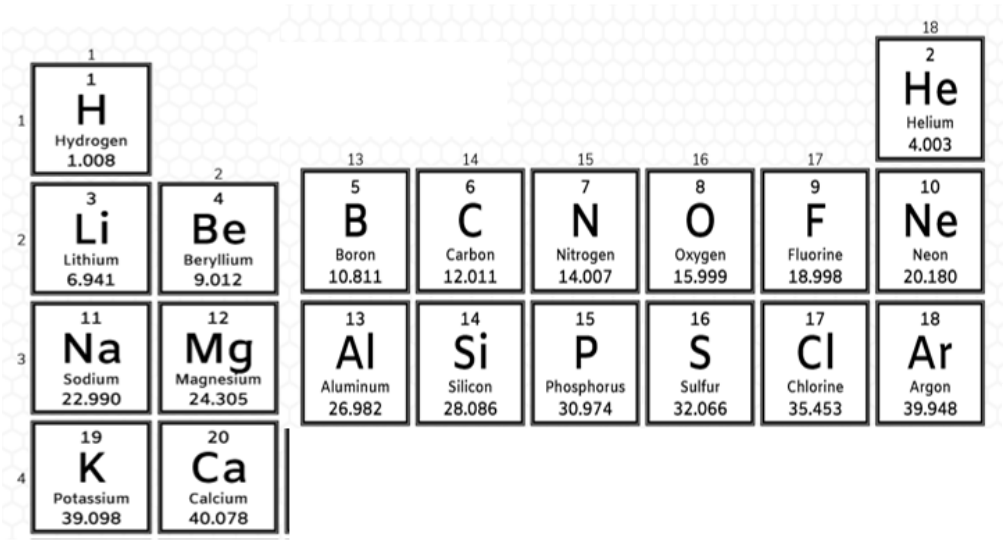


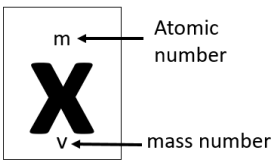

**Ionization energies of pesticide residues on tomatoes**




**Ionization energies of pesticide residues on cabbages**



**Task**

(a) Explain the category of enthalpy changes involved

(b) Calculate the relative atomic masses of the pesticide residues

(c) Using graphs of ionization energies,

(i) Write electronic configuration of elements in residues and identify them

(ii) Explain why the technician increased the energy

(c) Explain why on washing, the residues on cabbage easily melted whereas the other remained.

**Item 4**

Ahmed is a potter who makes ceramics such as cups and plates. He usually adds aluminum oxide solid into the clay paste to prevent it from easily melting when the ceramic is placed in a hot furnace. He also sometimes adds cement to the clay paste to increase the strength of the product. However, he usually mixes the cement using a 20M solution of sodium chloride so as the cement in the ceramic dries faster. When he placed the ceramic into the furnace with a metal ring, the ring melted away.


(a) Explain the category of structures of the ring on the ceramic and the compounds added to the clay paste.

(b) Calculate the mass of salt that must be dissolved in 500cm$^3$ of water to form the required concentration of the solution that is added to the cement.

(c) Explain why the product added to clay doesn't easily melt but the ring easily melts

(d) Describe the properties of the solid added to the clay

**END**