S3 CHEMISTRY

THE TEACHERS

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GOMBE SECONDARY SCHOOL

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PRE-TEST 1

Time allowed: 2 ½ hours.
Instructions:
- This paper consists of two sections A and B
- Answer all questions in section A and only 4 questions from section B
- Questions in section B carry equal marks.

Section A: attempt all questions

Section A

1. The chemistry laboratory is a risky place and requires learners to take precaution while conducting experiments. Recently a student sustained an injury shown by the image below.

a) i) Identify the nature of injury.
ii) how can such an injury be handled?
Ii) Explain how such an injury can be avoided.
iii) Design a poster or signage with precaution message to display on wall of the laboratory to avoid such injuries.
b) Why are laboratory rules and regulation important?

SECTION B

2. A student working hard on the laboratory experiment that uses a strong acid. Halfway through the laboratory, the student gets hungry and starts eating a bag of chips. When he finished, he started licking his fingers. Another student carefully pours unknown solution from a test tube into a beaker. His friend sneaks up behind him and surprise in friend. The students accidentally drops a beaker on the floor and pieces of glass land on the sandaled feet and both left without cleaning.
a) Identify the safety rules being violated.
b) What possible risks in this scenario and how can you minimize the harm?

3. Tooth decay begins when bacteria in your mouth break down leftover food to acids. The acids corrode the tooth's surface (enamel). This can lead to a small hole in a tooth, called a cavity. If tooth decay is not treated, it can cause pain, infection, and even tooth loss. Regular brushing of teeth can prevent tooth decay.
a) What is an acid?
b) How do acids corrode the teeth?
c) Explain how brushing the teeth with toothpaste prevents tooth decay?

4. After boiling water for some time, the heating element of a water heater appeared as shown below.

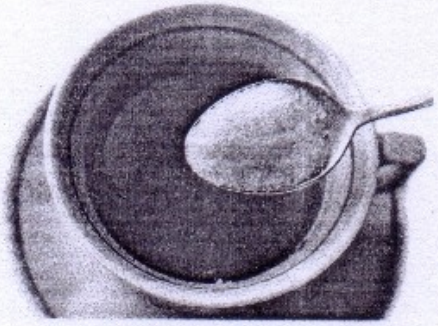
a) What happened to the heating coil?
b) How does the boiled water cause such an effect on the heating coil?

c) Explain how such a problem can be overcome.

5. Rocks in Uganda are found in a number of places. Some rocks are very big and shaped in ways that are amazing. In many societies mystery surrounds the formation of such rocks. Communities belief that rocks are associated with special powers and often perform rituals on rocks.

a) What is a rock?
b) How are rocks formed?
c) Briefly describe how rocks are important to your community?

6. Sugar, sucrose, and cane sugar are the same molecule. Cane sugar got from sugar canes is added to hot water as a sweetener. The sucrose chemical formula is $C_{12}H_{22}O_{11}$. In sugar molecular formula C represents carbon, H represents hydrogen and O represents oxygen. 12 atoms of carbon, 22 atoms of hydrogen, and 11 atoms of oxygen combine to form one molecule of sucrose. It is recommended that 6 teaspoons or 24 grams of sugar for most adult women are required per day.



Mr. Mutaaya the Head Teacher of Vision college takes tea twice a day with each time taking 500cm3. What is the concentration of sugar in tea each time he takes tea?

PRE-TEST 2

Paper 1
Time allowed: 2 ½ hours.
Instructions:
- This paper consists of two sections A and B
- Answer all questions in section A and only 4 questions from section B
- Questions in section B carry equal marks.

Section A: attempt all questions

SECTION B:

2. The trend in oxidising ability of the halogens can be determined by reacting aqueous solutions of halogens with aqueous solutions of potassium halide salts.
(a) Complete the table.

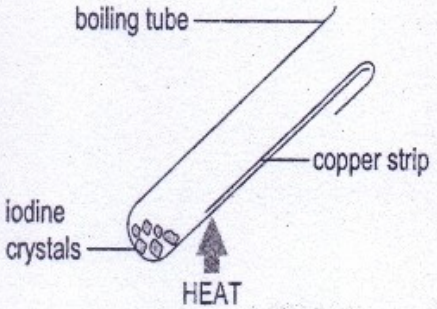
Aqueous solution	Colour of aqueous solution
Chlorine	
Bromine	
Iodine	
Potassium halide	

(b) A 1cm³ portion of each aqueous halogen solution is added separately to 1cm³ of potassium chloride solution in a test tube and any observations noted. The procedure is repeated using potassium bromide solution and also using potassium iodide solution.
(i) Complete the following table, using a tick (✓) to indicate that a reaction occurs and a cross (✗) to indicate that no reaction occurs.

	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine			✓
Bromine			
Iodine			

(ii) Write an equation for the reaction of chlorine with potassium iodide.
(iii) Some hexane was added to the test tube after the reaction of aqueous chlorine with potassium iodide solution was complete. The test tube was stoppered and shaken for one minute. The contents were allowed to settle. What would be observed?
(c) Chlorine reacts with water and with sodium hydroxide solution. (i) Write an equation for the reaction of chlorine with water.
(ii) State the conditions required for the reaction between chlorine and sodium hydroxide solution which yield products containing chlorine in the same oxidation states as those in (c)(i).
(iii) Suggest why ozone is often preferred to chlorine in water treatment.

3. The empirical formula of copper iodide may be determined using the apparatus below.



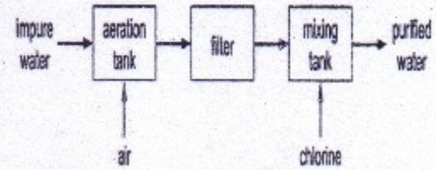
A small quantity of iodine crystals is added to the boiling tube. A clean copper strip is placed into the boiling tube and bent at one end so that it fits over the mouth of the boiling tube. The part of the copper strip nearest the iodine crystals is heated gently in a fume cupboard until no more purple vapour is observed. Once the boiling tube is cool, the copper strip is carefully removed and reweighed. The yellow coating of copper iodide is scraped from the surface of the copper strip and the copper strip reweighed. The following results are obtained.

	Mass /g
Initial mass of copper strip	2.94
Mass of copper strip and copper iodide	3.28
Final mass of copper strip	2.77

(a) Explain why the iodine crystals are not heated directly.
(b) Suggest why the procedure is carried out in a fume cupboard.
(c) Calculate the mass of iodine that reacted.
(d) Calculate the mass of copper that reacted.
(e) Calculate the empirical formula of the copper iodide formed

4.water is a natural resource.

(a) The water in rivers often contains pollutants such as acids. Describe how universal indicator paper can be used to determine the pH value of the water.
(b) The diagram shows some of the stages in water treatment.



(i) Air is blown through the aeration tank. Name the two gases that make up most of the air.
(ii) After aeration, the water still contains large insoluble particles. The filter is made up of fine sand and stones. Explain how the filter helps purify the water.
(iii) Explain why chlorine is used in water treatment.
(iv) Anhydrous cobalt(II) chloride is used to test for water. State the colour change in this test.

THE PERIODIC TABLE OF ELEMENTS

Group

I	II											III	IV	V	VI	VII	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen 1																	4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	98 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	266 Sg Seaborgium 106	264 Bh Bohrium 107	277 Hs Hassium 108	268 Mt Meitnerium 109	271 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						
* 58 – 71 Lanthanum series				140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
† 90 – 103 Actinium series				232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

Key: $^{a}_{b}X$
a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

SOLUTIONS NEXT WEDNESDAY

S3 CHEMISTRY SOLUTIONS

Responses to theory Paper 1

SECTION A:

1. The chemistry laboratory is a risky place and requires learners to take precaution while conducting experiments. Recently a student sustained shown by image below.

a) i) This injury is a result of corrosion from chemicals like acid or hydrogen peroxide

ii) Flush liquid-exposed skin and hair with plain water for at least 5 minutes. Wash exposed area extremely thoroughly with soap and water. Use caution to avoid hypothermia when decontaminating children or the elderly. Use blankets or warmers when appropriate. Flush exposed or irritated eyes with copious amounts of plain water or saline for at least 15 minutes. Remove contact lenses if easily removable without additional trauma to the eye. If a corrosive material is suspected or if pain or injury is evident, continue irrigation while transferring the victim for medical assistance.

ii) such injury can be prevented by wearing safety gear like hand gloves, clearly label chemicals and do not use chemicals before reading the label.

iii) the poster should be easer to see and interpret. It should show the danger being warned against. The signage below gives an insight into the signage required

b) Basic rules provide hygiene and behaviour safety information to avoid accidents in the laboratory. Laboratory specific safety rules may be required for processes, equipment, and materials, which should be addressed by laboratory standard operating procedures (SOPs).

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SECTION B

Attempt only four (4) questions

2. A student working hard on the laboratory experiment that uses a strong acid. Halfway through the laboratory, the student gets hungry and starts eating a bag of chips. When he finished, he started licking his fingers. Another student carefully pours unknown solution from a test tube into a beaker. His friend sneaks up behind him and surprise in friend. The students accidentally drops a beaker on the floor and pieces of glass land on the sandalled feet and both left without cleaning.

a) While working in chemistry lab students should take safety precautions and follow the rules. - Here in given scenario we can see that many rules are being violated which can be dangerous for all those who are working in lab. Violated rules include;

- Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages. Do not bring any food or drink into the laboratory. Any food or drink brought into the laboratory will be immediately disposed of in the interest of safety.
- Conduct yourself in a responsible manner at all times in the laboratory.
- Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
- Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
- Any time chemicals, heat, or glassware are used, students will wear laboratory goggles.

b) You endanger yourself and others in the lab.
You could easily ruin your experiment.
You put the lab at risk of an accident, which could damage equipment as well as harm people.
You could get suspended (if you're a student) or fired (if you're a researcher).

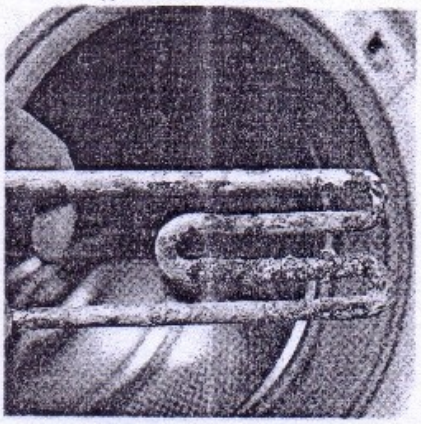
3. Tooth decay begins when bacteria in your mouth break down leftover food to acids. The acids corrode the tooth's surface (enamel). This can lead to a small hole in a tooth, called a cavity. If tooth decay is not treated, it can cause pain, infection, and even tooth loss. Regular brushing of teeth can prevent tooth decay.

a) An acid is a chemical substance, usually a liquid, which contains hydrogen and can react with other substances to form salts.

b) These acids can wash away the hard substance that makes up your teeth, leading to tooth surface loss. Acid can also soften the tooth surface, making it easier for it to be worn away by abrasion or teeth grinding. This is known as acid wear or erosive tooth wear.

c) Bacteria present in the mouth produces acids by degrading sugar and food particles. Due to the acids produced, the tooth enamel corrodes and the tooth decay starts. Toothpastes are basic in nature. They neutralise the effect of acids and thus prevent tooth from decaying.

4. After boiling water for some time, the heating element of a water heater appeared as shown below.



a) The heating element is corroded by hardwater.

b) The minerals in water are hard and abrasive substances and will corrode the element. As the water boils, the calcium deposits rub against the metal element – wearing away at it. The higher concentration of minerals in hard water results in greater wear and tear. Lime scale build-up will corrode the element even faster.

c) How to remove limescale in Kettle

- Fill the kettle ¾ full of either water and one lemon, or with equal parts water and vinegar (household vinegar is fine).
- Let it soak for one hour.
- Boil the kettle (three times for lemon, once for vinegar)
- Allow it to cool, then rinse thoroughly several times.

5. Rocks in Uganda are found in a number of places. Some rocks are very big and shaped in ways that are amazing. In many societies mystery surrounds the formation of such rocks. Communities belief that rocks are associated with special powers and often perform rituals on rocks.

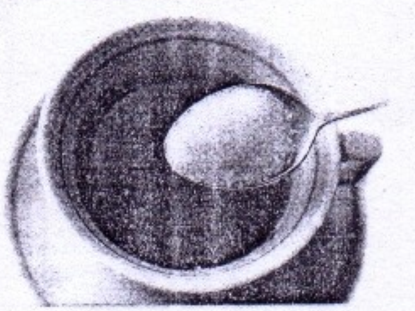
a) A rock is a natural substance composed of solid crystals of different minerals that have been fused together into a solid lump.

b) The three major types of rocks are igneous, sedimentary and metamorphic rocks. Igneous rocks are formed by the cooling of molten rocks; Sedimentary rocks are formed by the accumulation and lithification of sediments. Metamorphic rocks are caused by changes in rocks due to high heat and pressure.

c) Rocks are used for many purposes but some of them that we can see in our daily life are cited below : Making Cement (Limestone) (Sedimentary Origin) Writing (Chalk) (Sedimentary Origin) Building Material (Sandstone) (Sedimentary Origin)

S3 CHEMISTRY SOLUTIONS

6. Sugar, sucrose, and cane sugar are the same molecule. Cane sugar got from sugar canes is added to hot water as a sweetener. The sucrose chemical formula is $C_{12}H_{22}O_{11}$. In sugar molecular formula C represents carbon, H represents hydrogen and O represents oxygen. 12 atoms of carbon, 22 atoms of hydrogen, and 11 atoms of oxygen combine to form one molecule of sucrose. It is recommended that 6 teaspoons or 24 grams of sugar for most adult women are required per day.



Mr. Mutaaya the Head Teacher of Vision college takes tea twice a day with each time taking 500cm3. What is the concentration of sugar in tea each time he takes tea?

This questions requires one to understand then apply the knowledge of mole concepts.

Sucrose or cane sugar has a chemical formula, $C_{12}H_{22}O_{11}$ its molecular mass is C= 12x12=144, H= 1x 22 = 22, O=16x11 = 176, its formula mass =342.

Moles of sugar taken per day = 24/342 = 0.070175 moles

Mutaaya takes a total of 1000 cm^3 of tea a day

The molarity will be 0.070175 per1000 cm3 of solution. Since he divided the solution into two, the molarity of solution (tea) per intake will be;

1000 cm^3 of solution contain 0.070175 moles

500cm^3 of solution will contain 0.070175/1000 x 500 = 0.035moles per cup taken.

PRETEST 2

2. The trend in oxidising ability of the halogens can be determined by reacting aqueous solutions of halogens with aqueous solutions of potassium halide salts.

a) Completed table

Aqueous solution	Colour of aqueous solution
Chlorine	yellow
Bromine	Red
Iodine	yellowish-brown
Potassium chloride	colourless

b)(i)

	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		✓	✓
Bromine	X		✓
iodine	✓	✓	

(ii) $2KI(aq) + Cl_2(g) \rightarrow 2KCl(aq) + I_2(s)$

iii) purple solution is formed

c(i) When chlorine dissolves in water, it reacts to form the strong acid, HCl, and the weak but strongly oxidising acid, HOCl.

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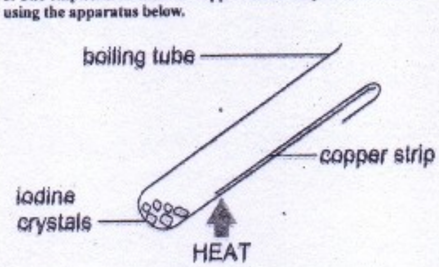
$$Cl_2(g) + H_2O(l) \rightarrow HOCl(aq) + HCl(aq) + [O]$$

(Chlorine) (water) (Hypochlorous acid) (Hydrochloric acid) (Nascent oxygen)

iii) Ozone is a strong oxidizer that instantly neutralizes biological matter, such as bacteria, viruses, and parasites, and has stronger disinfectant properties than chlorine. Ozone's oxidative strength also helps eliminate otherwise stubborn metals from water.

3. The empirical formula of copper iodide may be determined using the apparatus below.



(a) iodine crystal sublime when heated.

(b) the procedure is carried out in a fume cupboard because iodine fumes are toxic.

(c) the mass of iodine that reacted.

3.28 – 2.94 = 0.34 g

(d) Calculate the mass of copper that reacted.

2.94 – 2.77 = 0.17g

(e) Calculate the empirical formula of the copper iodide formed

Cu	I
0.17	0.34
0.17/64	0.34/127
0.00265625	0.002677
1	1

The empirical formula of copper Iodide is CuI.

4. (a) Universal indicator paper is a simple and convenient tool used to determine the pH value of a solution, including water. pH measures the acidity or alkalinity of a substance on a scale ranging from 0 (highly acidic) to 14 (highly alkaline), with 7 being neutral. Universal indicator paper contains a mixture of various pH-sensitive chemical compounds that change color in response to changes in the pH of the solution they come into contact with. Here's how you can use universal indicator paper to determine the pH value of water:

Materials required:

Universal indicator paper strips

A clean and dry container (glass or plastic)

The water sample you want to test

- Cut a small strip of universal indicator paper. The strip should be long enough to comfortably dip into the water without your fingers getting wet.
- Prepare your water sample. Make sure it is at room temperature if possible, as extreme temperatures can affect pH readings.
- Dip the universal indicator paper strip into the water sample. Make sure the entire strip is submerged for a few seconds to allow the paper to absorb the water and react with it.
- Remove the strip from the water and observe any color changes that occur. The universal indicator paper will change color based on the pH of the water. Compare the color of the strip to a pH color chart, which typically accompanies the universal indicator paper packaging. The chart will show the corresponding pH values for different colours.
- Match the colour of the strip to the pH color chart to determine the pH value of the water. The color change may not be an exact match to a single pH value, but you can estimate the pH within a reasonable range based on the closest color match.
- Record the pH value of the water sample. This value will indicate whether the water is acidic (pH below 7), neutral (pH 7), or alkaline (pH above 7).
- Keep in mind that universal indicator paper provides a qualitative pH measurement and may not be as precise as a pH meter for highly accurate measurements. However, it is a quick and cost-effective method for assessing the approximate pH of water samples in various applications, such as in educational settings, laboratories, or home testing.

(b) (i) the two gases that make up most of the air are nitrogen and oxygen.

(ii) Filtering is one of the common methods used to purify water by removing impurities and contaminants. The process of water filtration involves passing water through a physical barrier or medium that traps and removes particles, sediments, and potentially harmful substances.

Water filtration is a widely used method for improving the quality and safety of drinking water, and it can be an effective step in the overall process of water purification, especially for removing physical particles and improving taste and odor.

(iii) Chlorine is commonly used in water treatment for several important reasons:

- **Disinfection:** One of the primary reasons for using chlorine in water treatment is its powerful disinfection properties. Chlorine is highly effective at killing or deactivating a wide range of harmful microorganisms, including bacteria, viruses, and parasites, that can be present in water. This disinfection step is crucial for making water safe to drink and preventing the spread of waterborne diseases.
- **Residual protection:** Chlorine can leave a residual disinfectant in treated water. This residual chlorine continues to provide protection as water travels through distribution systems to consumers' taps. It helps prevent the regrowth of harmful microorganisms and maintains water quality as it moves through pipes to homes and businesses.
- **Oxidation:** Chlorine also serves as an oxidizing agent in water treatment. It can react with and break down various organic and inorganic substances that may be present in water, including some organic pollutants, sulfides, and certain metals like iron and manganese. This oxidation process helps improve the overall water quality by reducing tastes, odors, and color caused by these substances.
- **Taste and odour control:** Chlorine treatment can help control and eliminate unpleasant tastes and odors in water that may be caused by organic compounds or the presence of algae and bacteria. By oxidizing these substances, chlorine can improve the aesthetic qualities of the water, making it more palatable.
- **Residual monitoring:** Chlorine's presence in treated water can be easily monitored and controlled, ensuring that a minimum level of disinfectant is maintained throughout the distribution system. This helps utilities maintain water quality and safety standards.
- **Cost-effective:** Chlorine is a cost-effective water treatment option. It is readily available and relatively inexpensive compared to some alternative disinfection methods, making it a practical choice for many water treatment facilities.
- Anhydrous cobalt (II) chloride is used to test for water. State the colour change in this test.