

## MARKING GUIDE CHEMISTRY SET 2 2024

### Item 1

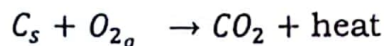
#### (a)(i) Category/type of product

Carbon based fuels can be renewable or non-renewable energy

Charcoal is a renewable fuel while natural gas is a non-renewable fuel.

#### (ii) functions (how the product works)

Charcoal fuel is carbon which undergoes complete combustion in air to form carbondioxide with release of a lot of energy that can be used to prepare food.



#### (b) side effects of the product

Complete combustion of carbon based fuels add carbondioxide to the atmosphere that can cause global warming.

Incomplete combustion of carbon based fuels add carbonmonoxide to air that is a respiratory poison.

Additon of carbondioxide to air can also cause acidic rain that corrodes iron roofs.

#### (c) Evaluation of the product

##### Similarities

Both fuels produce heat, emit carbondioxide into the atmosphere.

##### Differences

Charcoal is easy to store whereas natural gas requires special storage facilities

Charcoal is cheap whereas natural gas is expensive

Charcoal produces less heat per mole whereas natural gas produces more heat per mole.

Charcoal produces less pollutant gas compared to natural gas.

### Item 2

#### (a) Category of material

The sports equipment donated can be grouped into two types of materials;

Metallic and non-metallic

Metallic materials include pressure pumps, short put and javelin because metals are generally hard and strong.

Non-metallic materials include balls, nets and flags. These are flexible and not hard

#### (b) properties or predictions of materials

**Javelin;** is made of aluminium metal

**Aluminium has the following properties**

- o Is light /has low density
- o Is hard and strong
- o Is malleable and ductile
- o Does not rust
- o Durable
- o Good conductor of heat and electricity

**Iron/steel**

- Is hard
- Has high density
- Resistant to rusting
- Non-biodegradable

**Plastics such as nylon**

- Flexible
- Non-biodegradable/durable
- Resistant to harsh weather conditions
- Light and quickly dries up
- Easy to clean

**Cotton**

- Soft polymer
- Easy to clean
- Strong
- Is biodegradable
- Relatively light /can be swept by wind

**Synthetic rubber**

- Strong
- Elastic
- Non sticky
- Insoluble in water
- Can be easily coloured
- Durable
- Non biodegradable

**Wood**

- Readily available
- Strong
- Can be smoothed to give a nice appearance
- Easy to sharpen
- Is light when dry

**(c) uses of materials**

The choice of materials to serve the purpose it is meant to serve is dependent on its properties and impact on the environment.

Aluminium is used to make javelin due to its low density and strength, can be thrown along distance without breaking

Aluminium is also used to make pressure pumps. It is strong, light and easy to carry or move.

Pressure valves are made of plastic materials such as synthetic rubber. It is strong and less elastic

Balls are made of synthetic rubber which can expand and retain high pressure without bursting. It is also light and easy to move/ kick or throw

Shot put is made of steel due to its high density and resistance to rusting.

Flags are made of plastic polymers such as nylon due to their strength and non-wettability or from natural polymers like cotton with wooden stands



Nets are made of nylon which is a strong synthetic polymer durable and resistant to harsh weather

**(d) impact on the environment**

- Iron depletes soil nutrients and make the soil infertile or is non-biodegradable and spoils the soils or being a heavy metal can cause cancer
- Aluminium depletes soil fertility when it accumulates
- Plastics are non-biodegradable
- Cotton is biodegradable but takes long to decompose

**Item 3**

**(a) Raw materials**

Limestone, Aluminium oxide, silicon IV oxide and gypsum

**(b) process of production**

Limestone from the rocks is mixed with aluminium oxide/alumina and silica bearing materials such as clay and sand to a temperature of about 140°C in a kiln to form a hard substance called **clinker**

The clinker is the mixed with little amount of calcium sulphate (gypsum) and ground into powder that is called ordinary port land cement

Cement is a mixture of aluminium and calcium silicates with gypsum

The powder is packed and sold for construction

**(c) side effects of the process of production and mitigation**

- Air pollution by dust from crushing clinker into a powder
- Acidic gases such as carbondioxide from carbon based fuels running machines can cause acidic rain which reacts with iron roofs or lowers the soil PH
- Acidic rain (carbonic acid) can react with limestone to form temporally hardness of water
$$H_2CO_{3(aq)} + CaCO_{3(s)} \rightarrow Ca(HCO_3)_{2(aq)}$$
- Global warming

**Mitigation**

- Glinding clinker should be done in a closed vessel to reduce release of dust
- Workers should wear face masks and protective gears
- Fitting catalytic converters in exhaust pipes to convert oxides into non-harmful products like carbon monoxide to carbondioxide.
- Neutraulise acidic gases before releasing waste gases
- Plant trees to prevent global warming

**(d) social benefits**

- Employment opportunities, better income hence better standard of living
- Development of infrastructure such as road network, easy transport of materials and movement of people.
- Schools and hospitals built; literacy and medical health facilities improved thus better health and standards of living

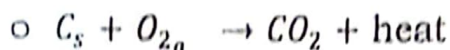
#### Item 4

##### (a) Raw material

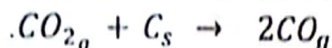
The extraction of iron requires raw materials such as hematite which the ore of iron, limestone and coke (consider other iron ores if named)

##### (b) process of production

- Haematite, limestone and coke are fed into the blast furnace from the top.
- Hot air is blown into the furnace from near its bottom to ignite coke
- Coke undergoes complete combustion to carbon dioxide with evolution of a lot of heat



- The carbon dioxide is reduced by un burnt coke in the middle of the furnace where there is limited air to carbon monoxide



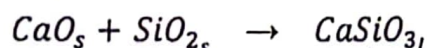
- The carbon monoxide reduces iron ore to iron near the top of the blast furnace  $Fe_2O_{3s} + 3CO_g \rightarrow 2Fe_l + 3CO_{2g}$

- Molten iron sinks to the bottom of the blast furnace where its tapped off separately and left to solidify into pig or cast iron.

- Limestone serves to remove silicon (IV) oxide which is the major impurity in the ore of iron.

- At temperatures of about 1000°C in the middle of the blast furnace, limestone decomposes to lime which reacts with silicon IV oxide to form molten slag/calcium silicate

- The molten slag floats on top of molten iron preventing iron from being re-oxidised. It is separately tapped off and used in surfacing roads making cement or fertilisers  $CaCO_{3s} \rightarrow CaO_s + CO_{2g}$



##### (c) side effects of the process of production and mitigation

- Air pollution from emissions of particulate matter, sulphur dioxide and other pollutants.
- Noise production and habitant destruction.

##### mitigation

- Improved technologies; invest in clean and more efficient technologies such as electric arc furnaces and direct reduced iron process which produce less pollutants
- Encourage recycling of iron scrap to reduce demand for virgin iron
- Filters to capture and reduce emissions of particulate matter, sulphur dioxide, nitrogen oxide and other pollutants
- Employ use of catalytic converters to convert the acidic oxides into non harmful products



**(d) social benefits**

- Employment opportunities, earn income therefore better living standards
- Improved road networks therefore better mobility and transport of materials to and from market.
- Improved health and education levels due to schools and healthy facilities built

**Item 5**

**(a) Identity/category of natural resource, reason and example**

Natural resources are classified into renewable and non-renewable.

Renewable natural resources can be replenished such as air, water, soil and vegetation

Non renewable natural resources get exhausted with continuous use/harvesting such as fossil oil, rocks and minerals.

The activity performed by Kalonzo affect the renewable natural resources; air, soil, water sources and the surrounding vegetation

**(b) composition of natural resources**

- Air consists of gases such as oxygen, nitrogen, carbondioxide, water vapour and pollutants.
- Soil has the minerals, humus, water and living components. Humus is the organic part whose components consists of elements of mainly carbon, hydrogen, oxygen.
- Vegetation like grass and trees comprises of the element carbon hydrogen and oxygen forming most of other tissues.
- Water consists of the elements hydrogen and oxygen as a compound. It also has dissolved oxygen, carbondioxide, living organisms, dissolved solids and suspended particles.

**(c) impact of the natural resource on the environment, how it works, physical and chemical reactions and mitigations**

**Air** oxygen in air is used for respiration of organisms such that they obtain energy for sustaining their survival

Plants need carbondioxide from air for photosynthesis

**Vegetation** contributes to the carbon cycle by reducing the carbondioxide in air to avoid global warming and formation of acidic rain. They also regulate the temperature of the air through cooling effect by water vapour they add to the atmosphere.

Evapotranspiration leads to formation of convectional rain fall thus play a vital role in the water cycle.

Plant roots anchor soil particles together preventing soil erosion.

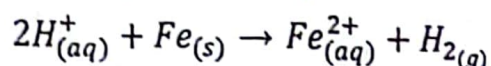
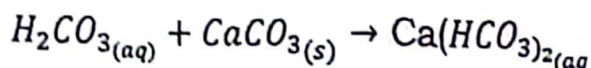
Plant litter decays to form debris that eventually form humus which adds fertility to the soil.

Humus sticks soil particles together

**Water** has dissolved oxygen for respiration of fish and some other organisms

Dissolved nitrates and phosphates contributes to water enrichment with nutrients for plant growth such as algae

**Burning** add carbondioxide to air. High levels of carbondioxide trap heat which is reflected back on the earth's surface and cause global warming. The much heat contributes to climate change. Also high carbondioxide levels in air can cause acid rain which crumbles rocks, lowers soil PH and corrodes iron roofs.  $CO_{2(g)} + H_2O_l \rightarrow H_2CO_{3(aq)}$



Carbondioxide released due to incomplete combustion of carbohydrates or carbon is a pollutant that is very harmful and can be fatal.

Other materials add acidic gases to air such as sulphurdioxide and nitrogen oxides which are harmful in that can dissolve in rain to form acidic rain which lowers soil PH, crumble rocks and corrode iron roofs.

Smoke from burning rubbish interferes with visibility and respiration. It pollutes air, smoke can cause lung cancer

Heat from burning rubbish reduces oxygen level in air, make the air drier and hot which causes discomfort in breathing

Ash particles pollute air when blown by wind or cause water enrichment with nitrites and phosphates that result in algal growth/blooms. Decay of algae rise the biological oxygen demand (BOD) in the water body which result in death of some aquatic organisms like fish.

#### **Mitigation measures**

- Avoid burning rubbish.
- Plant trees/vegetation to reduce carbondioxide levels in the atmosphere by using it for photosynthesis
- Dispose off wastes in land fills
- Protect water sources from nutrient enrichment from burning rubbish or vegetation
- Sensitization/create awareness of the effects of burning rubbish on the environment
- Plant grass where rubbish was burnt to prevent soil erosion

#### **(d) Benefits**

- Air facilitates respiration in which carbohydrates are oxidized to release energy.
- Photosynthesis
- Water is drunk by most animals.
- Water is a habitat for some organisms which require enough dissolved oxygen, neutral PH, transparency no turbidity or pollution.
- Plants need it for their growth
- Soil is a home for edaphic organisms
- Water is also vital in rain formation
- Water cools air temperatures

#### **Item 6**



**(a) Identity/category of the natural resource reason and example**

The natural resource is non-renewable type because the rocks get exhausted with continuous removal.

Air is a renewable natural resource because it does not get depleted

**(b) composition of the natural resource**

Rocks are of different types e.g igneous, sedimentary and metamorphic.

They contain minerals for example limestone, iron, gold, copper etc

**(c) Impact of the natural resource on the environment how it occurs and mitigation (physical and chemical reaction)**

- Quarrying impacts negatively on natural resources e.g in the course of breaking rocks noise is produced which may pollute air.
- Stones can roll from high altitude heating buildings or animals on low altitude which can cause harmful effects.
- Air pollution by dust
- Land degradation as rocks form soil through physical or chemical weathering are removed subjecting land to erosion.
- The holes left from the removed rocks can truck water in which mosquitoes may breed and spread malaria
- Soil structure is disturbed as deep soils are removed to the surface (land scape alteration)
- Vegetation is cut and soil is left bare subjecting to erosion

**Mitigation**

- Plant trees to replace those cut.
- Build terraces to reduce on soil erosion
- Fill up the holes with soil to avoid water collecting in them which would be breeding places for mosquitoes or spots for accidents such as drowning
- Regulate quarrying to avoid bio diversity loss

**(d) social benefits**

- Air facilitates respiration during which energy for sustaining life activities is obtained from the oxidation of carbohydrates
- Photosynthesis in plants is dependent on carbon dioxide from air.
- Rocks are a source of minerals like mica, quartz, feldspar, calcite among others some of which can be used for decoration of buildings or stone for protecting walls.
- Small stones from rocks are used in surfacing roads and in making concrete.
- Soil can be used in surfacing roads, cultivation or filling the foundation of buildings.

**End**