

MARKING SCHEME

CHEMISTRY

TIME: 2 HOURS

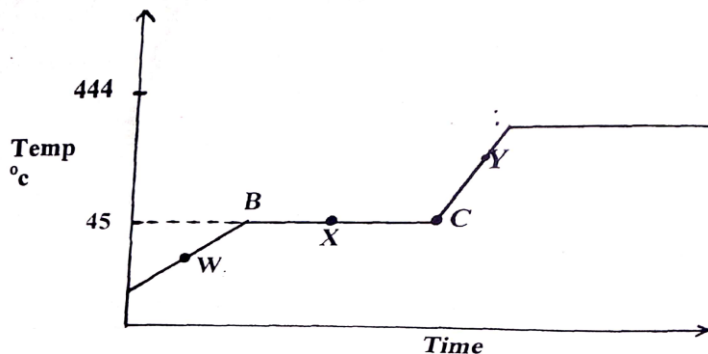
FORM 4

OPENER EXAMINATION: TERM 2 2024

INSTRUCTIONS.

➤ Answer all the questions in the spaces provided.

1. The diagram below shows the heating curve of a pure substance. Study it and answer the questions that follow.



- a) What are the physical states of the substances at point W and Y. (2mks)
- W – solid
 - Y – liquid
- b) Explain why the temperature remains constant between point B and C. (2mks)
- *The heat absorbed by the solid is to break the bond between the solid particles.*

2. Consider the reaction below.



Using oxidation numbers explain whether the above reaction is a redox reaction or not.

(3mks)

ON of Cr in Cr₂O₇²⁻

$$2\text{Cr} + (7 \times -2) = -2$$

$$2\text{Cr} + (7x - 2) = -2$$

$$2\text{Cr} + (-14) = -2$$

$$2\text{Cr} = +12$$

$$\text{Cr} = +12$$

$$\text{Cr} = +12/2 = +6$$

On of Cr in CrO₄²⁻

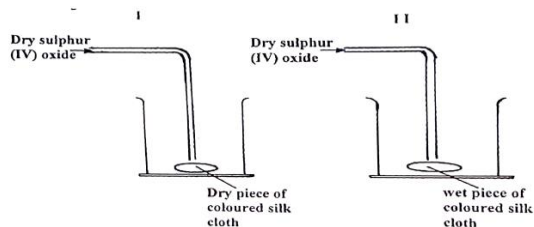
$$\text{Cr} + (4 \times -2) = -2$$

$$\text{Cr} + (-8) = -2$$

$$\text{Cr} = +8 - 2$$

$$\text{Cr} = +16$$

3. Dry sulphur (IV) oxide was passed through two pieces of coloured silk both in a gas jar as shown in the diagram.



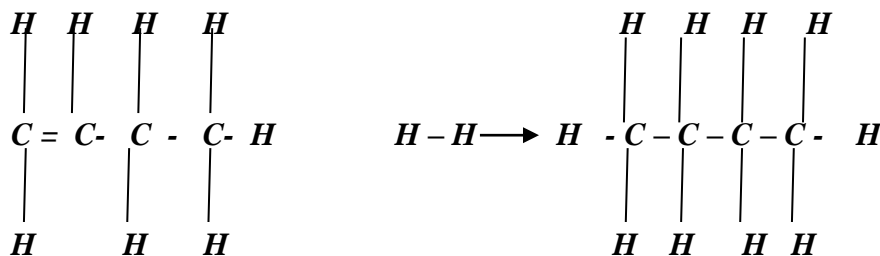
- a) State the observation in the gas jars. (2mks)
- **No observable change**
 - **The silk cloth was bleached**
- b) Write equations to explain your observations in flask II. (2mks)
- $SO_2(g) + H_2O(l) \longrightarrow H_2SO_3(aq)$
 - $H_2SO_3 + Dye \longrightarrow H_2SO_4 + (Dye - O)$
Colourless substance
4. The equations show some reactions. Use the equations to answer the following questions.



- a) Name the type of reaction in step I and II. (2mks)
- **Step I – Dehydration**
 - **Step – II - Hydrogenation**
- b) Explain why ethane burns with a more smoky flame than ethene. (2mks)
- **Ethane burns with more smoky flame than ethene since ethane has a higher percentage content of Carbon as compared to ethene and hence the carbon escapes unoxidized causing the smoky flame.**
5. The third member of the alkenes is converted to its corresponding saturated hydrocarbon by hydrogenation. Using the bond energy values given below, answer the questions that follow.

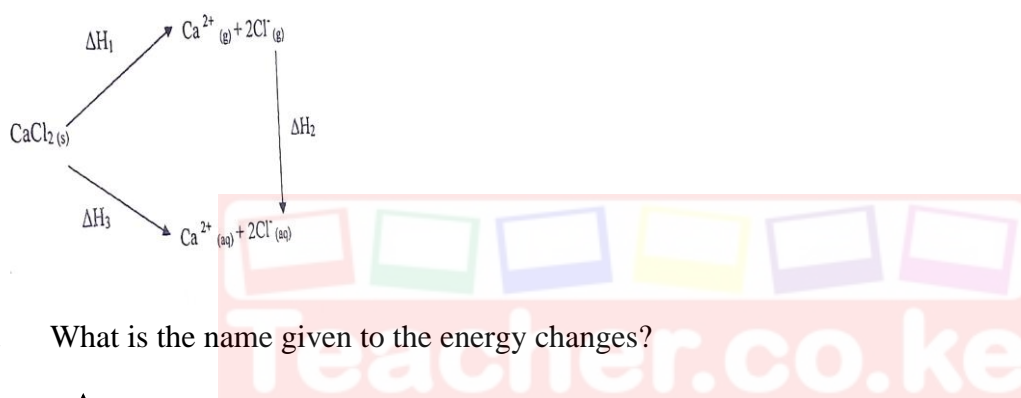
Bond	Bond energy kJ/mol
H-H	432
C=C	610
C-C	346
C-H	413

Determine the enthalpy change for the conversion of the third member of the alkenes to its corresponding saturated hydrocarbon by hydrogenation. (3mks)



$$\begin{aligned} \Delta H & (2 \times 346) + 610 + (4 \times 13) + 432 - (10 \times 413 + 3 \times 346) \\ & = 5083 - 5168 \\ & = -130 \text{ kJ mol}^{-1} \end{aligned}$$

6. a) Graphite is a non metal most commonly used as an electrode. State two properties that make it suitable for use as an electrode. (2mks)
- ***It is a good conductor of electricity***
 - ***It is unreactive/inert***
- b) Graphite is an allotrope of carbon. Distinguish between allotropes and isotopes. (2mks)
- ***Allotropes are different forms of an element in the same physical state while isotopes are atoms of the same element having the same atomic number but different mass numbers.***
7. Use the information in the energy cycle below to answer the questions that follow.



- i. What is the name given to the energy changes? (3mks)

ΔH_1 - ***Lattice energy***

ΔH_2 - ***Hydration energy***

- ii. Given $H_1 = 2237 \text{ KJ/Mol}$ and $\Delta H_2 = -2378 \text{ KJ/Mol}$, calculate the value of ΔH_3 . (1mk)

$$\begin{aligned} \Delta H_3 &= \Delta H_1 + \Delta H_2 \\ &= 2237 + (-2378) \\ &= -141 \text{ kJ mol}^{-1} \end{aligned}$$

8. The 1st, 2nd and 3rd ionization energies in KJ/Mol of element G and R are given below.

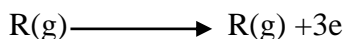
Element	1 st I.E	2 nd I.E	3 rd I.E
G	520	7,300	9,500
R	420	3,100	4,800

- i. Define the term 1st ionization energy. (1mk)

- ***Energy required to remove the first electron from an atom in the gaseous state.***

- ii. Apart from the decrease in energy levels, explain the big difference between the 1st and 2nd ionization energies. (1mk)
- **The second electron is being removed from a stable energy level.**

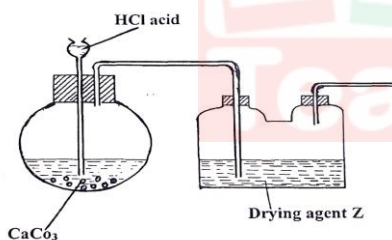
- iii. Calculate the amount of energy for the process. (1mk)



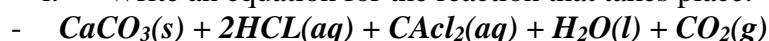
- $\Delta H = 430 + 3100 + 4800$
- $= 8320 \text{KJmol}^{-1}$

9. When solid Zinc carbonate was added to a solution of hydrogen chloride in methylbenzene, there was no observable change. On addition of some water to the mixture there was effervescence. Explain these observations. (2mks)
- **Hydrogen chloride in methyl benzene is in molecular form. It allows no reaction with zinc carbonate. When water is added, the hydrogen chloride ionizes and the H ions react with Zinc carbonate producing carbon (VI) oxide.**

10. a) The diagram below represents an incomplete set-up of apparatus that can be used to prepare dry carbon (iv) oxide gas. Complete the diagram and answer the questions that follow.



- i. Write an equation for the reaction that takes place. (1mk)



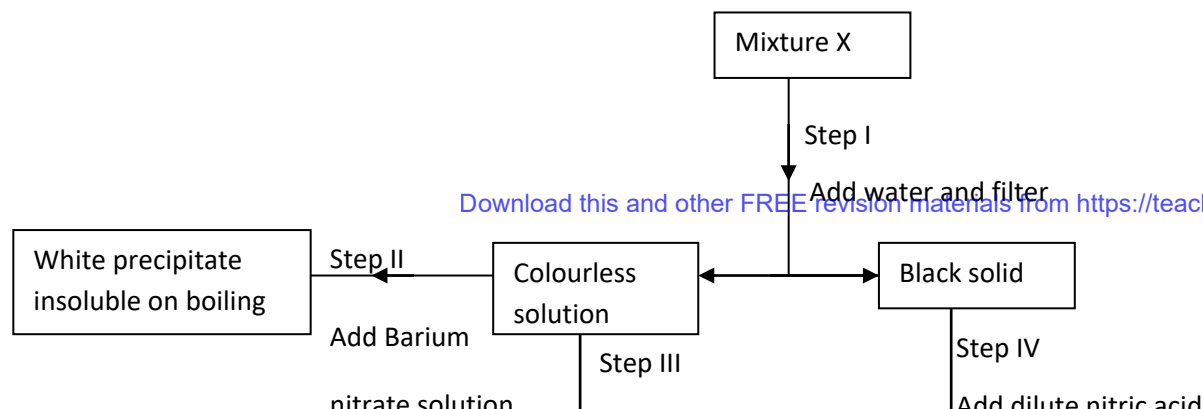
- ii. Name liquid Z. (1mk)

- **Liquid Z – concentrated sulphuric acid.**

- iii. State two advantages of using ‘dry ice’ over ordinary ice as a refrigerant. (2mks)

- **Last longer than ordinary ice**
- **Leaves no residue behind and it sublimates with ordinary ice which melts.**

11. Study the chart below and answer the questions that follow.



a) Name:

i. Cations present in mixture X. (1mk)
 - Cu^{2+} and Zn^{2+}

ii. Anions present in the solution. (1mk)
 - SO_4^{2-}

b) Write an equation to show how the white precipitate in step III dissolves. (1mk)
 - $\text{Zn}(\text{OH})_2(\text{s}) + 4\text{NH}_3(\text{aq}) \longrightarrow \text{Zn}(\text{NH}_3)_4^{2+}(\text{aq}) + 2\text{OH}(\text{aq})$

c) Name the process outlined in step IV above. (1mk)
 - **Neutralization**

12. i) A student intending to prepare lead (II) sulphate reacted lead metal with dilute sulphuric acid. However, he was not successful. Explain why he was not successful. (1mk)

- ***Insoluble lead (II) sulphate is formed and it coats the lead metal preventing further reaction with the acid.***

ii) Suggest a method the student could have used to prepare lead (II) sulphate. (2mks)

- ***Precipitation. React a soluble lead salt with a soluble sulphate.***

iii) Write an ionic equation that would take place in (ii) above. (1mk)

- $\text{Pb}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \longrightarrow \text{PbSO}_4(\text{s})$

13. In an experiment, ammonium chloride was heated in a test-tube. A moist red litmus paper placed at the mouth of the test-tube first changed blue then red. Explain these observations. (2mks)

- ***Ammonium chloride decomposes on heating to form ammonia and hydrogen chloride. Ammonia diffuses than hydrogen chloride and reaches the litmus first turning it blue. The hydrogen chloride turns blue litmus red again.***

14. An element X has two naturally occurring isotopes X-22 and X-20. If its relative atomic mass is 21.8, calculate the percentage abundance of the more stable isotope. (2mks)

- ***Let y be % abundance of most abundant***

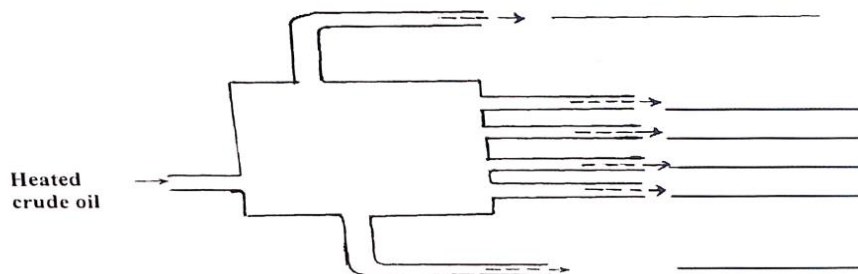
- ***$22y + (100-x) 20 = 218$***

$$\begin{aligned} & \frac{100}{= 218} \\ & Y = 90\% \end{aligned}$$

15. Fractional distillation of crude oil used to produce the following fractions; petrol, diesel, petroleum gases, kerosene, naphtha and bitumen. Below is a simplified diagram of a fractionating column used during the refining of crude oil.

i. On the diagram, write the names of these fractions in their correct positions.

(3mks)



ii. Which fraction is used as a jet fuel? (1mk)

- **Kerosene**

iii. What process is used to convert higher fractions to lower fractions? (1mk)

- **Cracking**

16. Carbon (iv) oxide and silicon (iv) oxide are both covalent oxides but carbon is a gas whereas silicon (iv) oxide is a solid with high melting point. Explain. (2mks)

- **Carbon (IV) oxide has simple molecular structure and hence weak vander waals forces of attraction while silicon (IV) oxide has giant atomic structure and a strong net work of strong covalent bonds.**

17. The ability of hard water to conduct electricity falls when water is boiled but is not much affected when the water hardness is removed by addition of washing soda (sodium carbonate). Explain.

(2mks)

- **Boiling precipitates magnesium carbonate or calcium carbonate and this reduces the concentration of ions. The addition of sodium carbonate exchanges ions which are responsible for electrical conductivity.**

18. When sulphur is heated in a boiling tube in absence of air, the yellow crystals melts into golden yellow mobile liquid at 113°C. The liquid changes at 180°C into a dark brown very viscous liquid. More heating to about 400°C, produces a brown less viscous liquid.

a) Draw the molecular structure of sulphur in the yellow crystals. (1mk)

b) Explain why the molten liquid becomes viscous. (1mk)

- **Rings open to chains which join up to form long chains which entangle up.**

c) If the brown liquid at 400°C is cooled rapidly by pouring it into cold water, which form of sulphur is produced? (1mk)

- **Plastic sulphur**

d) State the observation made when sulphur is heated in a deflagrating spoon. (1mk)

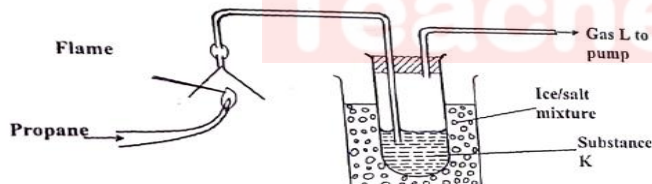
- **Melt and burns with a blue flame**

19. The table below gives some information about certain chemical substances. The letters used are not the actual chemical symbols or formulae.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity		
			Of solid	Of liquid	In water
A	1540	3000	Good	good	Insoluble
B	-114	-85	Poor	poor	good
C	712	1418	Poor	good	good
D	-39	357	Good	good	insoluble
E	2045	3000	Poor	good	insoluble
f	1700	2776	Poor	good	insoluble

- a) From the table, select;
- Two substances that cannot be elements. (1mk)
 - **C E**
 - A substance that is likely to have giant atomic structure. (1mk)
 - **F**
 - A substance that is likely to consist of molecules and which produce ions when added to water. (1mk)
 - **B**

20. Study the diagram below and answer the questions that follow.

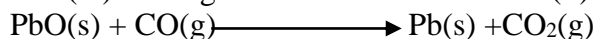


- Write the equation for the combustion of propane. (1mk)
 - $2C_3H_6(g) + 9O_2(g) + 6H_2O(g)$
- The pH of substance K was found to be less than 7. Explain this observation. (1mk)
 - **Carbon (IV) oxide which is acidic dissolves in the condensed water and forms carbonic acid whose pH is less than 7.**

21. Explain how you would separate a mixture of nitrogen and oxygen gases given that their boiling points are -196°C and -183°C respectively. (2mks)

- **Cool the moisture to a temperature below -190°C to form a liquid then start boiling and Nitrogen distills off as gas -196°C .**

22. Dry carbon (iv) oxide gas reacts with heated lead (ii) oxide as shown in the equation below.



- a) Name the process undergone by the lead (ii) oxide. (1mk)

- **Reduction**

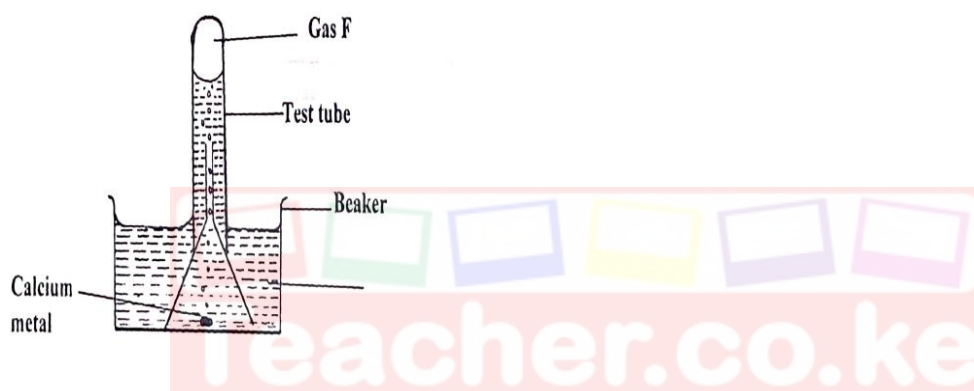
b) Give a reason for your answer in (a) above. (1mk)

- **Removal of oxygen gas from a substance is reduction or lead ions gained electrons to become lead metal and gain of electrons is a reduction.**

c) Name another gas that can be used to perform the same function as carbon(IV) oxide gas in the above reaction. (1mk)

- **Hydrogen gas**

23. The set-up below was used to collect gas F, provided by the reaction between water and calcium metal.



a) Name gas F. (1mk)

- **Hydrogen gas.**

b) At the end of the experiment the solution was found to be a weak base. Explain why the solution is a weak base. (2mks)

- **Calcium hydroxide is slightly soluble in water and only a few ions are produced.**

c) Give one laboratory use of the solution formed in the beaker. (1mk)

- **It is used for testing presence of Carbon IV oxide.**

- **Used in the preparation of ammonia/calcium oxide**

24. In terms of structure and bonding, explain why graphite is used as a lubricant. (2mks)

- **Graphite structure is layered with layers held together by weak van der waals forces.**

25. The reaction between a piece of magnesium ribbon with excess 2M hydrochloric acid was investigated at 25°C by measuring the volume of hydrogen gas produced as the reaction progressed. The sketch below represents the graph that was obtained.

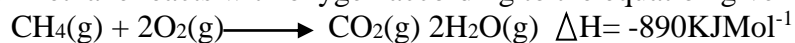


a) Name one piece of apparatus that may be used to measure the volume of hydrogen gas produced.
(1mk)

- **Gas syringe or a measuring cylinder.**

b) On the same diagram the curve that would be obtained if the experiment was repeated at 35°C.
(1mk)

26. Methane reacts with oxygen according to the equation given below;



Calculate the volume of methane which would produce 11.25KJ when completely burnt at r.t.p (molar volume of a gas at r.t.p = 24litre) (2mks)

From equation 890KJ 24 litres

1 mole of methane produce 890KJ

$$41.25 \longrightarrow \frac{11.25 \times 24}{890}$$

= 3 litres