UNIVERSITY OF ESWATINI

FACULTY OF EDUCATION

MAIN EXAMINATION PAPER

PGCE-FT/IDE-PGCE

APRIL 2021

Course Code/Title of paper: CTE529 Curriculum Studies in Chemistry I

IDE-CTE529 Curriculum Studies in Chemistry I

Time allowed: 3 hours

Instructions:

1. This paper contains FIVE questions.
2. Question 1 is COMPULSORY. You may then choose and answer ANY THREE questions from Questions 2, 3, 4, 5, in any order.
3. Marks for each question and sub-questions are indicated at the end of the question.
4. Any piece of material or work that is not intended for marking purposes should be clearly CROSSED OUT.
5. Ensure that responses to questions are NUMBERED CORRECTLY.

Special Requirements Information sheets:

Appendix I: Information on Homologous series

Appendix II: EGCSE Physical Science Syllabus section

Appendix III: Test constructed by Student teacher

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

QUESTION 1

This question is compulsory

Figure 1, given below, provides information on *"How does chromatography separate mixtures"* and "*Activity 3 Separating ink into its component using chromatography*" is taken from Macmillan Physical Science for Southern Africa Learner's Book.

Study the information and activity, and then answer the sub-questions (a) –(c) that follow.

NB: IGNORE the information on "Separating colourless substances using chromatography"

How does chromatography separate mixtures?

Different substances move through an adsorbent material (like filter paper) at different rates. (Adsorbent means that the substance collects on the surface.) To determine the components of a dye, a small drop of the dye is added to an adsorbent material (e.g. filter paper) and then a solvent is passed through it. The components of the dye dissolve in the solvent and move up the adsorbent material with it. The solubilities of the components in the solvent differ, so they do not move up the adsorbent material at the same rate. This is how they are separated from each other. The most soluble component is the least adsorbed and thus the first one to move up with the solvent as it rises up the material. The least soluble one is the most adsorbed and therefore the last to move up. An insoluble one remains at the starting point.

In the laboratory filter paper is usually used as the adsorbent material. Do the following activity to separate black ink into its components.

Activity 3

Separate ink into its components using chromatography

You will need:
Black ink, 1:1 water/ethanol mixture, filter paper, 250 mℓ beaker, retort stand

Do the following:
1. Cut out a long strip of filter paper (about 2 cm × 14 cm).
2. Add about 1 cm of the water/ethanol mixture into the beaker.
3. Place a very small drop of the ink (about 2 mm thick), 2 to 2.5 cm away from one edge of the filter paper strip.
4. Clamp the other end of the strip to support it vertically using the retort stand.
5. Place the beaker on the stand and carefully lower the strip into the liquid, ensuring that the ink dot is 1 to 2 cm above the liquid's surface (see figure 12).

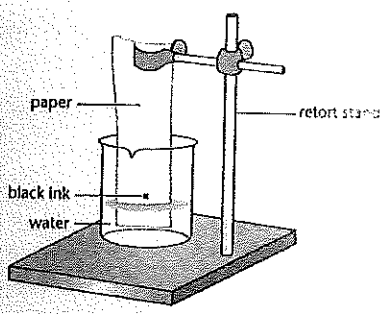


Figure 12 Paper chromatography

6. Leave the setup undisturbed until the solvent front is close to the opposite end of the filter paper strip. It should not reach the end. This may take longer than 40 minutes.
7. Remove the beaker from the stand and allow the paper to dry.
8. The filter paper containing the separated components is called a chromatogram.
   a) Draw a labelled diagram to show the appearance of the chromatogram.
   b) How many dyes was your black ink made of?
   c) What colours are the components of the ink?
   d) Which of these components was mostly adsorbed onto the filter paper?
   e) Which of the components was most soluble in the solvent?

Separating colourless substances by chromatography

Colourless substances may also be separated using chromatography. In this case an appropriate chemical is sprayed on the chromatogram after the solvent has run its full course. This reacts with the components such that they become coloured on the filter paper and are easily identified. These chemicals are called locating agents as they are used to locate the mixture components.

Figure 1. How chromatography separates mixtures

[Separating colourless substances is not part of Question 1]

a) State:

i) the **processes of science** learners engage in while working on Activity 3. Indicate the step where the process(es) occurs, e.g. *Step 0- Observing.* [10]

ii) **Three** examples of scientific knowledge learners may learn from reading the information and conducting the activity in Figure 1. [5]

b) Formulate **three** learning outcomes for a lesson involving Activity 3 given in Figure 1. [6]

c) Why is it advisable for a teacher to have well stated learning outcomes for Chemistry lessons? [4]

QUESTION 2

a) Teachers need to take certain precautions when using practical work in Chemistry lessons.

State, and justify, four precautions that a teacher may need to take when teaching chemistry using practical work. [12]

b) Discuss how learning Chemistry at school contributes to **cognitive, affective** and **psychomotor** development of learners. Use examples from Chemistry to support your discussion. [13]

QUESTION 3

a) Questions that can be used during the question and answer method of teaching in Chemistry can be classified in various ways. One way is to classify them as *cognitive memory questions, convergent questions, divergent questions* and *evaluative questions.*

i) Compare and contrast divergent questions and evaluative questions in the context of Chemistry. Use examples to illustrate your response [8]

ii) How might a Chemistry teacher maximise learning when using the question and answer method of teaching? [5]

b) Suppose you plan to use the *lecture method* and the *question and answer* method to teach a Form 5 class content from the syllabus topic **C14.4 Homologous series** in order to address learners' ability to:

1. *describe the homologous series as a 'family' of similar compounds with similar properties due to the presence of the same functional group*
2. *describe the general characteristics of a homologous series*

Supplementary information is provided in Appendix I

i) Describe these two methods, and justify their appropriateness for developing learners' abilities as stated above. [6]

ii) Outline the preparations necessary for the successful use of the two methods in the given context. [6]

QUESTION 4

A Chemistry education student teacher provided the following information on her ***50-minute* lesson** on the EGCSE Physical Science Sub-topic "**Air**". The relevant section of the EGCSE Physical Science syllabus in provided as **Appendix II.**

Preliminary lesson information has been omitted ***Learning outcomes:*** *At the end of the lesson learners should be able to:* 1. *Describe the volume composition of air* 2. *Describe the fractional distillation of liquid air to obtain oxygen gas, nitrogen gas and the noble gases for industrial use* 3. *Name common pollutants in air as carbon monoxide, sulfur dioxide, oxides of nitrogen, lead compounds, chlorofluorocarbons (CFCs) and excess carbon dioxide* 4. *Describe the sources of each of the pollutants: Carbon monoxide, sulfur dioxide, oxides of nitrogen from car exhausts, lead compounds from car exhausts, and excess carbon dioxide from the combustion of fuels and CFCs from aerosol sprays.*
Teaching and learning methods *Lecture, question and answer, discussion*
Teaching and learning resources: *Video clips on air pollution; Chalkboard; PowerPoint*

Critique the situation presented in the given information on student teacher's lesson plan. [25]

QUESTION 5

The quality of educational assessment instruments is described using terms such as *validity, reliability, objectivity* and *fairness.*

Study the test constructed by a student teacher during teaching practice attached as Appendix III.

Additional information from the EGCSE Physical Science syllabus is provided as Appendix II.

a) Construct a table of specification for the test. Use the syllabus specification grid shown below to guide you.

EGCSE Physical Science Specification grid	
Assessment Objectives	**Weighting of assessment objectives in overall qualification**
A Knowledge with understanding	50% (not more than 25% recall)
B Handling information and solving problems	30%
C Experimental skills and investigations	20%

[10]

b) Use the table of specification constructed in (a) to evaluate the quality of the test in terms of its ***content related validity*** and ***construct related validity***. [6]

c) Construct a marking guide for the test given as Appendix III. [6]

d) Describe the value of a marking guide in educational assessment. [3]

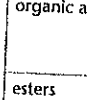
APPENDICES

Appendix I: Information on Homologous series (for use in Question 3)

acids.

Table 1 shows five classes or families of organic compounds with their corresponding functional groups.

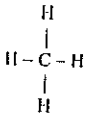
Table 1 Classes of organic compounds

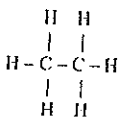
Class of organic compound	Functional group
alkanes	
alkenes	
alcohols	
organic acids	
esters	

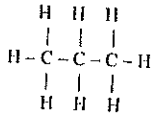
Compounds with the same functional group undergo similar chemical reactions.

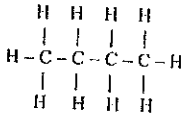
Organic compounds that have the same functional group but differ from each other by the number of carbon atoms they have are called members of the same **homologous series.**

For example,









All four of these compounds have the same functional group (single bonds between the carbon atoms). They only differ from each other by the number of carbon atoms in each molecule. These compounds form a homologous series.

Members of the same homologous series share the following characteristics:

- Have a general formula. For example, look at the following alkenes: C_2H_4, C_3H_6 and C_4H_8. The number of hydrogen atoms is twice the number of carbon atoms. So if the number of carbon atoms is represented by 'n', the number of hydrogen atoms is '2n'. The formula for alkenes is then written as C_nH_{2n}.
- Have the same functional group e.g. for alkanes it is single bonds yet for alcohols it is the '–OH' group of atoms.
- Undergo the same chemical reactions. For example all alcohols react with organic acids to form sweet-smelling compounds called esters.
- Show a gradual change in physical properties as the carbon chain length increases e.g. boiling points of alkanes increase with increasing chain length. (See Table 2.)

Table 2

Name of compound	Boiling point (°C)
Methane	– 164
Ethane	– 87
Propane	– 42
Butane	– 0.5

Appendix II: EGCSE Physical Science Syllabus section (for use with Question 4 & Question 5)

Syllabus section

C13.0 Non-metals

All learners should be able to:

C13.1 Air

1. describe the volume composition of air

2. describe the fractional distillation of liquid air to obtain oxygen gas, nitrogen gas and the noble gases for industrial use

3. name common pollutants in air as carbon monoxide, sulfur dioxide, oxides of nitrogen, lead compounds, chlorofluorocarbons (CFCs) and excess carbon dioxide

4. describe the sources of each of the pollutants:

- *carbon monoxide from incomplete combustion of carbon-containing compounds,*
- *sulfur dioxide from the combustion of fossil fuels containing sulfur compounds leading to 'acid' rain,*
- *oxides of nitrogen from car exhausts,*
- *lead compounds from car exhausts,*
- *excess carbon dioxide from the combustion of fuels and*
- *CFCs from aerosol sprays*

5. state adverse effects of the pollutants on:

- *buildings (SO2 and oxides of nitrogen),*
- *plants (SO2 and oxides of nitrogen)*
- *health (oxides of nitrogen, sulfur dioxide, lead compounds, carbon monoxide)*
- *the ozone layer (CFCs)*

6. state the composition of catalytic converters in car exhaust systems (palladium, platinum and rhodium)

7. explain the importance of catalytic converters in car exhaust systems to remove carbon monoxide and oxides of nitrogen

8. describe the role of carbon dioxide in global warming

9. describe the role of ozone in absorbing ultraviolet (UV) radiation

Appendix III: Test constructed by a Student teacher (for use with Question 5)

Form 4B **Physical Science (Chemistry)** **23rd September 2020**

Topic Test 1: Air pollution

Time allowed: 50 minutes

Instructions

Answer questions in the answer sheet provided.

Answer all questions.

Question 1

a) Define air. (1)
b) Outline the gases found in air and their composition. (6)
c) What can disturb the balance in atmospheric gases? (1)
[8 marks]

Question 2

a) Define the process of fractional distillation. (2)
b) With the aid of a diagram apply the process of fractional distillation in the separation of the components of air. .....(5)
[7 marks]

Question 3

a) Define a pollutant. (2)
b) Name the sources of the following pollutants.
i. Carbon monoxide (1)
ii. Carbon dioxide (1)
iii. Nitrogen oxide (1)
iv. Lead oxide (1)
v. CFCs (1)
(c) Why was the manufacture and production of CFCs stopped? (2)
[8 marks]

Question 4

a) What is the name given to gases such as carbon dioxide? (1)
b) Name one way through which carbon monoxide emission can be minimized? (1)
c) India is one of the countries highly affected by air pollution in the world. Evaluate the effect of large carbon dioxide emission on climate change. (6)
[8 marks]

Total [30 marks]

The End