UNIVERSITY OF SWAZILAND

FACULTY OF EDUCATION

MAIN EXAMINATION PAPER

APRIL/MAY 2014

B. Ed. III AND PGCE

Title of paper: Curriculum Studies in Chemistry II

Course number: EDC 379

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, and 5.
3. Marks for each question and sub-question are indicated at the end of the question.
4. Any piece of material or work which is not intended for marking purposes should be clearly CROSSED OUT
5. Ensure that responses to questions are NUMBERED CORRECTLY

Special Requirements

3-page attachment: Extract from text book and extract from Integrated Science syllabus.

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

Question 1 (This question is Compulsory)

The passage below is an introduction to a practical activity that pupils in a Form 4 class might be engaged in. Read the passage and then answer the questions that follow the passage. You may also use the attached information extracted from Dube, T. et al. (2008). *Macmillan Physical Science for Southern Africa: Learner's Book.* Manzini Swaziland Macmillan Boleswa Publishers (Pty) LTD. Pages 98-101.

> ***Effect of temperature on the rate of a chemical reaction***
>
> *A chemical reaction only occurs when atoms or molecules of the reactants are in contact. Thus, the speed of a given reaction will depend on the frequency with which the reacting particles collide. Not all collisions result in a chemical reaction, however, because they do not meet the energy requirements for the reaction or, in some cases, molecules are not properly aligned for the reaction.*
>
> *Any change in the reaction condition that will increase the number of collisions (or the violence of the collision) between the particles will result in increasing the rate of the reaction.*

a) What pre-requisite concepts should pupils have developed to be able to understand the passage? [5]

b) What key concepts might pupils learn from the above passage? [6]

c) What difficulties might pupils experience in understanding the passage given above? [4]

d) Describe, with the aid of an activity, how you might teach any **one** of the concepts noted in (b) above, to promote pupils' understanding of the concept and the passage. [10]

[25 marks]

Question 2

For the topic Air and Life (see attached Integrated Science syllabus section on the topic):

a) Give and justify a sequence for at least **five** sub-topics dealt with in this topic. [11]

b) Choose one sub-topic from those given in 2(a) above and

i) Describe **two** resources you could use to facilitate learning of the content in the sub-topic. [6]

ii) Discuss how you might use the two resources, indicating the precautions you could take regarding the resources. [8]

[25 Marks]

Question 3

a) Acker and Otley (1993) note in their article "Gender issues in education for Science and Technology: Current situation and prospects for change" that a lot has been published on gender and education but of interest is *gender equity in education for science and technology and ... features of educational innovation and teachers* work that attempt to achieve such equity.

i) Why is there a need for gender equity in education for Science and technology? [6]

ii) How might school Chemistry teachers contribute to low gender equity in Science? [9]

b) Discuss how the following factors may constitute barriers to successful teaching of Chemistry in schools.

i) Teachers [6]

ii) Infrastructure [4]

[25 Marks]

Question 4

a) Current views on learning encourage linking formal learning and pupils' knowledge acquired in informal settings.

Show how such a link could be beneficial for learning Chemistry. [5]

b) Identify and discuss **three** sources of misconceptions in Chemistry. [11]

c) Some pupils attribute properties of substances to the particles (atoms and molecules) when explaining the observed behaviour of matter, for example "*sugar molecules dissolve in water*", "*water molecules melt when ice melts*".

i) How might you explain how these misconceptions arise? [3]

ii) How might a Chemistry teacher help pupils realise that particles of matter do not dissolve or melt [6]

[25 Marks]

Question 5

a) "The whole area of language ... needs careful thought. ... Language helps or hinders interactions (*of new information*) with *(knowledge in)* long term memory but it can also be a source of information overload."(7) (Sirhan, G. (2007). Learning difficulties in Chemistry: An overview. *Journal of Turkish Science Education,* 4 (2) 2-20.) [Modifications for clarity]

In the context of Chemistry learning in Swaziland, what language related challenges may lead to the above observations? [15]

b) Discuss the relationship between needs assessment and the curriculum development process, using the context of Chemistry. [10]

[25 Marks]

Extract from Dube, T. et al. (2008). *Macmillan Physical Science for Southern Africa: Learner's Book.* Manzini Swaziland Macmillan Boleswa Publishers (PTY) LTD. Pages 98-101.

UNIT 6.3

Rates of reaction

In this unit you will learn about factors that affect the rate of any chemical reaction. There are fast reactions such as the burning of wood or the explosion of dynamite or the reaction of potassium metal and water. There are slow reactions such as ripening of fruit or maturing of cheese or rusting of iron which may take months. The table below shows some common reactions and the time they take:

Reaction time	Common examples
seconds	reaction between liquid hydrogen and liquid oxygen, which is used to propel rockets
minutes	oxidation of calcium metal in air
hours	burning of coal in a fire
days	dulling of brass or copper
weeks	rusting of steel
years	yellowing of old documents

The speed at which chemical reactions occur is called the rate of reaction. The study of rates of reaction is called **chemical kinetics**. This is very important in industry. To make profits the yield must be high and the products must be made in a short time. The rate of a reaction is the speed of a reaction. This is usually found by plotting graphs as shown in the next activity.

Factors affecting the rate of chemical reactions

The most important factor affecting the speed at which a reaction will take place, or the reaction rate, is the number of **effective collisions** that occur between the reactant particles. Any factor that increases this number of collisions will increase the reaction rate. These factors include: nature of the reactants, concentration or pressure in gases, particle size, temperature, light and catalysts.

Nature of the reactants

No factor will cause a reaction to occur if the reactants are unable to react with each other. The **collision theory** states that chemical reactions occur when particles of the reactants collide. They must collide with a certain minimum energy, called the **activation energy** (E_A). For example methane and oxygen do not react at room temperature. To make them react they need heating to provide energy, so they are ignited.

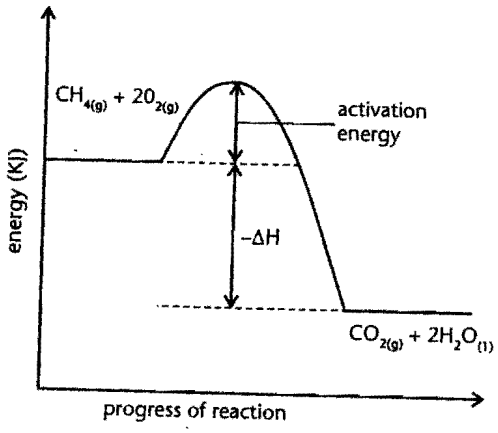

Figure 2 Potential energy diagram for methane/ oxygen

Concentration

Concentration – although an increase in concentration means that there are more particles per unit volume and therefore an increased number of effective collisions, in general there is a concentration above which the reaction rate will decrease rather than increase. This is called the optimal concentration.

In the case of reactions involving gases, the pressure is an indication of the concentration of the gas, the greater the pressure the greater the number of particles per unit volume.

Many reactions are carried out in solution with water as the solvent. In a concentrated solution there are more collisions so the reaction rate is faster than in a dilute solution.

Particle size

A cube of marble 1 cm × 1 cm × 1 cm is cut into two smaller pieces along the dotted line as shown in Figure 3. What is the increase in surface area after cutting?

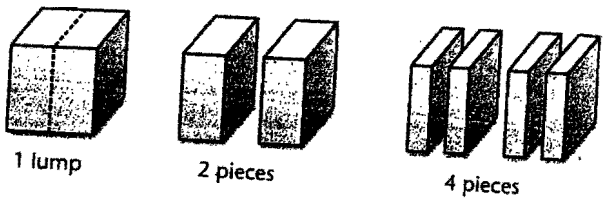

Figure 3 Determining the total surface area

One piece has the smallest surface area, two pieces have a greater surface area and four pieces have the greatest surface area. This shows that as the size of the particles decreases so their effective surface area increases. Therefore the number of positions where collisions between reactants can occur increases, and the reaction rate increases. Powders have an enormous surface area and react very quickly.

Chewing food before swallowing breaks the large particles into smaller ones. This increases the surface area for enzymes to break down and helps to digest food easily and quickly.

Chemical reactions occur on the surfaces of the reactants. A small surface area slows down the rate of chemical reaction and a large surface area increases the rate of a chemical reaction. Bigger lumps of reactants have a smaller surface area for contact and this slows down the reaction. Small pieces of reactant have a greater surface area for contact, hence the reaction rate increases.

Danger of explosive combustion with fine powders

Flour explodes under certain conditions for two reasons. The first is that flour is a starch. Starches, like other carbohydrates, burn very easily. Secondly, flour is not explosive in its normal state, but it is capable of spreading in the air and creating a potentially explosive dust cloud. Flour explosions most often occur where flour is constantly being handled, although a small scale explosion can be created at home as well. Flour is made from chains of glucose molecules, meaning that it is a complex carbohydrate. Although flour is not sweet to the taste, it does retain the highly flammable properties of sugars.

However, flour will not ignite if it is densely packed, as it often is in a home kitchen. Flour must have ample space to explode, as might be the case in a flour mill when a tossed sack of flour splits open, for example.

For flour to explode, it must be in a highly dispersed state. Approximately 56 grams of flour suspended in a cubic metre of air has explosive properties. If a flame is introduced to the flour dust, the individual flour particles will burn. If the dust cloud is large enough, a flash fire inside the dust cloud will result, which can create a serious explosion.

Flour explosions are a much larger risk in areas where large amounts of flour are handled. Although a small dust cloud of flour might ignite in a home kitchen, the damage would probably not be severe. In a grain elevator or flour mill, however, the possibility of a very large cloud of flour or grain dust is much higher. For this reason, care is taken in these facilities to prevent dust clouds, and any open flame is usually protected.

Some science classes create a small flour explosion to illustrate the principle. A simple and relatively safe way to do this is to light a candle inside a can with a lid. Poke a straw through a small hole drilled at approximately candle level, and puff flour into the can through the straw. A small fire should result, blowing off the lid of the can. If only a small amount of flour accomplishes this, the results of a larger flour explosion can easily be imagined.

Temperature

In general, due to the increased speed of the particles with increased temperature, the number of effective collisions between reactants increase. Consequently the reaction rate increases. This is true for all reactions.

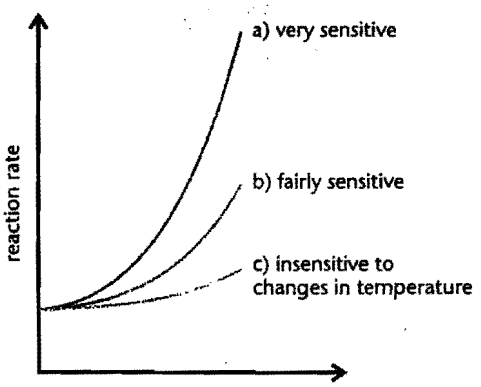

Figure 4 Graph of variation of reaction rate and temperature

Light

Light is a source of energy and so can increase the kinetic energy of the particles. For this reason in some reactions light can provide enough energy for the reaction to proceed. This is seen in both photography and photosynthesis.

Integrated Science Syllabus section on the topic Air and Life

FORM 2 LEARNING OUTCOMES

9. Air and Life

Learners should be able to:

(a) describe the composition of air (20% oxygen, 79% Nitrogen - remainder being mixture of noble gases, water vapour and carbon dioxide)
(b) prepare, collect and describe the properties of hydrogen
(c) use a lighted splint to identify hydrogen
(d) prepare, collect and describe the properties of oxygen
(e) use a glowing splint to identify oxygen
(f) state the uses of oxygen including use of oxygen in hospitals and with acetylene in welding
(g) describe in simple terms the idea combustion and rusting
(h) describe methods of rust prevention: paint and other coatings e.g galvanising to exclude oxygen
(i) prepare, collect and describe the properties of carbon dioxide
(j) use lime water to identify carbon dioxide
(k) state the uses of carbon dioxide
(l) describe respiration as the burning of glucose in oxygen to release energy in cells
(m) compare respiration and combustion
(n) label parts of respiratory system
(o) state differences between inhaled and exhaled air
(p) describe role of lungs in removal of carbon dioxide and water
(q) define photosynthesis as the process of making carbohydrates in green plants using water carbon dioxide and light and give a word equation for photosynthesis
(r) investigate the conditions necessary for photosynthesis
(s) state that most photosynthesis occurs in the leaves