SYSTEMIC ASSESSMENT AS A NEW TOOL FOR ASSESSING STUDENTS LEARNING IN CHEMISTRY USING SATL METHODS: Systemic True False [STFQs] and Systemic Sequencing [SSQs] Question Types

A.F.M. Fahmy and J. J. Lagowski*
Faculty of Science, Department of Chemistry, Ain Shams University, Abbassia, Cairo, Egypt
E-mail: afmfahmy42@yahoo.com
*Department of Chemistry and Biochemistry, The University of Texas at Austin, Austin, Texas, 78712, USA
E-mail: jjl@mail.utexas.edu
Website: www.satlcentral.com

ABSTRACT

Systemic assessment [SA] has been shown to be a highly effective new vehicle in raising the level of students academic achievements, increasing equity of students learning outcomes, improving students' ability to learn by enhancing the process of teaching and learning, and involving the student as an active participant in this process. Systemic assessment questions (SAQs) are the building unites of systemic assessment which measures the students' ability to correlate between concepts and to discover the new relations between concepts. In this paper we illustrate two new types of SAQ, s namely, systemic true false questions [STFQs], and systemic sequencing questions [SSQs]. *[AJCE, 2(2), February 2012]*

INTRODUCTION

The systemic approach to teaching and learning (SATL) which was first described in 1998 (1-6) helps learners to deduce new relationships among concepts that enrich the operation of teaching and learning using elements of the cognitive, psychomotor, and emotional domains. We have proposed systemic assessment (SA) of learners to produce a more efficient evaluation of the systemic- oriented objectives in the SATL techniques and as an effective tool for assessing students' meaningful understanding of chemistry topics at the secondary and tertiary levels (7, 8).

Recent studies indicated that SAQs are valid and reliable evaluation tools for 11th grade high school students. SAQs consider several concepts at once applying them in a new situation which requires the synthesis of a comprehensive answer (9).

Here we continue our work on systemic assessment to assess students academic achievements in chemistry using systemic multiple choice questions [SMCQs], we illustrate here another type of SAQs, namely, systemic true/false questions [STFQs] and systemic sequencing questions (SSQs).

Why Systemic Assessment?

Systemic assessment (SA) has the following advantages:

i. it measures the cognitive structure from the quantitative through the qualitative (domains);
ii. assesses students' higher-order thinking skills where they are required to analyze, synthesize, and evaluate;
iii. measures the students' ability to correlate between concepts;
iv. enables the students to discover new relationships among concepts;

v. gives the students rapid feedback during the term about how well they understand the course material;

vi. assesses the students in a wide range of concepts in the course units;

vii. measures the systemic intended learning outcomes (SILOs) beside linear intended learning outcomes (LILOs)

viii. develops the ability to think systemically, critically, and creatively, and to solve problems;

ix. very easily scored;

x. is objective, realistic and valid.

SYSTEMIC ASSESSMENT QUESTIONS [SAQS]

SAQs are the building questions of any systemic assessment [SA], namely, systemic multiple choice questions [SMCQs], systemic true-false questions [STFQs], systemic matching questions [SMQs], systemic sequencing questions [SSQs], systemic synthesis questions [SSyQs], and systemic analysis questions [SAnQs].

Requirements for building Systemic Assessment

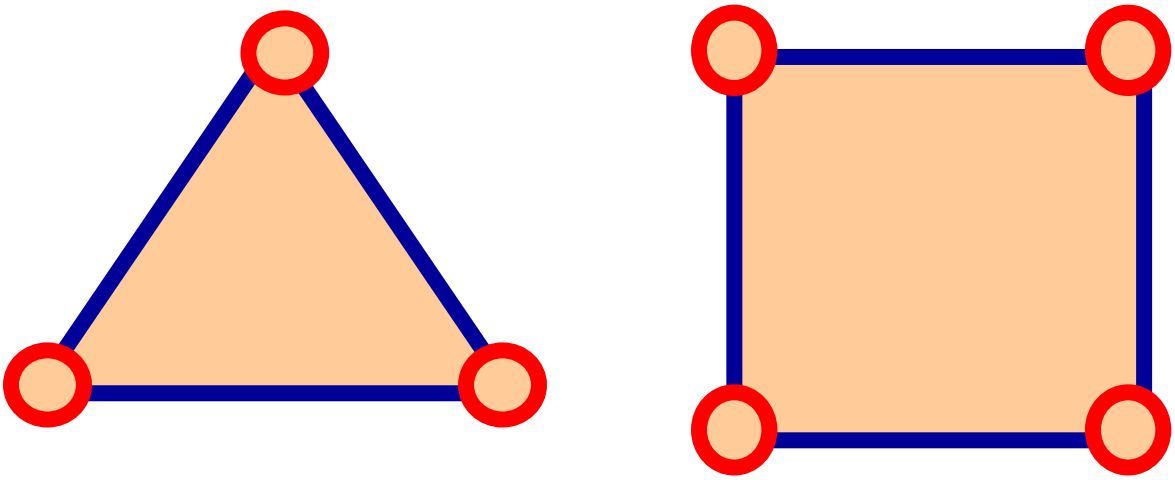
We start with content analysis of the course units into concepts and the related knowledge skills and attitudes. Then determine the type of relationship that exists between the given concepts, the size of the building systemic [triangular, quadrilateral, etc.], and finally choose the type of the systemic assessment questions [SAQs].

Geometric Forms of Systemic Assessment Questions (SAQs)

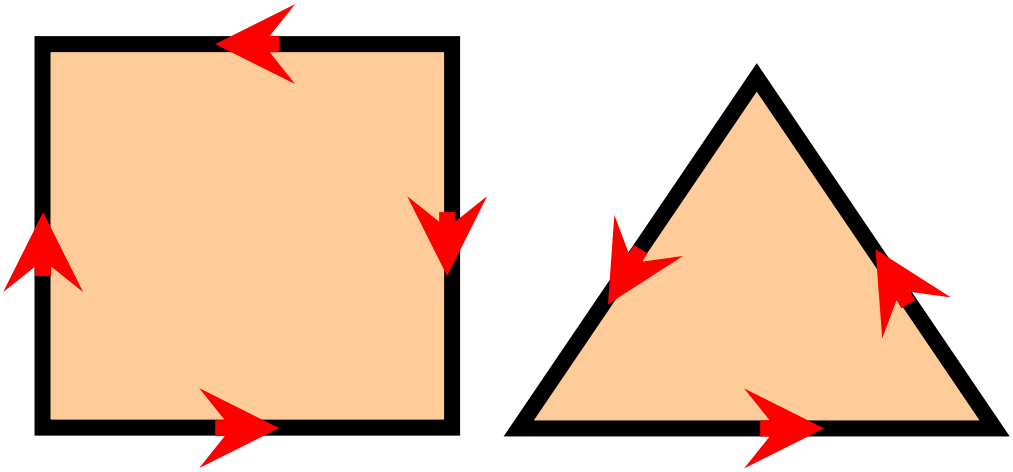
The systemic are the building units of the SAQs and these take various geometric shapes such as triangular, quadrilateral, pentagonal, hexagonal, etc., depending on the number of

concepts that are incorporated in the diagram (Figure 1)(6, 7). We take into consideration the following points when we build this type of question.

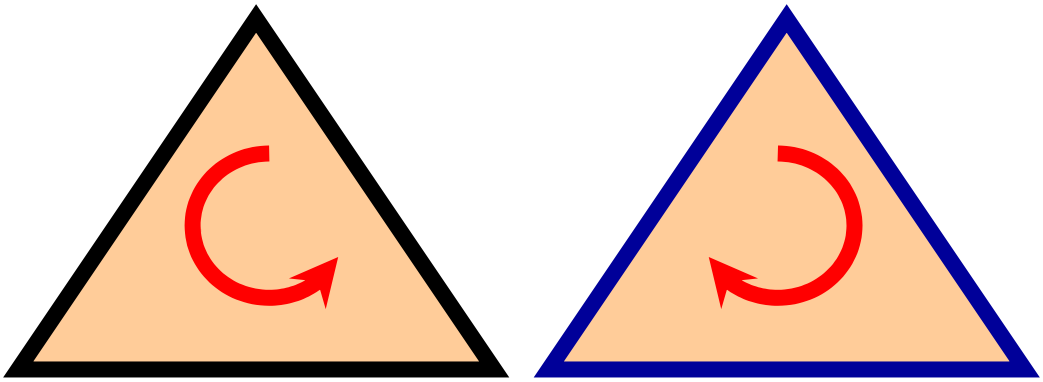
1- Concepts or facts are placed at the corners of these diagrams:



2- We use the sides of these diagrams as arrows pointing to the relationships between concepts or facts.



3- The head of arrows could direct clockwise or anticlockwise.



(Clockwise) (Anticlockwise)

Type I: Systemic True False Questions [STFQs]

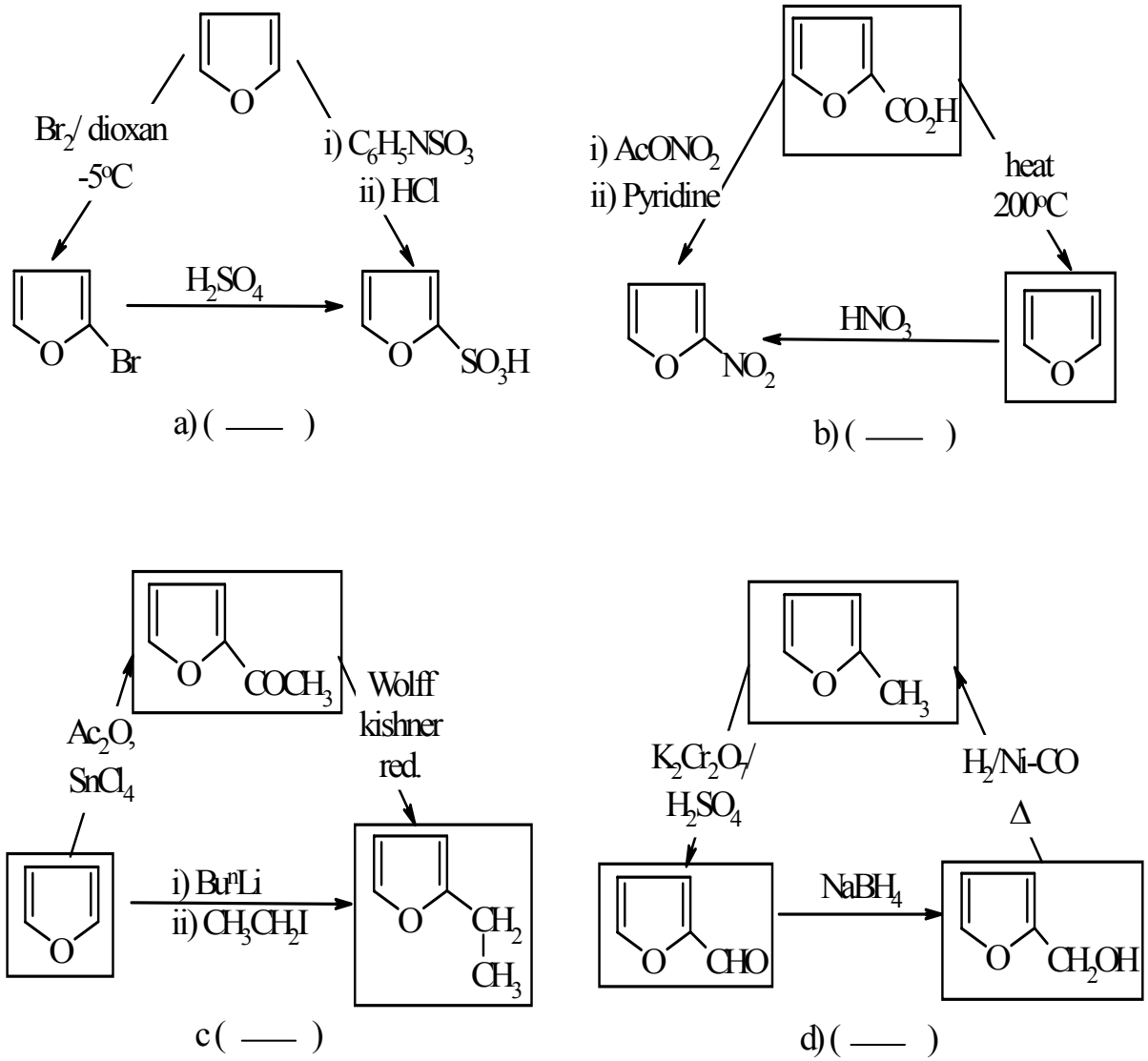
STFQs are well suited for testing student comprehension, synthesis and analysis, and require a student to assess whether a systemic is true or false. The advantages of STFQs are:

- Students can respond to many STFQs covering a number of concepts and facts and their relationships in a short time.
- Students can be assessed of their higher-order thinking skills to analyze, synthesize, and evaluate,
- Teachers can easily score STFQs.

Examples

The following examples are intended to illustrate how STFQs have been and can be used in Chemistry.

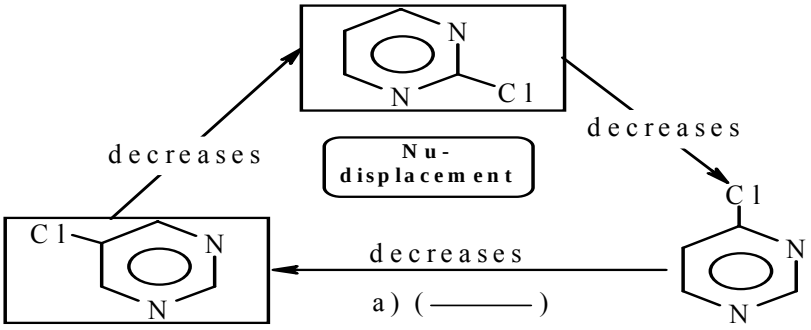
Q-1-Indicate which of the following systemics are true (T) and which are False (F):



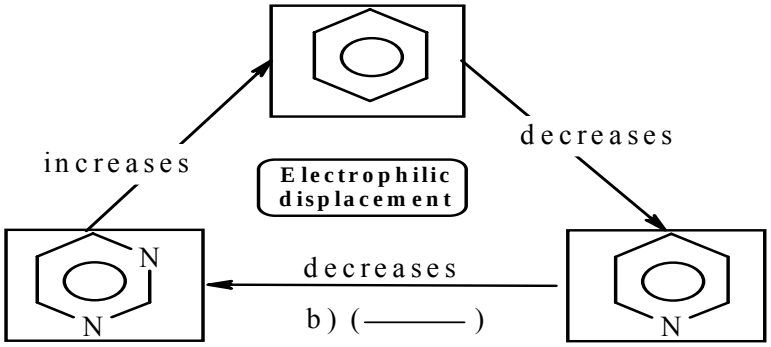
Answer: True systemics are (a & c); False systemics are (b & d)

Q-2-Indicate which of the following systemics are true (T) and which are false (F):

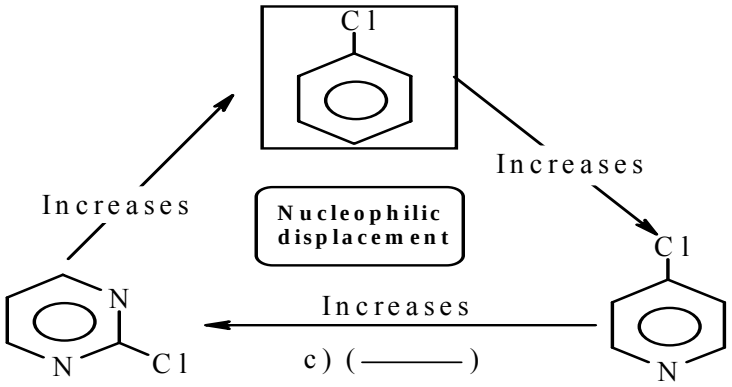
1)



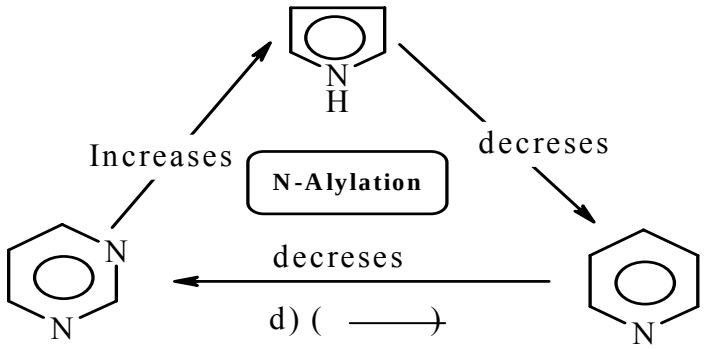
2)



3)

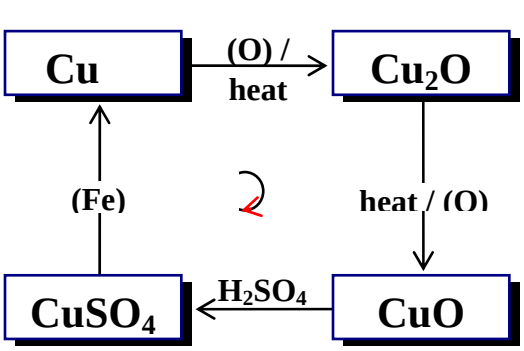


4)

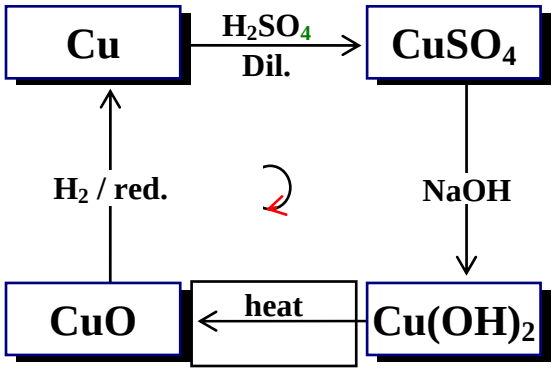


Answer: True systemics are (2 & 4); False systemics are (1 & 3)

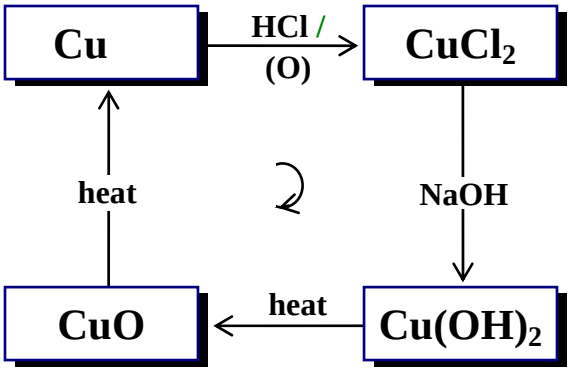
Q3-Indicate which of the following systemics are true (T) and which are false (F):



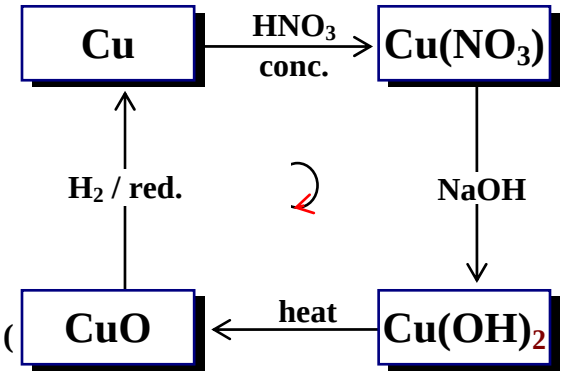
(a)



(b)



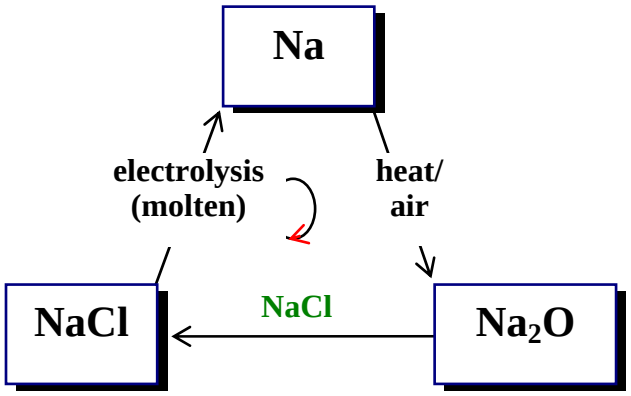
(c)



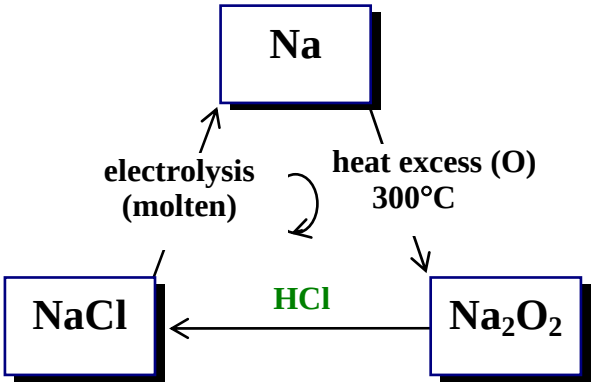
(d)

Answer: True systemics are (b& c); False Systemics are (a & d)

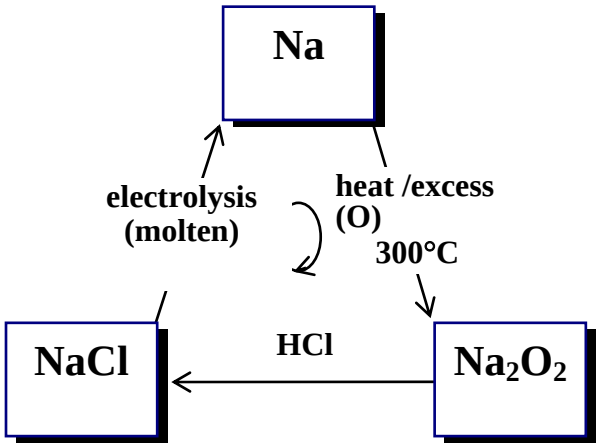
Q4-Indicate which of the following systemics are true(T) and which are false(F):



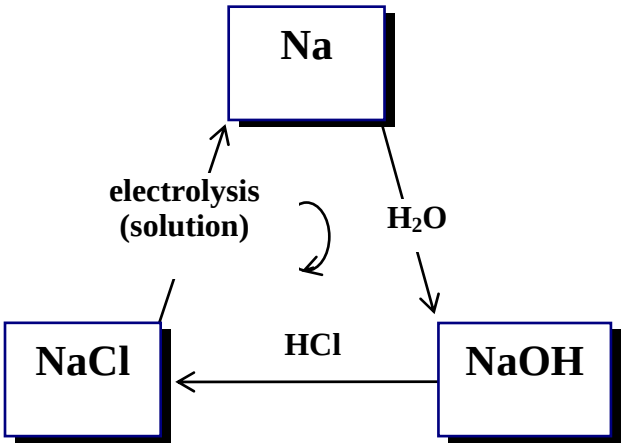
(a)



(b)



(c)



(d)

Answer: True systemics are (b & c); False Systemics (a & d)

For more examples, see (10 and 11)

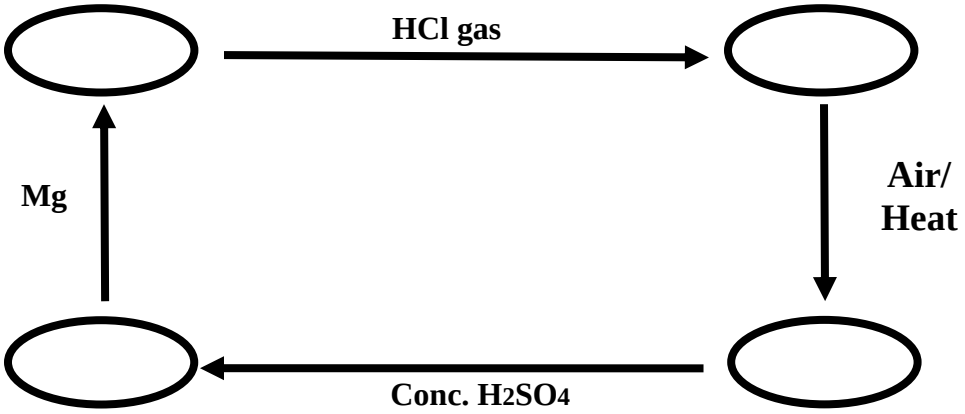
Type 2: Systemic Sequencing Questions [SSQs]

SSQs require the student to position text or a formula in a given sequence of a systemic diagram; these kinds of systemics can assess higher-order thinking skills.

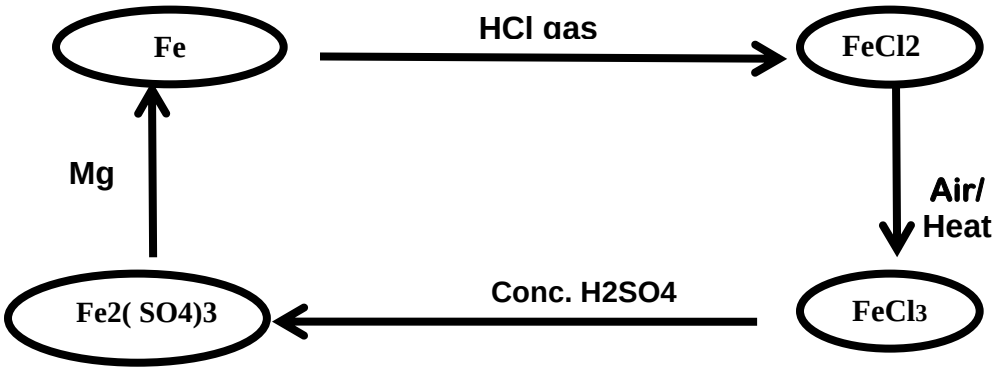
Examples

Q1-Arrange iron and its related compounds in the correct places of the following systemic diagram:

[Fe, $FeCI_2$, $FeCI_3$, $Fe_2(SO_4)_3$]

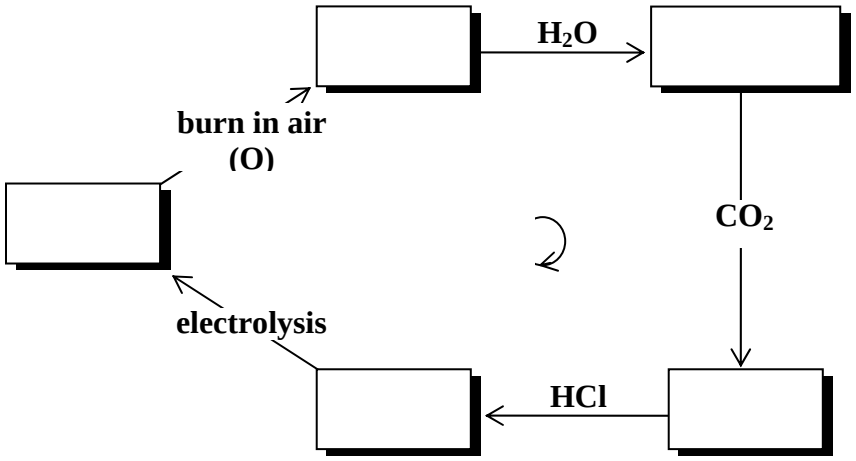


Answer:

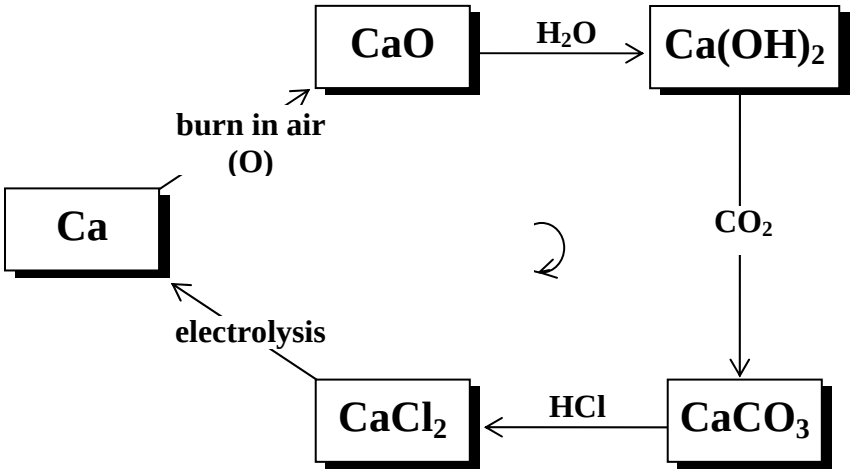


Q2-Arrange calcium and its related compounds in correct places of the following systemic diagram:

[CaO- Ca - $CaCO_3$ _ CaCl2- $Ca(OH)_2$]

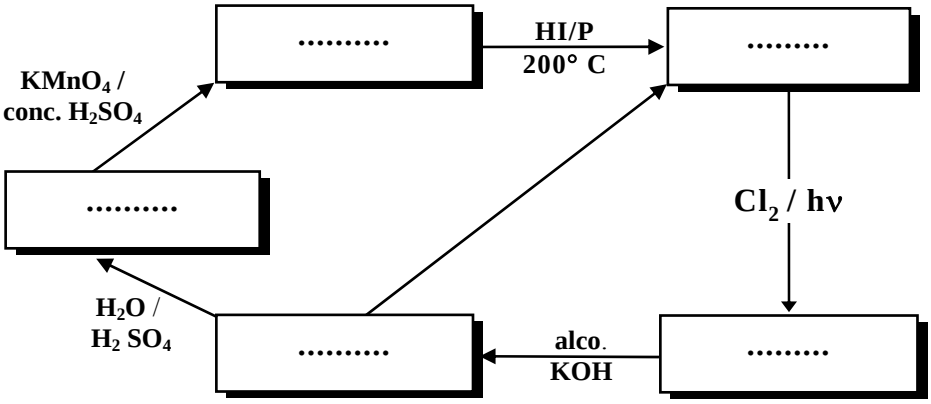


Answer:

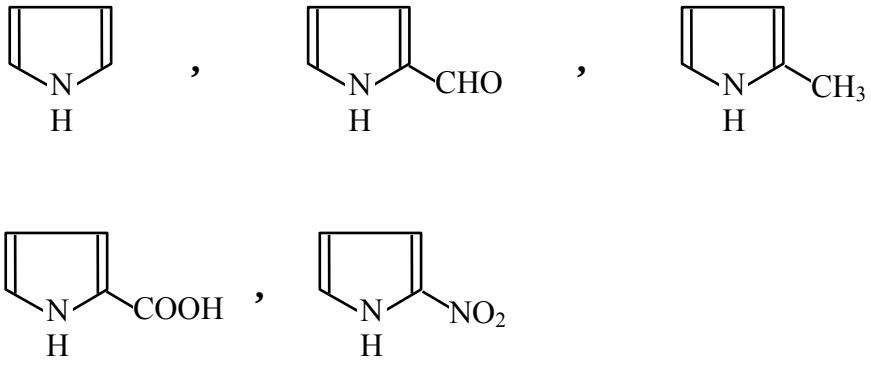


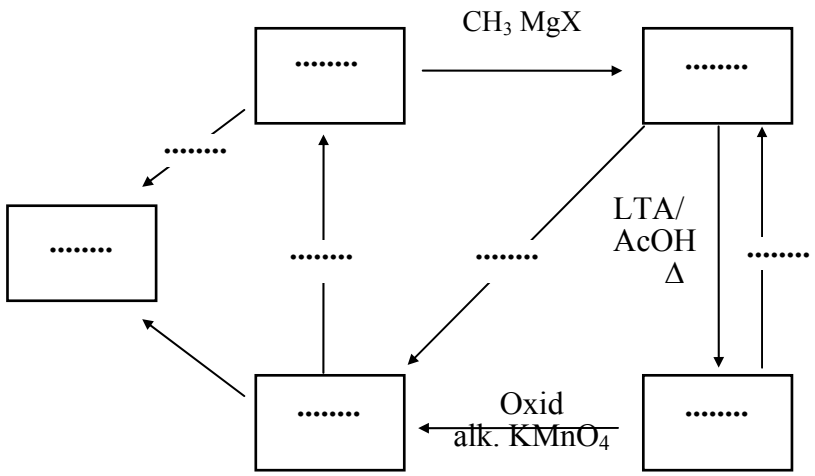
Q3-Arrange the given organic compounds in the correct places of the following systemic diagram:

[$CH_2=CH_2$, C_2H_5OH, CH_3CH_2Cl , CH_3CH_3, CH_3COOH]



Q4-Arrange the given heterocyclic compounds in the correct places of the following systemic diagram and complete the reaction conditions for the process.





For more examples, see (10 and 11)

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