

The Open University of Sri Lanka  
B.Sc. Degree Programme – 2013/14  
Industrial Chemistry – CMU3232  
Continuous Assessment Test II (CAT) - No Book Test  
Duration: 1 hour



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Date: 17:08.2014

Time: 1.00 p.m. - 2 00 p.m.

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Answer all the questions

Registration Number: .....

Invigilator's signature: .....

No.	Marks
1	
2	
Total	
Average	
%	

1. a.i. What are the basic ingredients of ceramic materials?

.....

(05 marks)

ii. What is the main difference between traditional ceramics and new ceramics?

.....  
.....

(05 marks)

iii. Write down the raw materials used in Ceramic Industry and their role in a ceramic body.

	Raw Material	Role
1.		
2.		
3.		

(15 marks)

b.i. For what purpose, do we use the following processes in ceramic industry?

Ball milling .....

Casting .....

Firing .....

(15 marks)

ii. What do you understand by the term “Glazing” of a ceramic body?

.....  
 .....  
 .....

(05 marks)

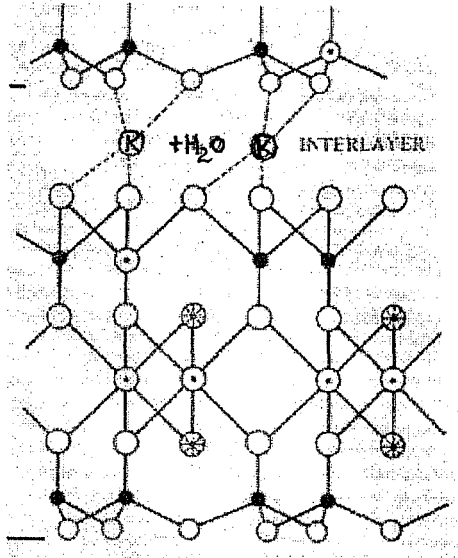
iii. List down the three main components of glaze and their role in glazing a ceramic body.

No	Components of Glaze	Role f components
1.		
2.		
3.		

(15 marks)



The following structure is a layer structure of a phyllosilicate mineral.



iv. Briefly describe the structural features of the above silicate mineral.

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(10 marks)

v. Comment on cation exchange capacity of the above silicate mineral.

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(10 marks)

2.a.i. Why do you say glass is an amorphous substance?

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(10 marks)

ii. The composition of ordinary glass is modified by adding various oxides to the glass body mixture for different applications.

Oxide	Useful property	Application
Lead oxide		

(10 marks)

iii. What colour will be imparted when we use the following metals in the formation of the coloured glass?

Cobalt .....

Selenium .....

(10 marks)

b.i. What do you meant by the term “glass formers”? Give **two** examples.

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**(10 marks)**

ii. What is the reason for using borosilicate glass for manufacturing chemistry laboratory glass wares?

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iii. What physical property of borosilicate glass is associated for the above property?

.....

**(15 marks)**

c. The principal source of phosphorous compounds is phosphate rock - a complex material containing the mineral fluorapatite,  $[3Ca_3(PO_4)_2.CaF_2]$ .

i. Using balanced chemical equation show how triple super phosphate can be produced from fluorappaite.

.....  
.....

**(05 marks)**

- ii. Suggest the most suitable value addition product from Eppawala phosphate deposit in terms of economic viability

.....

**(05 marks)**

- d. The mineral sands are generally found in areas on or closer to the beaches in sand dunes. Sri Lanka has one of the richest mineral sand deposits in the world.

- i. What do you mean by the term 'mineral sands'? Name **two** main mineral sands found in Sri Lanka.

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**(15 marks)**

- ii. Pigment grade  $TiO_2$ , a value added product of a mineral sand which can be obtained via chloride process. Briefly explain chloride process by giving its balanced chemical equation.

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**(20 marks)**



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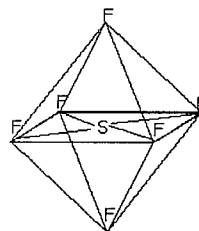
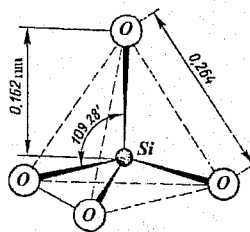
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Answer Guide for Continuous Assessment Test II (CATII)

- 1.a. i. Clay, sand and Feldspar  
ii. Traditional Ceramics – Silicate minerals  
New Ceramics – Non Silicate minerals  
iii. Clay – Plasticity/ ability to mould into shape  
Silica- Hardness/ strength  
Flux – To fuse raw materials
- b. i. Ball milling – Size reduction of raw materials  
Firing – To melt and fuse the tiny platelets in order to give a durable product with strength.  
ii. Glazing can be defined as a layer of glassy substance on the surface of a ceramic body. It gives beauty and added value to a ceramic body.  
iii. Silicon dioxide – to provide the main body  
 $\text{Al}_2\text{O}_3$  – to enhance the viscosity of the glaze  
Flux/ alkali/ alkaline earth metal oxide – to lower the melting of the mixture.

C i.



- ii. Montronite/ Vermiculite/ illite/mica
- iii. Isomorphic substitution is the substitution of one element for another in a mineral without a significant change in the crystal structure. It takes place within the clay crystal. Normally it occurs at the time of formation; it is irreversible and is governed by size.
- iv. Structural features
  - It is a 2:1 layer structure, i.e. it has two Si tetrahedral sheet and one Al- octahedral sheet.
  - Isomorphic substitution at Si – tetrahedral sheet.
  - Negative charged developed.
  - Developed negative charge is balanced by  $K^+$
  - Interlayer is opened and hydrated.
- v. Dominant interlayer balancing cation is  $K^+$ . It has been observed that in many clays if the dominant cation is  $K^+$ , the minerals will not swell.  $K^+$  behaves as fixed. Therefore CEC is low.

- 2.a.
  - i. In glass structure, Si-O bonds are deformed. Si-O-Si bond angles are different. The regular arrangement is lost by the variation of the bond angles around oxygen.
  - ii. Lead oxide- **Useful property** – High refractive index.  
**Application** – High qualities art objects
  - iii. Cobalt – Blue  
Selenium – Red
- b.
  - i. Any oxide that readily forms glass on its own.  
 $B_2O_3$ ,  $GeO_2$ ,  $P_2O_5$
  - ii. Borosilicate withstand high temperatures as it contains the essential ingredient  $B_2O_3$ . It contains less alkali and is less prone to chemical attacks.
  - iii. Thermal expansion coefficient
- c.
  - i.  $3Ca_3(PO)_4 \cdot CaF_2 + 14 H_3PO_4 \rightarrow 10Ca(H_2PO_4)_2 + 2HF$
  - ii. Single super phosphate

- d. i. Mineral sands are loose aggregates of unlithified materials containing combinations of minerals with high specific gravity above 2.85.

Ilmenite, Rutile, Zircon

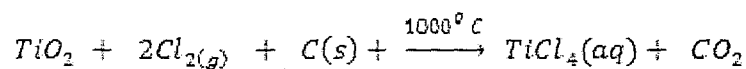
- ii. It is a continuous process.

It usually requires  $\text{TiO}_2$  content >90%

There are two main stages

- The conversion of rutile to Ti(IV) chloride
- The oxidation of Ti(IV) chloride

In the first stage Titanium ore is heated at  $1000^\circ\text{C}$  in a stream of chlorine gas in the presence of coke.



In the second stage purified  $\text{TiCl}_4$  is burnt with  $\text{O}_2$  gas at  $1000^\circ\text{C}$ .

