



KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER
SUPPLEMENTARY EXAMINATIONS
FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SPH 420

COURSE TITLE: THE CERAMICS

DATE:

3/02/2021

TIME:

8:00-10:00 AM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

KIBU observes ZERO tolerance to examination cheating

QUESTION ONE [30 MARKS]

- (a) Briefly explain the following ceramic structures giving an example in each case: perovskite, spinel and corundum. [6 marks]
- (b) State four main classes defects as applied to ceramics [4 marks]
- (c) State three factors that electrical properties of ceramics depend on. [3 marks]
- (d) State three properties of refractories. [3 marks]
- (e) Calculate the volume of iron oxide crystal hence compute its theoretical density if $n' = 4$, $A_{Fe} = 55.85g/mol$ and $A_O = 16.00g/mol$ [$r_{Fe^{2+}} = 0.077nm$, $r_{O^{2-}} = 0.140nm$ and $N_A = 6.023 \times 10^{23} atoms/mol$] [5 marks]
- (f) Calculate the fraction of atom sites that are vacant in a certain ceramic crystal at $327^\circ C$ if the energy for vacant formation is $0.55eV/atom$. [4 marks]
[$k = 8.62 \times 10^{-5} eV/K$]
- (g) A three point transverse bend test is applied on alumina cylinder with a reported flexural strength of $390MPa$. If the specimen radius is $2.5mm$ and a super point separation distance is $30mm$, estimate whether or not the specimen will fracture when a load of $620N$ is applied. [5 marks]

QUESTION TWO [20 MARKS]

- (a) Draw a well labelled phase diagram of a $SiO_2 - Al_2O_3$ system and outline its main features [20 marks]

QUESTION THREE [20 MARKS].

- (a) What is crystalline defect? [1 mark]
- (b) Briefly explain three causes of imperfection or defects in crystals [6 marks]
- (c) Briefly explain each of the following defects: Frenkel, Substitutional and Schottky. [9 marks]
- (d) Using Griffith's expressions for elastic and surface energies of a brittle material show that: $\sigma = \sqrt{2\gamma E / \pi c}$. [4 marks]

QUESTION FOUR [20 MARKS]

- (a) Briefly explain four characteristic features of clay [8 marks]
- (b) Explain the following fabrication techniques in clay products: hydroplastic, slip casting, drying, firing, powder pressing and tape casting. [12 marks]

QUESTION FIVE [20 MARKS]

- (a) Explain main features and applications of the following ceramics: boron carbide, graphite and fullerene. [8 marks]

(b) Classify ceramics in six broad classes and briefly comment on each of them [12 marks]