



# KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS  
2019/2020 ACADEMIC YEAR

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

COURSE CODE: SPH 425

COURSE TITLE: THERMODYNAMICS AND SELECTION OF  
MATERIALS

DATE: 5/2/21

TIME: 11-1 Pm

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## 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) compulsory**

- (a) State and briefly discuss the diffusion equation (3mks)
- (b) (i) Define the term crystal defect (1mk)  
(ii) Briefly describe the following point defects: Frenkel type; Schottky type and Impurity type (6mks)
- (c) Outline the application of Ellingham diagrams in the extractive metallurgy industry (2mks)
- (d) The solubility product constant of Lead (II) oxide is  $1.4 \times 10^{-8}$  at  $25^{\circ}\text{C}$ . Determine the  $\Delta G$  for the dissociation of Lead (II) oxide in water ( $R = 8.314\text{J/k.mol}$ ), hence or otherwise, comment on the dissociation of Lead (II) oxide at equilibrium. (5mks)
- (e) What do you understand by the term Ellingham diagram (1mk)
- (f) Discuss the following properties of metals:  
(i) Ductility/Formability (2mks)  
(ii) Weldability (2mks)  
(iii) Machinability (2mks)  
(iv) Tensile strength (2mks)
- (g) Discuss situations involving entropy changes (4mks)

**QUESTION TWO (20 marks)**

- (a) A spherical constant temperature heat source of radius,  $r_1$ , is at the centre of a uniform solid sphere of radius,  $r_2$ . Find out the rate which is proportional to heat transferred through the surface of the sphere. (8mks)
- (b) (i) Compute the possible increase in temperature of water going over Niagara Falls, 49.4m high ( $g = 9.81\text{ms}^{-2}$ , specific heat capacity of water,  $c = 4190\text{J/kg.k}$ ) (3mks)  
(ii) Briefly discuss a factor that would tend to prevent this possible rise (2mks)
- (c) Briefly describe vacancy crystallography (3mks)
- (d) Briefly discuss diffusion in semiconductors (4mks)

**QUESTION THREE (20 marks)**

- (a) Define the following terms: (3mks)
- (i) Sintering
  - (ii) Single-phase alloys
  - (iii) Multi-phase alloys
- (iii) Briefly discuss metal and ceramic sintering (6mks)
- (iv) Outline the procedure for ceramic sintering (5mks)
- (v) Discuss the advantages of powder technology (6mks)

**QUESTION FOUR (20 marks)**

- (a) Briefly discuss various corrosion control methods (12mks)
- (b) Discuss the following types of corrosion:
- (i) Pitting corrosion (4mks)
  - (ii) Crevice corrosion (4mks)