



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE OF
BACHELOR OF SCIENCE (CHEMISTRY) AND BACHELOR
OF INDUSTRIAL CHEMISTRY**

COURSE CODE: SCI 461E

**COURSE TITLE: GLASS, CERAMIC AND CEMENT
CHEMISTRY**

DATE: 26TH APRIL 2022

TIME: 8.00 - 10.00

INSTRUCTIONS TO CANDIDATES

Total Marks: 70

Answer all the Questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (19 Marks)

- (a) Define the following and state their role in glass making: (6 marks)
- (i) Annealing
 - (ii) Tempering
 - (iii) Culletts
- (b) Briefly discuss why some glass have the following properties:
- (i) Photochromic/photosensitive glass (3 marks)
 - (ii) Transparency (2 marks)
 - (iii) coloured (2 marks)
- (c) On the same graph, sketch the graph of a strong glass and a fragile glass state any three differences between the two (6 marks)

QUESTION TWO (17 Marks)

- (a) State the purposes of drying ceramic products before firing (2 marks)
- (b) State **two** main factors which affect the packing of ions in ionic solids (2 marks)
- (c) Define feldspar and state its role in ceramics (3 marks)
- (d) State **five** purposes of glazing in ceramics (5 marks)
- (e) Define the sintering process and briefly explain what occurs to the ceramic particles during this process (5 marks)

QUESTION THREE (17 Marks)

- (a) Define cement (2 marks)
- (b) Briefly describe the process of manufacturing white cement (4 marks)
- (c) State the role of the following ingredients in cement: (2 marks)
- (i) MgO
 - (ii) SiO₂
- (d) State two factors that influence heat of hydration in Portland cement (2 marks)
- (e) List four advantages of pozzolans (4 marks)
- (f) Briefly discuss the composition of acid resistant cement (3 marks)

QUESTION FOUR (18 Marks)

- (a) Define flint and its role in ceramics (2 marks)
- (b) A soda-lime glass has a viscosity of $10^{14.6}$ P at 560°C . Calculate its viscosity at 675°C if the activation energy for viscous flow is 430 kJ/mol (5 marks)
- (c) State three ways of preparing coloured glass (3 marks)
- (d) List four principle mineral compounds in Portland cement, their oxide formulae plus their respective symbols (4 marks)
- (e) Using Pauling's equation, calculate the percent covalent character of the following compounds: hafnium carbide, titanium carbide, tantalum carbide, boron carbide and silicon carbide, given: (4 marks)

Compound	Electronegativities	
	X_A	X_B
HfC	1.2	2.5
TiC	1.3	2.5
TaC	1.4	2.5
BC	2.0	2.5
SiC	1.8	2.5

Periodic Table of the Elements 2006

1 H 1.01																	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 15.99	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (270)	109 Mt (268)	110 Ds (291)	111 Rg (272)							

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	62 Pm (145)	63 Sm 150.36	64 Eu 151.97	65 Gd 157.25	66 Tb 158.93	67 Dy 162.50	68 Ho 164.93	69 Er 167.26	70 Tm 168.93	71 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	94 Np (237)	95 Pu (244)	96 Am (243)	97 Cm (247)	98 Bk (247)	99 Cf (251)	100 Es (252)	101 Fm (257)	102 Md (258)	103 No (259)	103 Lr (262)