



(University of Choice)

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

**MAIN CAMPUS**

**SUPPLEMENTARY/SPECIAL EXAMINATION**

**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 461 E**

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

**DATE: 04/08/2022**

**TIME: 8.00-10.00 AM**

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INSTRUCTIONS TO CANDIDATES

Total Marks: 70

Answer all the Questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

**QUESTION ONE (19 Marks)**

- (a) State the process of manufacturing ceramic ware using the wet process (6 marks)
- (b) Distinguish between traditional and engineering ceramic materials and give examples of each (4 marks)
- (c) Describe the vitrification process in ceramics (2 marks)
- (d) Briefly state what causes the lack of plasticity in crystalline ceramics (2 marks)
- (e) A soda-lime plate glass between 500 °C (strain point) and 700 °C (softening point) has viscosities between  $10^{14.2}$  and  $10^{7.5}$  P, respectively. Calculate a value for the activation energy in this temperature region. (5 marks)

**QUESTION TWO (16 Marks)**

- (a) Define a tempered glass and explain how it is produced (4 marks)
- (b) (i) State the basic composition of soda-lime glass (2 marks)  
(ii) State any **two** advantages and **two** disadvantages of soda-lime glass (4 marks)
- (c) List three basic components of traditional ceramics (3 marks)
- (d) State three major applications of ceramic products in industries (3 marks)

**QUESTION THREE (17 Marks)**

- (a) Write a brief account on setting and hardening of cement (4 marks)
- (b) Write Reactions involved in setting and hardening of cement for:
  - (i) dicalcium silicate (2 marks)
  - (ii) tricalcium aluminate (2 marks)
  - (iii) tetra calcium alumino ferrite (2 marks)
- (c) Explain why sintered alumina is widely used as a substrate for electronic-device applications (2 marks)
- (d) Explain how specific volume versus temperature plot for a glass differ from that for a crystalline material when these materials are cooled from the liquid state (5 marks)

**QUESTION FOUR (18 Marks)**

- (a) Explain how a glass is distinguished from other ceramic materials (2 marks)
- (b) Explain how cracking of ceramic articles is controlled (2 marks)
- (c) State any four properties of glasses that make them indispensable for many engineering designs (4 marks)
- (d) Briefly state what causes the lack of plasticity in crystalline ceramics (3 marks)
- (e) Define glass network modifiers and explain why they are added to silica glass (3 marks)
- (f) A soda-lime glass has a viscosity of  $10^{14.3}$  P at  $570^{\circ}\text{C}$ . Calculate the temperature at which its viscosity will be  $10^{9.9}$  P if the activation energy for the process is 430 kJ/mol (4 marks)

**Periodic Table of the Elements 2006**

H 1.01																	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	3	4	5	6	7	8	9	10	11	12	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 (281)	111 Rg (272)																																			
<table border="1"> <tbody> <tr> <td>58 Ce 140.12</td> <td>59 Pr 140.91</td> <td>60 Nd 144.24</td> <td>Pm (145)</td> <td>62 Sm 150.36</td> <td>63 Eu 151.97</td> <td>64 Gd 157.25</td> <td>65 Tb 158.93</td> <td>66 Dy 162.50</td> <td>67 Ho 164.93</td> <td>68 Er 167.26</td> <td>69 Tm 168.93</td> <td>70 Yb 173.04</td> <td>71 Lu 174.97</td> </tr> <tr> <td>90 Th 232.04</td> <td>91 Pa 231.04</td> <td>92 U 238.03</td> <td>Np (237)</td> <td>94 Pu (244)</td> <td>95 Am (243)</td> <td>96 Cm (247)</td> <td>97 Bk (247)</td> <td>98 Cf (251)</td> <td>99 Es (252)</td> <td>100 Fm (257)</td> <td>101 Md (258)</td> <td>102 No (259)</td> <td>103 Lr (262)</td> </tr> </tbody> </table>																		58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	Pm (145)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97	90 Th 232.04	91 Pa 231.04	92 U 238.03	Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)
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