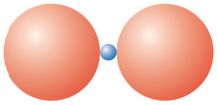
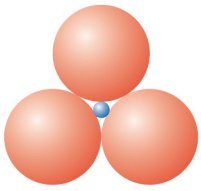
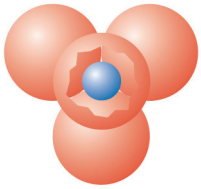
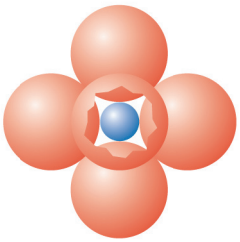
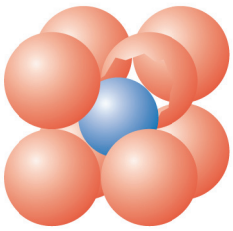
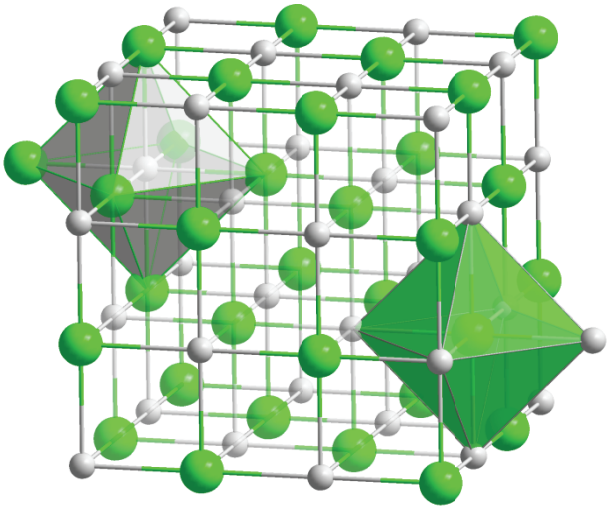
MSE250 - Homework 8 Textbook Figures. Tables and Questions (8th ed.)

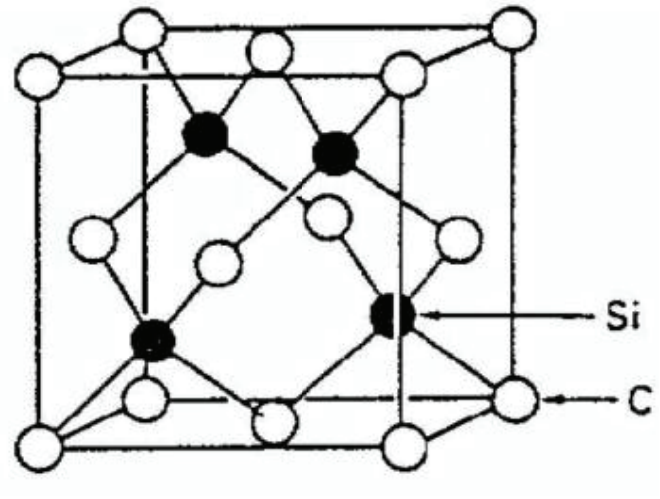
Table 12.2 Coordination Numbers and Geometries for Various Cation–Anion Radius Ratios (r_C/r_A)

Coordination Number	Cation–Anion Radius Ratio	Coordination Geometry
2	<0.155	
3	0.155–0.225	
4	0.225–0.414	
6	0.414–0.732	
8	0.732–1.0	

Source: W. D. Kingery, H. K. Bowen, and D. R. Uhlmann, Introduction to Ceramics, 2nd edition. Copyright © 1976 by John Wiley & Sons, New York. Reprinted by permission of John Wiley & Sons, Inc.



Magnesium oxide (magnesia)
MgO



Silicon carbide (silica)
SiC

12.47 The modulus of elasticity for beryllium oxide (BeO) having 5 vol% porosity is 310 GPa (45×10^6 psi).

(a) Compute the modulus of elasticity for the nonporous material.

(b) Compute the modulus of elasticity for 10 vol% porosity.

For Question 5:

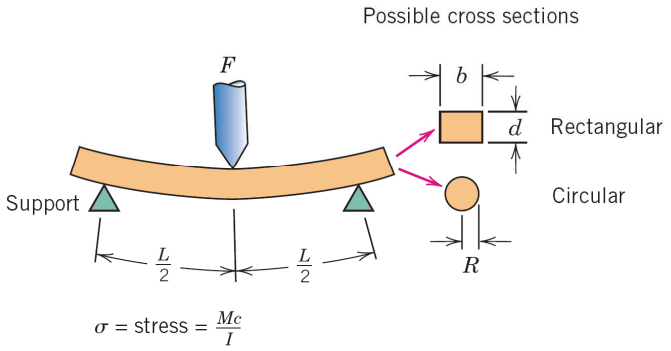


Figure 12.32 A three-point loading scheme for measuring the stress–strain behavior and flexural strength of brittle ceramics, including expressions for computing stress for rectangular and circular cross sections.

σ = stress = $\frac{Mc}{I}$

where M = maximum bending moment
c = distance from center of specimen to outer fibers
I = moment of inertia of cross section
F = applied load

	M	c	I	σ
Rectangular	$\frac{FL}{4}$	$\frac{d}{2}$	$\frac{bd^3}{12}$	$\frac{3FL}{2bd^2}$
Circular	$\frac{FL}{4}$	R	$\frac{\pi R^4}{4}$	$\frac{FL}{\pi R^3}$

$$\Delta y = \frac{FL^3}{48EI}$$

Table 12.5 Tabulation of Flexural Strength (Modulus of Rupture) and Modulus of Elasticity for Ten Common Ceramic Materials

	Flexural Strength		*Modulus of Elasticity*	
Material	***MPa***	***ksi***	***GPa***	***10^6 psi***
Silicon nitride (Si_3N_4)	250–1000	35–145	304	44
Zirconia[a] (ZrO_2)	800–1500	115–215	205	30
Silicon carbide (SiC)	100–820	15–120	345	50
Aluminum oxide (Al_2O_3)	275–700	40–100	393	57
Glass-ceramic (Pyroceram)	247	36	120	17
Mullite ($3Al_2O_3$–$2SiO_2$)	185	27	145	21
Spinel ($MgAl_2O_4$)	110–245	16–35.5	260	38
Magnesium oxide (MgO)	105[b]	15[b]	225	33
Fused silica (SiO_2)	110	16	73	11
Soda-lime glass	69	10	69	10

[a] Partially stabilized with 3 mol% Y_2O_3.

[b] Sintered and containing approximately 5% porosity.

13.17 In your own words, briefly describe what happens as a glass piece is thermally tempered.