Composite midterm 025/026 1ˢᵗ semester

1) It is necessary to select a ceramic material to be stressed using a three-point loading scheme. The specimen must have a circular cross section and a radius of 2.8 mm, and must not experience fracture or a deflection of more than 6.2×10^{-2} mm at its center when a load of 400 N is applied. If the distance between support points is 50 mm, which of the materials in the table below are candidates? The magnitude of the centerpoint deflection may be computed using the equation $\Delta y = FL^3 / 48\,EI$

Material	Flexural Strength		Modulus of Elasticity	
	MPa	ksi	GPa	10^6 psi
Silicon nitride (Si$_3$N$_4$)	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$_2$O$_3$)	275–700	40–100	393	57
Glass-ceramic (Pyroceram)	247	36	120	17
Mullite (3Al$_2$O$_3$-2SiO$_2$)	185	27	145	21
Spinel (MgAl$_2$O$_4$)	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

2) Find the shape factor for a cylindrical part with a height-to-diameter ratio 3:1.

3) Explain why surface films are considered a problem in powder metallurgy.

4) Explain the glass's extremely flat surface.

5) In the silica-alumina phase, adding a small amount of alumina affects the high-temperature probabilities of the silica.

6) Explain the liquid phase sintering and give an example.