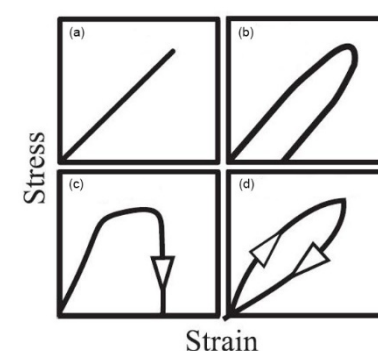


(A) True or false question (15%)

- () The activation energies of viscous flow are high at low temperatures and low at high temperatures.
- () DMA works by applying a constant deformation to a sample of known geometry.
- () Glass strength is mainly determined by its composition.
- () The crack front moves faster in regions of higher compression
- () The refractive index of optical glass changes with the temperature.

(B) Select the correct answer from the list (60%)

- In the glass softening range, which of the following method is not commonly used? (a) Fiber elongation viscometers (b) Falling sphere (c) Beam-bending viscometers (d) Parallel plate viscometer (e) Ball penetration viscometer
- The sample is not easy to prepare in which of the following methods? (a) Beam-bending viscometers (b) Rotating spindle viscometers (c) Fiber elongation viscometers (d) Parallel plate viscometer (e) Ball penetration viscometer
- The Littleton softening point is defined by the temperature when the rate of extension of the lower end of a fiber is (a) 1 cm/min (b) 1 mm/min (c) 0.1 mm/min (d) 1 cm/s (e) 1 mm/s
- In the beam-bending method, a small beam of known cross sectional area is placed in a (a) 2-point bending (b) 3-point bending (c) 4-point bending (d) ring on ring bending (e) ball on ring configuration
- The Vogel-Fulcher-Tamman equation provides a good fit to viscosity data at (a) extremely low (b) low (c) intermediate (d) high (e) extremely high temperature.
- In the right figure, which is the stress-strain curve illustrating a viscoelastic behavior? (a) a (b) b (c) c (d) d (e) none of the above
- Which of the following glass has the highest strength? (a) window glass (b) blown glass (c) drawn glass fibers (d) pressed glass (e) sandblasted glass
- Which of the following is not true? (a) Glass strength decreases with increasing number of grit sandpapers (b) Tensile strength is time-dependent and stress rate dependent (c) Increasing the stress rate results in an increase of strength (d) Glass strength decreases with increasing stressed area (e) none of the above
- Glass strength is usually measured in which kind of forces? (a) tensile force (b) compressive force (c) shear force (d) bending force (e) torsion force
- Which of the following does not measure the strength of the edges of glass? (a) two-point flexural test (b) three-point flexural test (c) four-point flexural test (d) ring on ring test (e) tensile test
- The stiffness typically decreases with increasing temperature. However, which of the following is an exception? (a) fused silica (b) aluminosilicate glass (c) soda lime glass (d) borosilicate glass (e) lead glass
- Which of the following is not a brittle feature? (a) No plastic deformation (b) Low critical strain (c) High crack growth speed (d) Stress concentration is strong (e) High fracture toughness
- Which of the following about Poisson's ratio is not true? (a) $\nu_{\text{diamond}} < \nu_{\text{bcc}} < \nu_{\text{fcc, hcp}}$ (b) For a given crystalline structure and valence, Poisson's ratio mostly increases with atomic number (Z). (c) High melting points favor low Poisson's ratio in IIA group. (d) $\nu_{0d} < \nu_{1d} < \nu_{2d} < \nu_{3d}$ (e) none of the above
- Which of the following is not commonly used to determine glass hardness? (a) Brinell hardness test (b) Vickers hardness test (c) Knoop hardness test (d) Mohs scale (e) none of the above
- The crack accelerates from near zero velocity to terminal velocity within the (a) fracture origin (b) mirror (c) mist (d) hackle (e) scarp region
- (a) Beer's Law (b) Brewster's law (c) Snell's law (d) Fresnel equation (e) Malus law quantitatively defines the amount of bending of waves dependent on the refractive index of the two media.
- What is an athermal glasses? (a) positive dn/dT , nearly zero ds/dT (b) negative dn/dT , nearly zero ds/dT (c) positive dn/dT , positive ds/dT (d) nearly zero dn/dT , negative ds/dT (e) negative dn/dT , positive ds/dT
- Which of the following about crown glasses is not true? (a) low refractive index (b) low dispersion (c) positively powered element (d) low Abbe number (e) soda-lime silicate is an example
- The larger the dispersive power, (a) the smaller is the spread D of the two reference lines (C and F). (b) the larger is the deviation angle δ of the standard line (D) from the original ray direction. (c) the smaller the Abbe Number. (d) the amount of color shift between red and blue focus decreases. (e) none of the above
- The absorption of glass is not related to (a) glass thickness (b) glass transition temperature (c) surface roughness (d) wavelength of light (e) glass composition

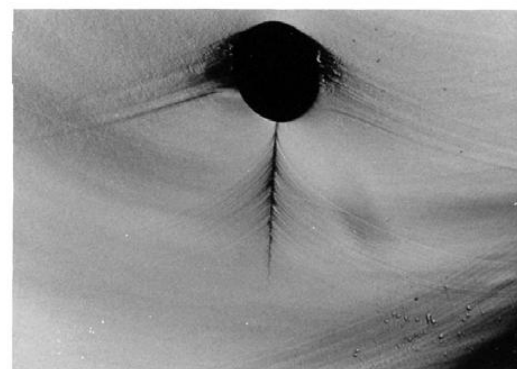
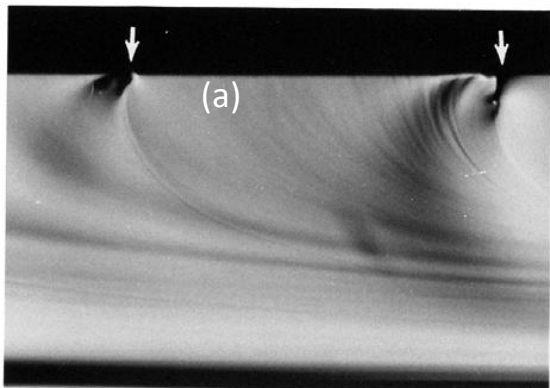


(C) Answer the following questions (50%)

26. What is the difference between Littleton softening point and dilatometric softening point? What method will you use to obtain the two points? (10%)

27. Three-point and four-point bending tests were carried out on samples of silicon carbide, and the median values of the flexural strength were 350 and 300 MPa, respectively. A tensile test was also carried out using a sample of identical material and dimensions, but loaded in tension along its length. The median value of the tensile strength was only 230 MPa. Explain why there is a difference between the three measures of strength. (10%)

28. Please explain the formation of primary Wallner lines from the figures shown below. What is the propagation direction in the two figures? (10%)



29. Describe total internal reflection. How is it applied to the measurement of refractive index of glass? Give one example. (10%)

30. What is an achromatic doublet? Explain why a large Abbe number separation ($\nu_1 - \nu_2$) between crown and flint glasses is favored for optical design. (10%)