1. An ice sheet with thickness h is moving with velocity U against a vertical and flat structure with width D.

    a. The ice will experience different failure modes. Name the 6 failure modes indicated with letters in the enclosed drawing. (3p)

    b. The crushing failure depends strongly on the loading velocity. Compare the ice failure process and ice-structure contact in cases with high and low loading velocity. (3p)
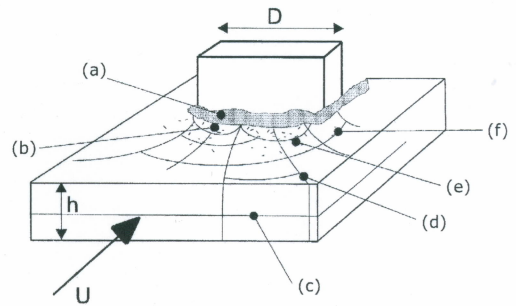
2. The compressive strength of columnar grained sea ice σ_c is one of the important engineering properties of ice. The value of σ_c depends on many parameters. Describe how the parameters listed below effect the compressive strength of ice. Graphs may help to explain the phenomena.

    a. Strain rate (3p)

    b. Loading direction (1p)

    c. Temperature (1p)

    d. Porosity (1p)

3. The structure of sea ice is shown in the drawing on the right. Explain the formation and structure of the Transition Zone and the Columnar Zone. (6p)
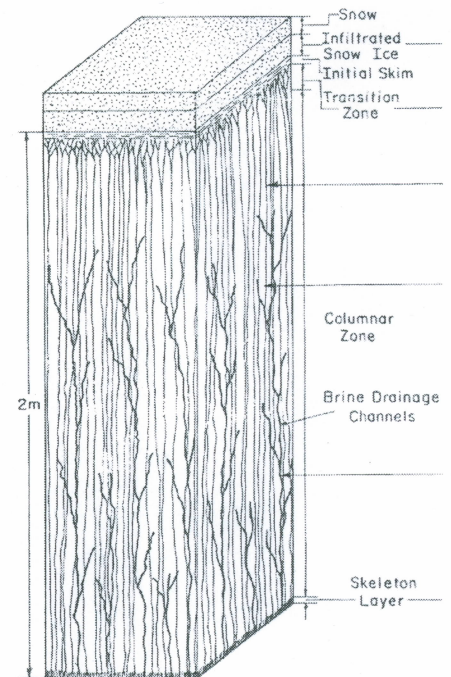
4. Explain the terms below.

    a. Multi-year ice (1p)

    b. Pancake ice (1p)

    c. Pack ice (1p)

    d. Growler (1p)

    e. Stamukha (1p)

    f. Rafting (1p)