GEORGIA INSTITUTE OF TECHNOLOGY

The George W. Woodruff
School of Mechanical Engineering

Ph.D. Qualifiers Exam - Fall Quarter 1995

TRIBOLOGY (TR)

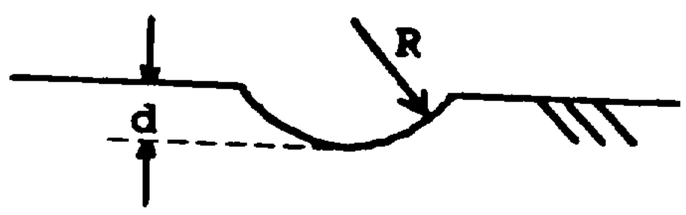
EXAM AREA

Assigned Number **(DO NOT SIGN YOUR NAME)**

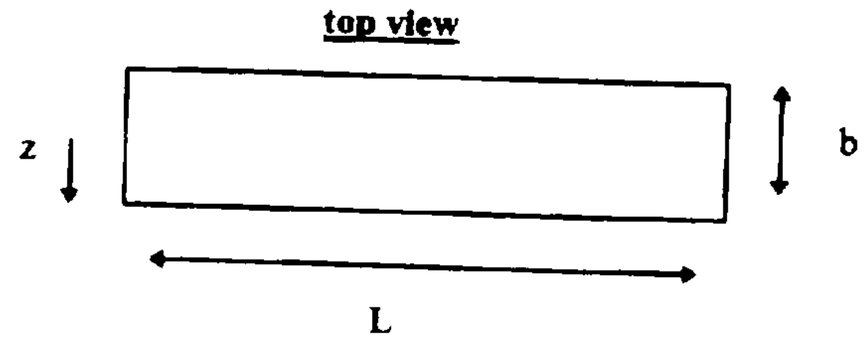
-- Please sign your name on the back of this page --

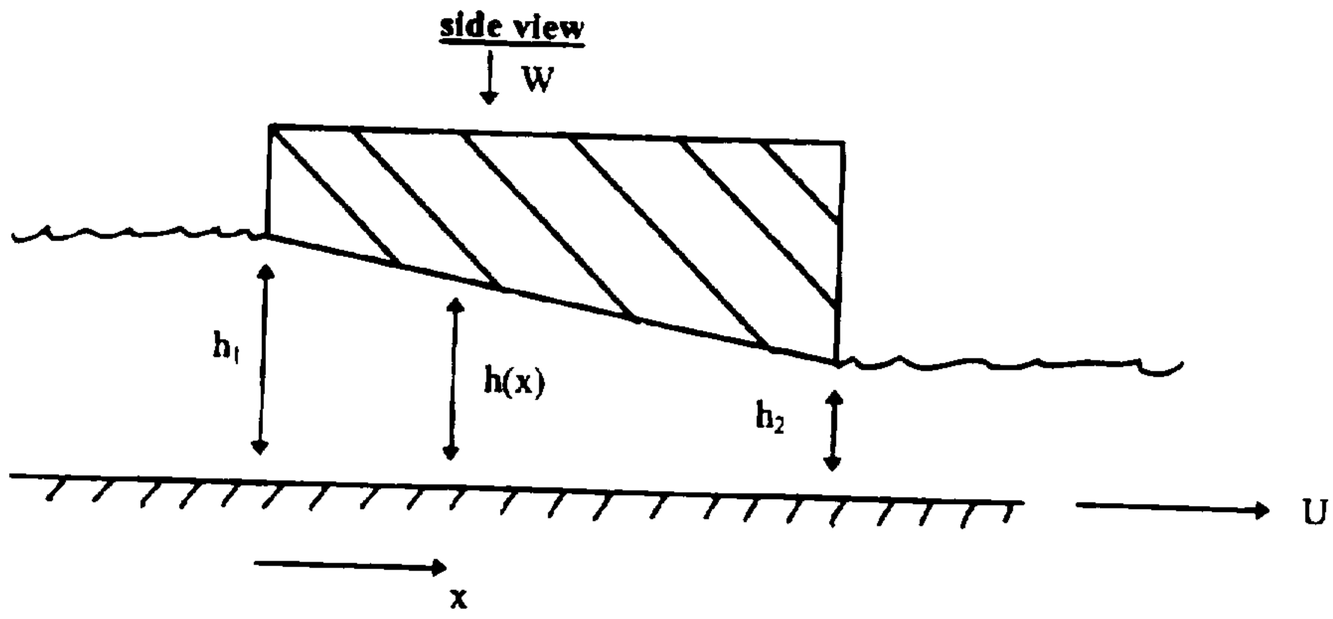
Problem 1

In a pin-on-flat wear test, a hemispherical capped pin of 1 mm radius slides against the flat in a 20 cm stroke, at constant velocity of 10 cm/sec. The flat and pin have a hardness of H = 750 MPa, under a load, W, of 12 N. It is found that after 5,000 cycles a wear track is formed which has a maximum depth, d, of 0.06 mm and whose cross section forms a section of a circle. Assuming that the radius of curvature, R, of the wear track is 1 mm, estimate the wear coefficient, K, of Archards Wear Eqn. State any assumptions you feel you need to make.



Problem 2

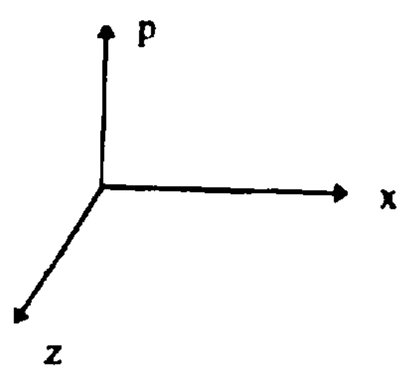




Consider the slider bearing, shown above. The width b is very small compared to length L, so the narrow bearing approximation can be used. Note that the slope of the lower slider surface, $\frac{dh}{dx} = h'$, is a constant.

Starting from the Reynolds equation, find the pressure distribution under the slider as a function of the significant parameters of the problem.

Qualitatively, draw the pressure distribution



Find an expression for the load W supported by the bearing. You may leave your answer in terms of the integral $\int_0^L \frac{dx}{h^3}$.

Problem 3

Three types of bearings are described in the figure: (a) a deep groove ball bearing, (b) self aligning ball bearing, and (c) a roller bearing. All bearing parts are made of steel. The inner and outer race radii for all three cases are 18.2 mm and 27.7 mm, respectively. The rolling element is either a ball of 9.5 mm in diameter, or a roller of 9.5 mm in diameter and 9.5 mm in length. Based on Hertzian theory classify the three bearings from best to worst for the purpose of carrying a given radial load.

After the written exam, think about how you would make quantitative computations to support your answer to the above question.