ME 340 LAB #2 - YIELD CRITERIA/FAILURE THEORIES January 7, 1999 WINTER 1999

NAMES:_

- ✓ Work in groups of 2-3 people.
- ✓ Put names in alphabetical order.
- ✓ Work in pencil.
- ✓ Points will be deducted for sloppy work.
- \checkmark Work must be turned in at the end of the period.

A certain 2WD Nissan pickup truck uses the front wheel bearing, spindle, and steering knuckle shown in the figure below (left-hand side shown). The spindle/steering knuckle is 4130 steel quenched and tempered at 400 °F. For the purposes of this exercise, consider the spindle (shaft part that carries the bearings) to be a solid bar of 30mm in diameter with 100mm between the inner and outer tapered roller bearings. The truck also has expensive alloy wheels with zero offset (i.e. the tire tread is centered over the two bearings) and Pirelli PZero P235 40 R17 tires. Loads are generated on the spindle due to the weight of the truck, cornering forces, braking forces and other suspension reactions. Consider the following loads when answering the questions below: weight of the truck, -0.3g braking acceleration, and 0.4g lateral acceleration due to a right hand turn. Assume all vehicle loads are evenly distributed over all four wheels. The truck has a mass of 1225kg.

- (2pts) Draw a free body diagram for the spindle.
- (3pts) Draw shear and bending moment diagrams for the spindle in both planes.
- (1pt) Calculate the maximum shear stress in the spindle.
- (1pt) Identify the critical point on the spindle for this loading, i.e.: its location.
- (1pt) Calculate all stresses and the VonMises equivalent stress at the critical point.
- (1pt) Calculate the factor of safety in yield for the spindle.

