Problem Set 1   **Calculus 2**   **Due 9/14/09**

You are encouraged to work in groups of two to four on this assignment and make a single group submission. Each problem is worth 5 points. For full credit indicate clearly how you reached your answers. All work must be legible and submitted on clean paper without ragged edges.

1. [Inspired by Judith V. Grabiner's "'Some Disputes of Consequence': Maclaurin among the Molasses Barrels," from *Social Studies of Science* 28/1 (February 1998) 139-68] In 1735 the great British mathematician Colin Maclaurin "wrote a 94-page memoir to the Scottish Excise Commission, explaining how to gauge, with a single dip of a dipstick, the amount of molasses in the barrels in the Port of Glasgow." [p. 139] In this treatise he proved several surprising theorems to the general effect that the difference between the frustum of the solid produced by revolving a conic section around one of its axes and an approximating cylinder matching the radius at the midpoint of the frustum depends only on the height of the frustum. In particular, he proved that for a paraboloid of revolution the volume of the frustum is the same as the volume of the cylinder. Express the volume of a frustum of a paraboloid as a solid of revolution and show why this is true.

2. Maclaurin also showed that the difference between a frustum of a right circular cone and the corresponding cylinder is one-fourth the volume of a similar cone, with the same height as the frustum and with diameter one-half the difference between the upper and lower diameters of the frustum. Express the volume of a frustum of a right circular cone as a solid of revolution and show why this is true.