1. Volleyball (8 points)

Consider a simplified model of a volleyball: a thin spherical envelope filled with air. The envelope material is non-stretchable, easily foldable. The excess pressure inside the ball $\Delta p = 20\,\text{kPa}$, the ball radius $R = 10\,\text{cm}$ and mass $m = 400\,\text{g}$ (the air mass inside the ball is negligible). You can neglect the dependence of the excess pressure on the deformation of the ball.

1) The ball is pressed between two parallel rigid plates, the distance between of which is $2R - 2h$ (so that the height of the deformed segments is $h = 1\,\text{cm}$). Find the force between the ball and a plate N.

2) Ball moves with velocity $v_0 = 2\,\text{m/s}$ and hits a rigid wall. Find the maximal height of the deformed segment $h_m \ldots$

3) …and the collision time τ.

4) For small excess pressures, the ball can lose its spherical shape even in those points, which are not in touch with the wall. Which condition between the quantities Δp, R, m and h has to be satisfied in order to ensure that such a loss of sphericity is negligible?