Name: ______________________________

Date: ______________________________

Collaborators: ____

(Collaborators submit their individually written assignments together)

Question:	1	2	3	4	Total
Points:	15	15	15	25	70
Score:					

Instructor/grader comments:

1. (15 points) I've watched the video recording of the R. Feynman's lecture assigned as a part of the homework.

   Sign and date here: ____________________

2. (15 points) Calculate the strain tensor for the displacement field

$$\vec{\mathbf{u}} = (Ax_1 + Cx_2, Cx_1 - Bx_2, 0),$$

   where A, B, C are (small) constants. Under what conditions the volume is unchanged?

3. (15 points) A displacement field is given by

$$\begin{aligned} u_1 &= \alpha(x_1 + 2x_2) + \beta x_1^2 \\ u_2 &= \alpha(x_2 + 2x_3) + \beta x_2^2 \\ u_3 &= \alpha(x_3 + 2x_1) + \beta x_3^2. \end{aligned}$$

   where α and β are small. Calculate the strain tensor.

4. An (fictional) elevator to the center of the Earth can be created if it becomes technically feasible to dig a tunnel and lower a line to the Earth center. Assume that (i) the line is unstretchable and has constant cross-section A and constant density ρ, (ii) the Earth is an ideal uniform sphere. Assume that you know the radius of the Earth R and the acceleration of the gravity at the surface of the Earth g. Neglect the influence by the Earth rotation.

   (a) (15 points) Calculate tension in the line, $\sigma(r)$. Find the maximal tension.

   (b) (10 points) Estimate the numerical value of the ratio of maximal tension to line's density. Compare with the tensile strength (breaking tension) for steel: $\sigma_t \approx 4 \times 10^6$ Pa, $\rho \approx 8 \times 10^3$ kg/m^3.