# PHYS 301
# HOMEWORK #8

## Due : Friday 6 April 2017

1. Starting from the equation describing the element of length :

$$d\mathbf{l} = h_i \, dq_i \, \hat{\mathbf{q}}_i \tag{1}$$

where d**l** (also written as d**s**) is the element of length, h represent the scale factors and q represents the spatial coordinates,

a) write d**l** in cylindrical polar coordinates

b) for the specific case of a cone defined by

$$z^2 = x^2 + y^2$$

show that the scalar element of length can be written as

$$ds = \sqrt{2 + z^2 (\phi'(z))^2}$$

2. Do parts a), b) and c) for problem 14.27 from Felder and Felder (the online chapter on Calculus of Variations). This will complete the proof of why Euler - Lagrange works.

3. Start with eq. (1) from above and show that ds on the surface of a sphere of radius r is given by eq. (6.41) in Marion/Thornton.

4. Problem 14.51 from Felder and Felder.

5. Problem 14.52 from Felder and Felder.

6. Problem 14.53 from (oh, guess). You may use Mathematica' s DSolve function to solve the resulting ODE, but do the ODEs in the other problems by hand.