Exercise 16.

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$$u = \sum_k c_k \psi_k$$

Using that we need to show

$$\frac{\partial}{\partial c_j} ||\nabla u||^q = q||\nabla u||^{q-2} \nabla u \cdot \nabla \psi_j \tag{1}$$

Where I have assumed there's a typo and the exercise means c_j and not u_j

$$\frac{\partial}{\partial c_j} ||\nabla u||^q = \sum_k c_k ||\nabla||^q \psi_k = q||\nabla u||^{q-2} \nabla u \cdot \nabla \psi_j$$

I did not get the time to finish this and the other two exercises unfortunately.