AMSC/CMSC 661 Quiz 4 , Spring 2010

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no calculators, cellphones, or any other electronic devices, and don't communicate with other students. You may use the Larsson&Thomèe textbook, anything taken from the course website, and your own notes.

Name ____

1. Consider solving the equation

$$- \nabla \cdot \nabla u = f$$

in Ω, with $u = 0$ on the boundary of Ω, using piecewise linear finite elements, which gives us a linear system of equations $\mathbf{AU} = \mathbf{g}$. The domain Ω (see figure) has been divided into 26 triangles.

Let P be the point where triangles 3 and 7 intersect, and let Q be the point where triangles 14 and 20 intersect.

Let ϕ_P be the basis function that is 1 at P, and let ϕ_Q be the basis function that is 1 at Q.

a. (3) What is the dimension of the matrix $\mathbf{A}$?

b. (3) One of the matrix entries is equal to $a(\phi_P, \phi_Q)$. Which triangles are used in computing this entry?

c. (3) How many nonzeros are in the row of the matrix corresponding to the equation $a(u_h, \phi_P) = (f, \phi_P)$?

d. (3) How many triangles are used in computing (f, ϕ_P)?

2. (8) Draw an inadmissible triangulation of the unit square and explain what makes it inadmissible.