

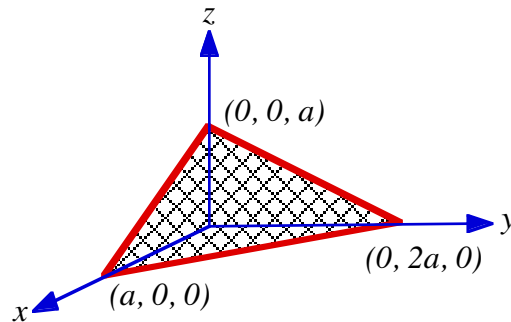
**Midterm Exam # 1, Physics 217**  
**October 17, 2001, 8.30 am – 9.50 am**

**Problem 1 (35 points)**

Check Stoke's theorem for the vector function

$$\vec{v}(x,y,z) = y \hat{k}$$

using the triangular surface shown in Figure 1. Express all your answers in terms of  $a$ .



**Figure 1. Problem 1.**

**Problem 2 (30 points)**

A spherical shell of radius  $R$  has a uniform surface charge density. The total charge on the shell is  $q$ . Find the electrostatic energy of this system in two different ways. Express all your answers in terms of  $q$  and  $R$ .

**Problem 3 (35 points)**

Consider the following three vector functions:

(1)  $\vec{E}_1(x,y,z) = \alpha[(y^2) \hat{i} + (2xy + z^2) \hat{j} + (2yz) \hat{k}]$

(2)  $\vec{E}_2(x,y,z) = \alpha[(y^2) \hat{i} + (2xy + z^2) \hat{j} - (2yz) \hat{k}]$

$$(3) \vec{E}_3(x, y, z) = \alpha \left[ (xy)^2 \hat{i} + (2yz) \hat{j} + (3xz) \hat{k} \right]$$

where  $\alpha$  is a constant with the appropriate units.

- a) Which of these three vector functions can describe an electrostatic field?
  - b) For the vector function of part a) that can describe an electrostatic field find the corresponding electrostatic potential at point  $P(x, y, z)$ , using the origin as your reference point.
  - c) Find the charge distribution that produces the electrostatic potential obtained in part b).
- Express all your answers in terms of  $\alpha$ ,  $x$ ,  $y$ , and  $z$ .