Math 317, Homework #5, due Wednesday, Feb. 29

(1) Section 17.3, #6
(2) Section 17.3, #8
(3) Section 17.3, #16
(4) Let $C$ be the upper half of the ellipse $4x^2 + y^2 = 4 \; (y \geq 0)$ oriented counter-clockwise. Compute $\int_C \mathbf{F} \cdot d\mathbf{s}$ for each of the following vector fields:
   (a) $\mathbf{F}(x, y) = (e^x \sin y + 2y, e^x \cos y + 2x - 2y)$
   (b) $\mathbf{F}(x, y) = (e^x \sin y + 3y, e^x \cos y + 2x - 2y)$
(5) Section 17.3, #29, 30, 31, 32
(6) Describe each of the following sets in English and determine which are simply connected.
   (a) $\{(x, y, z) : 4x^2 + 9y^2 + 25z^2 < 2\}$
   (b) $\{(x, y, z) : 4x^2 + 9y^2 + 25z^2 > 2\}$
   (c) $\{(x, y, z) : x^2 + y^2 \neq 1\}$
   (d) $\{(x, y, z) : x^2 + y^2 \neq 1 \text{ or } z \neq 0\}$
(7) For the vector field:
   $$\mathbf{F}(x, y) = \left(\frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2}\right),$$
evaluate $\int_C \mathbf{F} \cdot d\mathbf{s}$, where
   (a) $C$ is the ellipse
   $$\frac{x^2}{16} + \frac{(y - 4)^2}{9} = 1,$$
   oriented in the counter-clockwise direction.
   **Hint:** Recall we looked at this vector field in class.
   (b) $C$ is the circle of radius $\epsilon$ centred at the origin, oriented in the counter-clockwise direction.