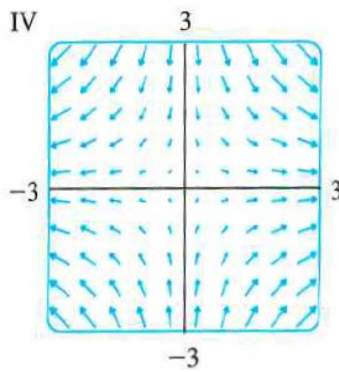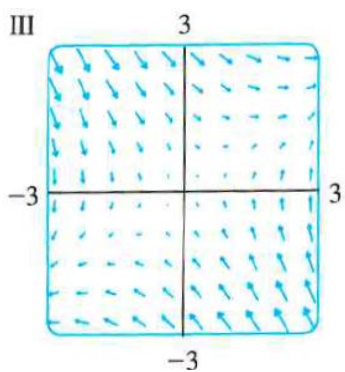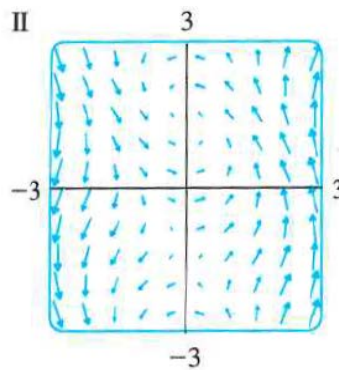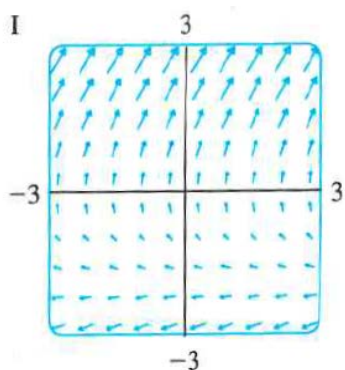# MA 213 Worksheet #19
Section 16.1

1 *16.1.11-14* Match the vector fields, **F**, with the plots below. Give reasons for your choices.

(a) $\mathbf{F}(x, y) = \langle x, -y \rangle$

(b) $\mathbf{F}(x, y) = \langle y, x - y \rangle$

(c) $\mathbf{F}(x, y) = \langle y, y + 2 \rangle$

(d) $\mathbf{F}(x, y) = \langle \cos(x + y), x \rangle$

2 *16.1.23* Find the gradient vector field of $f(x, y, z) = \sqrt{x^2 + y^2 + z^2}$

3 *16.1.25* Let $f(x, y) = \frac{1}{2}(x - y)^2$. Find the gradient vector field, ∇f, of f and sketch it.

4 *16.1.33* A particle moves in a velocity field $\mathbf{V}(x, y) = \langle x^2, x + y^2 \rangle$. If it is at position $(2, 1)$ and time $t = 3$, estimate its location at time $t = 3.01$.
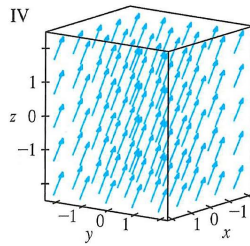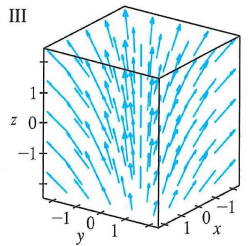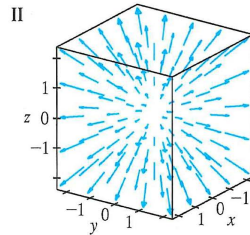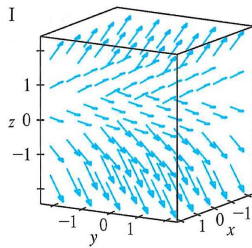
5 *16.1.15-18* Match the vector fields, **F**, with the plots below. Give reasons for your choices.

    (a) $\mathbf{F}(x, y, z) = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$

    (b) $\mathbf{F}(x, y, z) = \mathbf{i} + 2\mathbf{j} + z\mathbf{k}$

    (c) $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + 3\mathbf{k}$

    (d) $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$

6 *16.1.29-32* Match the functions, f, with the plots of their gradient vector fields below. Give reasons for your choices.

    (a) $f(x, y) = x^2 + y^2$

    (b) $f(x, y) = x(x + y)$

    (c) $f(x, y) = (x + y)^2$

    (d) $f(x, y) = \sin \sqrt{x^2 + y^2}$

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