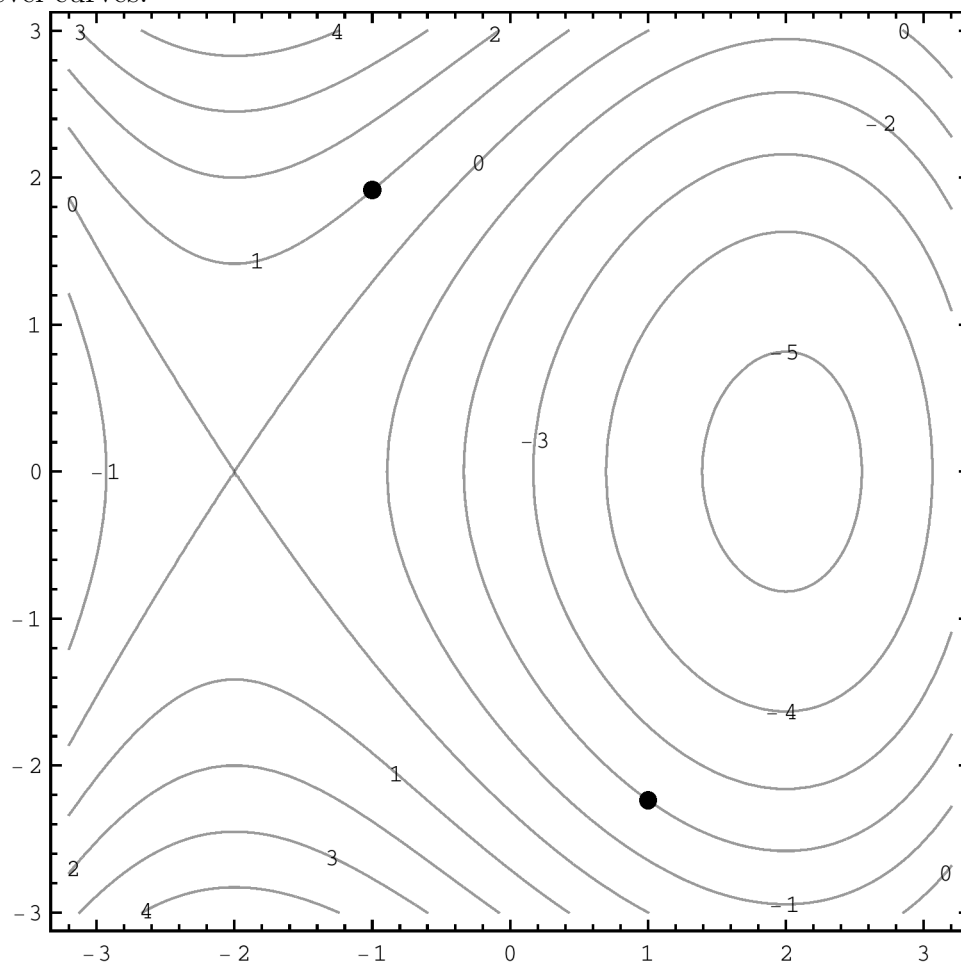**Math 241 X8**   **Name:**

Quiz # 3

September 24, 2013   No electronic devices or interpersonal communication allowed. Show work to get credit.

Let $f(x,y) = \frac{1}{2}y^2 + \frac{1}{6}x^3 - 2x - \frac{8}{3}$. A contour map for f is shown below, with integer-valued level curves.

1) [4pts.] At each of the two points shown, sketch in the gradient vector of f with its tail at that point.

2) [5pts.] Mark the (approximate) locations of the critical points of f. Classify them (as local max/min/saddle). How do you know?

3) [8pts.] Let $f(x, y) = 3x + 4y$. Find the maximum and minimum values of f on the region $x^2 + 2y^2 \leq 17$.

3) A closed curve in the plane is parametrized by $\langle x(t), y(t) \rangle$ and is traced out counterclockwise as t advances from 0 to 8. In terms of $x(t)$ and $y(t)$, find each of the following for each t (i.e., as functions of t):

(a) [2pts.] a tangent vector to the curve;

(b) [4pts.] a unit tangent vector to the curve;

(c) [4pts.] an outward-pointing normal vector to the curve.

(The curve is "nice enough": no self-intersections, continuous, no corners, etc. "Closed" means it starts and ends at the same point.)