

NAME: _____

Math 370

Take-Home Quiz #3

Due Monday 4/3

This quiz should take you approximately 25 minutes. You can use your calculator, your book, and your notes, but do not work together and do not get help.

(10 pts) 1. Let $F(x, y, z) = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$, let $\varphi(x, y, z) = x + y + z$, and let $r(t) = (t, t, t)$. For each part, decide if the quantity is vector or scalar valued. You DO NOT need to compute each part.

a. $\operatorname{div} F$

b. $\nabla\varphi$

c. $\frac{\partial\varphi}{\partial x}$

d. φF

e. $\varphi(r(t))$

f. $F(r(t))$

g. $\operatorname{curl} F$

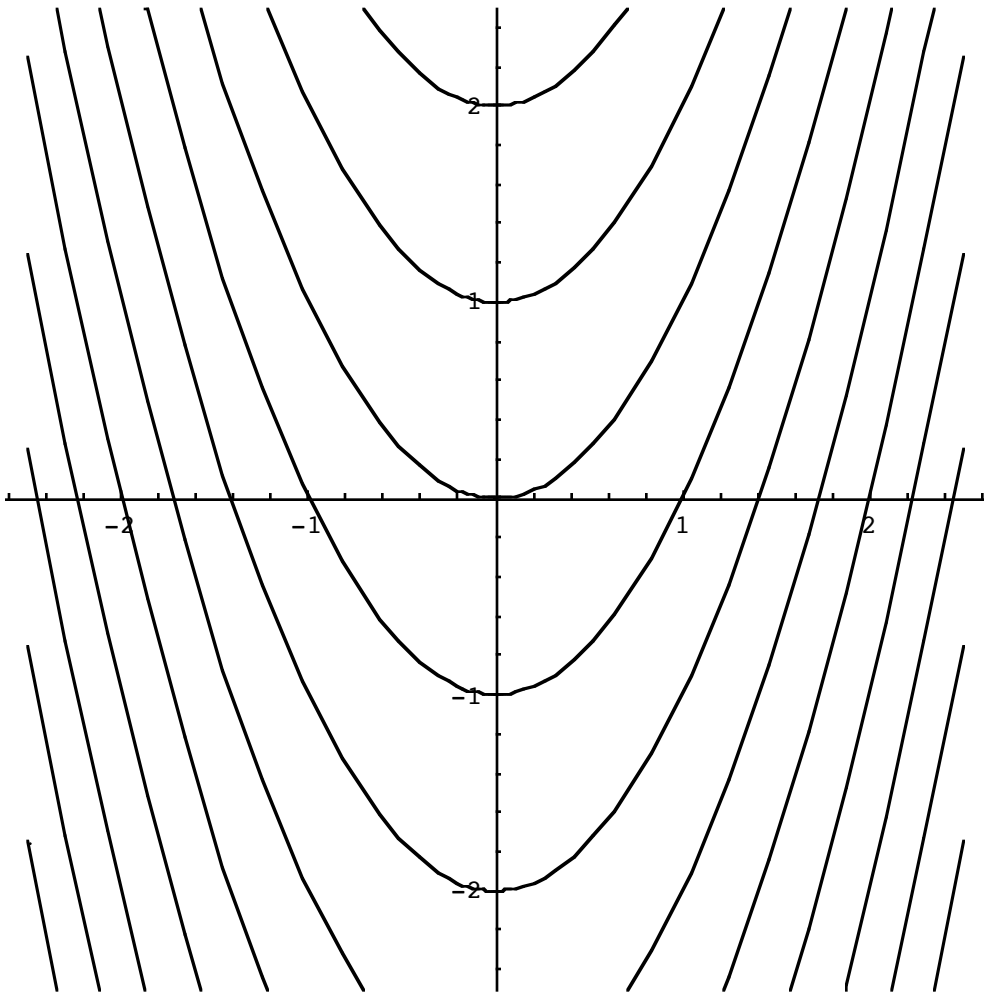
h. $F \cdot F$

i. $r'(t)$

j. $\int_C F \cdot dr$

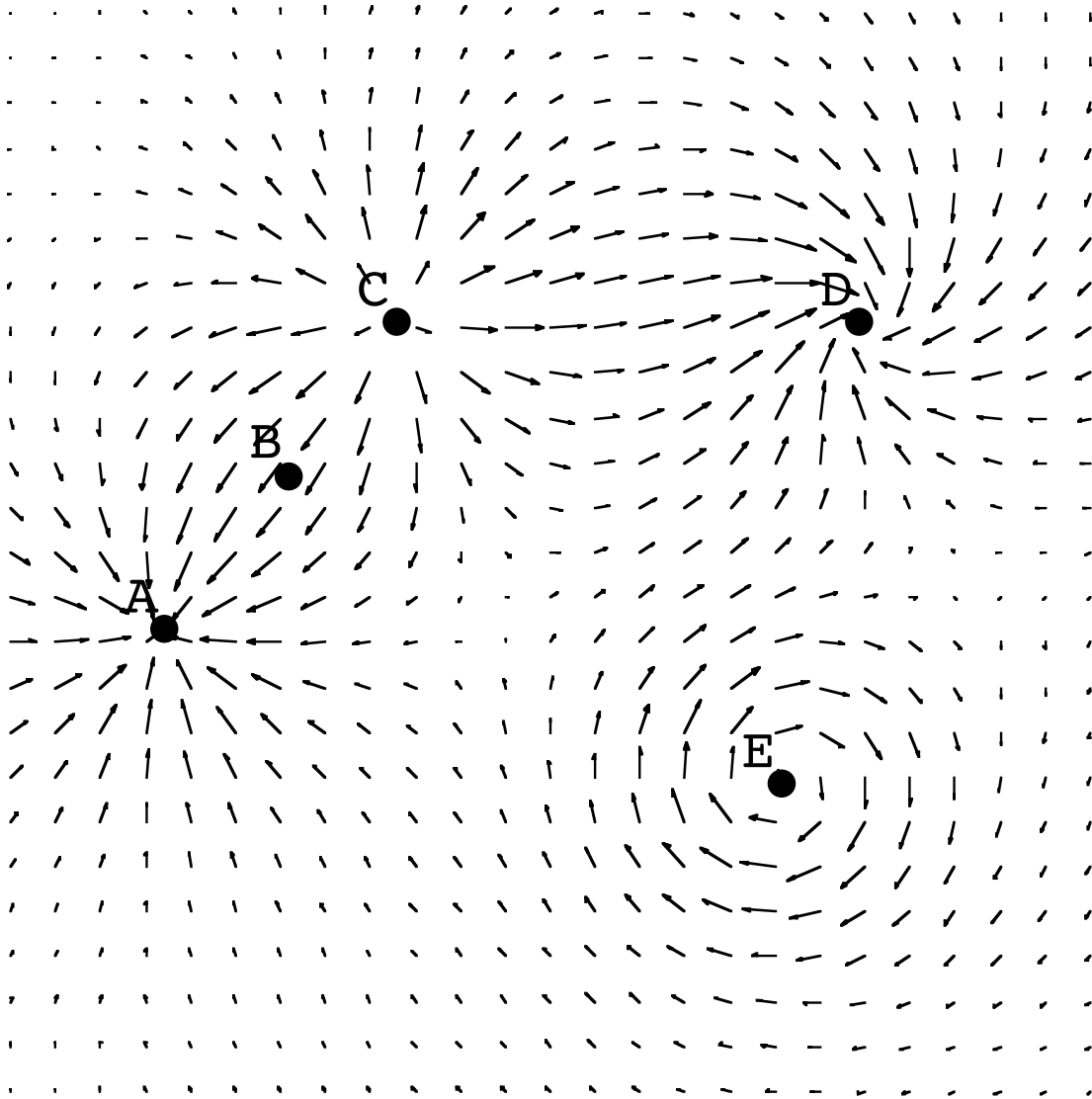
(10 pts) 2. Compute the directional derivative of $\varphi(x, y, z) = x^2y + 2z$ in the direction $\mathbf{i} + \mathbf{j} - \mathbf{k}$ at the point $(3, 0, 3)$.

- (10 pts) 3. Level curves for $f(x,y) = x^2 - y$ are shown below. On the same picture, sketch the vector field $\mathbf{v} = \nabla f$. Show at least a dozen vectors.



- (10 pts) 4. Let C be the arc of the helix $r(t) = (\cos(t), \sin(t), t)$ with $0 \leq t \leq 2\pi$.
Let $F(x, y, z) = x\mathbf{i} + y\mathbf{j} - \mathbf{k}$. Compute the line integral $\int_C \mathbf{F} \cdot d\mathbf{r}$

(10 pts) 5. Consider the vector field F shown below:



a. Answer for each of the five labeled points: is $\text{div } F$ positive, negative or zero?

b. Answer for each of the five labeled points: is $\text{curl } F$ zero or not?