Fundamental Theorem of Line Integrals

1. (a) Show that $\mathbf{F}(x, y) = x^2\mathbf{i} + (y^2 + 3)\mathbf{j}$ is conservative.

   (b) For $\mathbf{F}$ as above, find a function $f(x, y)$ such that $\Delta f = \mathbf{F}$.

2. Use the fundamental theorem of line integrals to find $\int_C \mathbf{F} \cdot dr$, where C is the path

$$(\cos 2t - 1, \sin 2t, \sin t)$$

   from $(0, 0, 0)$ to $(-2, 0, 1)$, and $\mathbf{F} = \Delta(e^{xyz} + 3)$.