1. Build a parameterization for this curve. Both segments are linear.

2. Let $\mathbf{F}(x, y) = < F_1(x, y), F_2(x, y) >$ be a 2D vector field.
   a) Given $F_1(x, y) = e^y$ (so $\mathbf{F} = < e^y, F_2 >$), use the cross-partial property to find the function $F_2(x, y)$ that makes $\mathbf{F}$ be a conservative field.

   b) Find a potential function for this field $\mathbf{F}$.
3. Evaluate the line integral $I = \int_C f \, ds$ where $f(x, y, z) = x + 2y - 4z$ and $\vec{r}(t) = \langle 2, 3t, 1+t \rangle$ for $0 < t < 1$.

\begin{center}
3: 15 pts
\end{center}

4. Compute the flow of the vector field $\vec{F} = \langle x, y^2, 3z \rangle$ along the curve $\vec{r}(t) = \langle 2t, t, 3t \rangle$ for $1 < t < 2$.

\begin{center}
4: 15 pts
\end{center}
5. Set up but do not evaluate the integral for the flux of the vector field \( \mathbf{F} = \langle x^2, y, z^3 \rangle \) across the portion of the surface \( 2x - y + z = 12 \) in the first octant.

6. Use Green's Theorem to set up the integral for the flow of the vector field \( \mathbf{F} = \langle -y, x^2 \rangle \) around the closed curve \( C \) shown below. Do not evaluate the integral.
7. The vector field $\mathbf{F} = \langle y^2 - 2, 2xy + 1 \rangle$ is conservative, with potential $V(x, y) = xy^2 - 2x + y + 7$. Evaluate $I = \int_C \mathbf{F} \cdot d\mathbf{s}$ for a smooth curve $C$ that starts at the point $(2, 1)$ and ends at the point $(0, 4)$.

8. Let $\mathbf{F} = \langle y, z, x \rangle$. Use the fact that $\nabla \times \mathbf{F} = \langle -1, -1, -1 \rangle$ and Stokes' Theorem to set up the integral for the net circulation over the portion of the surface $z = (x^2 - 1)(y^2 - 1)$ that lies above the rectangular base $[-1, 1] \times [-1, 1]$. Do not evaluate.
9. Using cylindrical coordinates, set up but do not evaluate the integral for the volume of the region that is bounded on the sides by the cylinder $x^2 + y^2 = 1$, on the top by $z = 20 + x^2 + y^2$ and on the bottom by $x^2 + y^2 + z^2 = 1$. 

9: 15 pts
10. Using spherical coordinates, set up but do not evaluate the integral for the volume of the region that is bounded above by $z = 15 - x^2 - y^2$ and below by $z = 2\sqrt{x^2 + y^2}$. 

10: 15 pts