1. Suppose a particle has acceleration $\mathbf{a}(t) = \langle 2t, 1, t^2 \rangle$ initial velocity $\mathbf{v}(0) = \langle 0, 1, 0 \rangle$ and initial position $\mathbf{r}(0) = \langle 1, 0, 0 \rangle$. Find $\mathbf{r}(t)$.

Anti-differentiating $\mathbf{a}(t)$ gives us $\mathbf{v}(t) = \langle t^2, t, \frac{1}{3}t^3 \rangle + \mathbf{c}$. Where $\mathbf{c}$ is a constant vector. The condition $\mathbf{v}(0) = \langle 0, 1, 0 \rangle$ gives us $\mathbf{c} = \langle 0, 1, 0 \rangle$.

So $\mathbf{v}(t) = \langle t^2, t + 1, \frac{1}{3}t^3 \rangle$. Integrating again to get $\mathbf{r}(t)$ and using that $\mathbf{r}(0) = \langle 1, 0, 0 \rangle$ gives us

$$\mathbf{r}(t) = \langle \frac{1}{3}t^3 + 1, \frac{1}{2}t^2 + t, \frac{1}{12}t^4 \rangle.$$ 

2. Find and sketch the domain of the function $\ln(4 - x^2 - y^2)$.

The domain is the set of all points $(x, y)$ such that

$$4 - x^2 - y^2 > 0 \Rightarrow x^2 + y^2 < 4.$$

Thus this is the solid open circle of radius 2 (the boundary is not included).