$\boxed{\#2}$ Let $\vec{r}(t) = \langle \sqrt{2-t},\ (e^t-1)/t,\ \ln(t+1) \rangle$

(a) Find the domain of $\vec{r}$

(b) Find $\lim_{t\to 0} \vec{r}(t)$

(c) Find $\vec{r}\,'(t)$

(a) $2 \geq t$, $t \neq 0$, $t > -1$ D: $[-1,0) \cup (0,2]$

(b) $\lim_{t\to 0} \vec{r}(t) = \langle \sqrt{2}, 1, 0 \rangle$

(c) $\vec{r}\,'(t) = \langle \frac{1}{2}(2-t)^{-1/2}(-1),\ \frac{e^t \cdot t - e^t}{t^2},\ \frac{1}{t+1} \rangle$

$\boxed{Ex.}$ Find a vector function that represents the cure of intersection of

$$x^2 + y^2 + z = 4 \quad \text{and} \quad x^2 + y^2 = 9$$

$x = 3\cos t$ $y = 3\sin t$ $z = 4 - 9 = -5$

$$\boxed{\vec{r}(t) = \langle 3\cos t, 3\sin t, -5 \rangle}$$

Reparametrize $\vec{r}(t) = \langle e^t, e^t, e^t \rangle$ with respect to arc length measured from $(1,0,1)$ in the direction of increasing t.

$$S(t) = \int_0^t |\vec{r}\,'(u)|\,du = \int_0^t \sqrt{(e^{2u}) + e^{2u} + e^{2u}}\,du$$

$$= \int_0^t \sqrt{3}e^u\,du = \sqrt{3}(e^t - e^0) = \sqrt{3}e^t - \sqrt{3}$$

$t = \ln\left(\frac{s+\sqrt{3}}{\sqrt{3}}\right)$

$$\boxed{\vec{r}(s) = \left\langle \frac{\sqrt{3}}{3}s + 1,\ \left(\frac{\sqrt{3}}{3}s+1\right),\ \left(\frac{\sqrt{3}}{3}s+1\right) \right\rangle}$$

#18 A particle starts at the origin with initial velocity $i - j + 3k$ and its acceleration is $\vec{a}(t) = 6t\vec{i} + 12t^2\vec{j} - 6t\vec{k}$. Find its position function and its speed function.

$$\vec{v}(t) = \int \vec{a}(t)\,dt = \langle 3t^2, 4t^3, -3t^2 \rangle + \langle 1, -1, 3 \rangle$$

$$\boxed{\vec{P}(t) = \int \vec{v}(t)\,dt = \langle t^3 + t,\ t^4 - t,\ -t^3 + 3t \rangle}$$

$$\text{Speed} = |\vec{v}(t)| = \boxed{\sqrt{(3t^2+1)^2 + (4t^3-1)^2 + (-3t^2+3)^2}}$$