1.

(a) Note that:

$$\frac{n}{n+1} < \frac{n+1}{n+1} < 1, \forall n \in \mathbb{N}$$

so the sequence is bounded by 1

Also note that:

$$x_n = \frac{n}{n+1} < \frac{n+1}{n+2} = x_{n+1}, \forall x \in \mathbb{N}$$

so the sequence is monotone increasing, then by monotone convergence theorem, $\{x_n\}$ converges.

We WTS that $\lim_{n\to\infty}\{x_n\} = 1$.

Let $\epsilon > 0$ be given. Note that:

$$|x_n - 1| < \epsilon$$

$$\Leftrightarrow 1 - x_n < \epsilon \text{ since } 1 > x_n, \forall x \in \mathbb{N}$$

$$\Leftrightarrow 1 - \frac{n}{n+1} < \epsilon$$

$$\Leftrightarrow \frac{1}{n+1} < \epsilon$$

$$\Leftrightarrow n + 1 > \frac{1}{\epsilon}$$

$$\Leftrightarrow n > \frac{1}{\epsilon} - 1$$

So let the natural number N be the smallest number that greater than $\frac{1}{\epsilon} - 1$, then $\forall n > N$, we will have $|x_n - 1| < \epsilon$. So $\{x_n\}$ converges to 1.

(b)

Note that $\forall n \geq 2$,

$$x_n = \frac{2^n}{n!} = \frac{(n+1)2^n}{(n+1)!} > \frac{2 \times 2^n}{(n+1)!} = x_{n+1}$$

So the sequence is monotone decreasing.

Also, $\forall n \in \mathbb{N}$, 2^n and $n!$ are strictly greater than 0, so $\{x_n\}$ is bounded below by 0. By monotone convergence theorem, $\{x_n\}$ converges.

Finally, we WTS that $\lim_{n\to\infty}\{x_n\} = 0$.