2) We will start by choosing Claim 2:

To prove that $S \subseteq T$, we will prove that $\boxed{1}$ T contains a value that S doesnt and $\boxed{2}$ every value of S is in T. To start we will use induction

base case: $n, m = 1$

$$S = \sum_{k=1}^{n} \frac{1}{k(k+1)} = \sum_{k=1}^{1} \frac{1}{k(k+1)} = \frac{1}{1(2)} \qquad T = \frac{m-1}{m} = \frac{1-1}{1} = 0$$

$$S = \{1/2\} \qquad T = \{0\}$$

* $\boxed{1}$ is proven as $\{0\} \subseteq T$ but since S is an increasing series and the smallest value of S is $1/2$, $\{0\} \not\subseteq S$

Inductive step: Let $i \in \mathbb{N}$, $\sum_{k=1}^{i} \frac{1}{k(k+1)} \in T$ or that

$\sum_{k=1}^{i} \frac{1}{k(k+1)} = \frac{z-1}{z}$ for some natural number z, we will now show the $i+1$ case holds:

$$\text{NTP: } \sum_{k=1}^{i+1} \frac{1}{k(k+1)} = \frac{(z+1)-1}{z+1}$$

$$\text{LHS: } \sum_{k=1}^{i+1} \frac{1}{k} - \frac{1}{(k+1)}$$

- we will expand out the sigma notation and then simplify:

$$\Rightarrow \left(\frac{1}{1} - \frac{1}{(1+1)}\right) + \left(\frac{1}{2} - \frac{1}{(2+1)}\right) + \left(\frac{1}{3} - \frac{1}{(3+1)}\right) + \dots + \left(\frac{1}{i} - \frac{1}{(i+1)}\right) + \left(\frac{1}{i+1} - \frac{1}{((i+1)+1)}\right)$$

$$\Rightarrow \left(1 - \frac{1}{2}\right) + \left(\frac{1}{2} - \frac{1}{3}\right) + \left(\frac{1}{3} - \frac{1}{4}\right) + \dots + \left(\frac{1}{i} - \frac{1}{i+1}\right) + \left(\frac{1}{i+1} - \frac{1}{i+2}\right)$$

$$\Rightarrow 1 - \frac{1}{i+2}$$

$$\Rightarrow i+2$$

LHS: $\frac{i+2-1}{i+2}$ RHS: $\frac{(z+1)-1}{(z+1)}$

- however since z is any arbitrary natural number, we can make $v = z+1$ such that:

$(i \in \mathbb{N})$ LHS: $\frac{(i+2)-1}{(i+2)}$ RHS: $\frac{(v+2)-1}{(v+2)}$ $(v \in \mathbb{N})$

- Since there will always be a natural number bigger then the last, $\boxed{2}$ is proven as any S value can be found in T

$\therefore$ because of $\boxed{1}$ and $\boxed{2}$ S must be a proper subsequence of T so claim 2 is correct and proven