⑥ $x=\left(0;\ \frac{\ln 3}{3};\ \frac{\ln 4}{4};\ \frac{\ln 5}{5};\ \ldots\right)$

$$x=\begin{cases}0, & k=1\\ \frac{\ln k+1}{k+1}; & k>1\end{cases}$$

$$\sum_{k=1}^{\infty}|x_k|^p=\sum_{k=2}^{\infty}\left|\frac{\ln k+1}{k+1}\right|^p+0^p=\sum_{k=2}^{\infty}\left|\frac{\ln k+1}{k+1}\right|^p$$

$$\left(\frac{\ln k+1}{k+1}\right)\sim\left(\frac{\ln k}{k}\right)^p$$

при больших k $(\ln k)^p$ возрастает медленнее, чем $k^p \Rightarrow$

$$x_k^p\sim\frac{1}{k^p}$$

$\sum\limits_{k=2}^{\infty}\frac{1}{k^p}$ сходится при $p>1\Rightarrow p_{min}=2$

$\sum\limits_{k=2}^{\infty}\frac{\ln^2(k+1)}{(k+1)^2}$ – сходится по интегральному признаку

$$\int_2^{\infty}\frac{\ln^2(k+1)}{(k+1)}dk=\lim_{x\to\infty}\int_2^x\frac{\ln^2(k+1)}{(k+1)^2}dk$$

$$\int\frac{\ln^2(k+1)}{(k+1)^2}dk=\begin{Bmatrix}u=k+1\\ du=dk\end{Bmatrix}=\int\frac{\ln^2 u}{u^2}du=-\frac{\ln^2 u}{u}+$$

$$+\int\frac{2\ln u}{u^2}du=-\frac{\ln^2 u+2\ln u-2}{u}=-\frac{\ln^2(k+1)+2\ln(k+1)-2}{k+1}$$

$$\lim_{x\to\infty}\left(-\frac{\ln^2(k+1)+2\ln(k+1)-2}{k+1}\right)\Bigg|_2^x=\lim_{x\to\infty}-\frac{\ln^2(x+1)+2\ln(x+1)-2}{x+1}-$$

$$\lim_{x\to\infty}-\frac{\ln^2 3+2\ln 3-2}{3}=0-\left(-\frac{\ln^2 3+2\ln 3-2}{3}\right)=\frac{\ln^2 3+2\ln 3-2}{3}$$

$$\Rightarrow\sum_{k=2}^{\infty}\frac{\ln^2(k+1)}{(k+1)^2}\approx\frac{\ln^2 3+2\ln 3-2}{3}.$$

Ответ: $p_{min}=2$