

Let $P(x)$ be the power series

$$1 - \frac{x}{2} + \frac{x^2}{3} - \frac{x^3}{4} + \cdots = \sum_{k=0}^{\infty} \frac{(-x)^k}{k+1}$$

1. Does the series converge when $x = 1$?
2. Does the series converge when $x = -1$?
3. Does the series converge when $x = \frac{1}{2}$?
4. For what values of x does $P(x)$ converge absolutely?

(*Hint:* Use the Ratio Test on $\sum_{k=0}^{\infty} \left| \frac{(-x)^k}{k+1} \right|$.)