The discrete random variable X has probability function

$$\boldsymbol{P(X = x) = k\left(\frac{2}{5}\right)^{x}} \text{ for } x \in \mathbb{Z}, x > 0$$

Work out the value of $\boldsymbol{k}$

$$\boldsymbol{P(X = x) = k\left(\frac{2}{5}\right)^{x}} \text{ for } x \in \mathbb{Z}, x > 0$$

Work out some probabilities

$$P(X = 1) = k\left(\frac{2}{5}\right)^{1} = \frac{2}{5}k$$

$$P(X = 2) = k\left(\frac{2}{5}\right)^{2} = \frac{4}{25}k$$

$$P(X = 3) = k\left(\frac{2}{5}\right)^{3} = \frac{8}{125}k$$

We know that the sum of the probabilities = 1

$$\frac{2}{5}k + \frac{4}{25}k + \frac{8}{125}k + \cdots = 1$$

$$k\left(\frac{2}{5} + \frac{4}{25} + \frac{8}{125} + \cdots\right) = 1$$

This is an infinite geometric series.

$$\frac{2}{5} + \frac{4}{25} + \frac{8}{125} + \cdots = \frac{1}{k}$$

$$S_{\infty} = \frac{U_1}{1 - r}$$

$$S_{\infty} = \frac{\frac{2}{5}}{1 - \frac{2}{5}}$$

$$S_{\infty} = \frac{\frac{2}{5}}{\frac{3}{5}} = \frac{2}{3}$$

$$\frac{2}{3} = \frac{1}{k}$$

$$k = \frac{3}{2}$$