1. We consider the function

$$f(x) = \left(1 - \frac{5}{x}\right)^x$$

and note that $\lim_{x\to\infty} f(x) = 1^\infty$ indeterminate form, so we apply l'Hôpital's Rule. We let

$$y = \ln(f(x)) = \ln\left(\left(1-\frac{5}{x}\right)^x\right)$$

$$= x \ln\left(1 - \frac{5}{x}\right)$$

$$= \frac{\ln(1 - 5/x)}{1/x} \qquad \text{so } \lim_{x\to\infty} y = \frac{0}{0} \text{ indeterminate form}$$

$$\lim_{x\to\infty} y \overset{H}{=} \lim_{x\to\infty} \frac{[\ln(1-5/x)]'}{[1/x]'}$$

$$= \lim_{x\to\infty} \frac{\left[\ln\left(\frac{x-5}{x}\right)\right]'}{[1/x]'}$$

$$= \lim_{x\to\infty} \frac{\frac{x}{x-5} \cdot \frac{5}{x^2}}{-\frac{1}{x^2}}$$

$$= \lim_{x\to\infty} \frac{-5x}{x-5} = -\frac{5}{1} = -5$$

Therefore $\lim_{x\to\infty} f(x) = e^{-5}$ so, by the Evaluation Theorem,

$$\boxed{\lim_{i\to\infty} a_i = e^{-5}}$$