Exercise 1. Revise your knowledge of factorials — calculate values of the following expressions.

a) $2!$, b) $4!$, c) $2!\cdot 3!$, d) $\binom{4}{1}$, e) $\binom{3}{2}$, f) $\frac{(n-1)!}{(n+1)!}$, g) $\frac{(n+2)!(n+1)!}{n!\cdot(n-1)!}$, h) $\frac{(n+1)!+n!}{(n+1)!-n!}$, i) $\frac{\binom{n+2}{n}}{n^2}$.

Answers: (a) 2, *(b)* 24, *(c)* 12, *(d)* 4, *(e)* 3, *(f)* $\frac{1}{n(n+1)}$, *(g)* $n(n+1)^2(n+2)$, *(h)* $\frac{n+2}{n}$, *(i)* $\frac{(n+1)(n+2)}{2n^2}$.

Exercise 2. Using the necessary condition for convergence of a series, justify the fact that these series are divergent.

a) $\sum_{n=1}^{\infty}\frac{n+2}{n+100}$, b) $\sum_{n=1}^{\infty}\frac{(-1)^n n^2}{100n^2+1}$, c) $\sum_{n=2}^{\infty}\frac{n}{\ln n}$, d) $\sum_{n=2}^{\infty}\sqrt[n]{\frac{n}{100}}$, e) $\sum_{n=1}^{\infty}(1+\frac{1}{n})^n$,

f) $\sum_{n=1}^{\infty}(1-\frac{1}{n})^n$, g) $\sum_{n=0}^{\infty}\frac{\pi^n}{e^n+3^n}$, h) $\sum_{n=1}^{\infty}\frac{\arctan n}{\operatorname{arccot}(-n)}$, i) $\sum_{n=1}^{\infty}\frac{(2n)!}{n^n}$, j) $\sum_{n=1}^{\infty}\frac{(3n)!(5n)!}{(7n)!}$.

Nobody's perfect – if you notice any mistakes in answers, please let us know!