Double series summation

1. Show that (exercise 1.1.15(a))

$$\sum_{n=2}^{\infty} \left[\zeta(n) - 1\right] \;=\; 1$$

2. Show that (exercise 1.1.15(b))

$$\sum_{n=2}^{\infty} (-)^n \left[\zeta(n) - 1\right] \;=\; \frac{1}{2}$$

3. Evaluate

$$\sum_{p=4}^{\infty} \sum_{q=2}^{p-2} (p-q)^{-q}$$

4. Evaluate

$$\sum_{r=8}^{\infty} \sum_{s=2}^{\left[\frac{r-2}{3}\right]} (-)^s \, (r-3s)^{-s}$$