Problem 1: Mark the following statements T for 'True' or F for 'False'.

(a) _____ : If a series $\sum a_n$ converges, then $\lim\limits_{n\to\infty} a_n = 0$.

(b) _____ : If $\lim\limits_{n\to\infty} a_n = 0$, then $\sum a_n$ converges.

(c) _____ : If $\sum a_n$ diverges, then $\lim\limits_{n\to\infty} a_n \neq 0$.

(d) _____ : If $\lim\limits_{n\to\infty} a_n \neq 0$, then $\sum a_n$ diverges.

(e) _____ : $\sum\limits_{n=1}^{\infty} \dfrac{1}{n^2} = \dfrac{\pi^2}{6}$.

Problem 2: Determine whether the following series converges or diverges. If the series converges, prove it. If the series diverges, prove it.

$$\sum_{n=1}^{\infty} \cos\left(\frac{1}{n}\right)$$

Problem 3: Determine whether the following series converges or diverges. If the series converges, find the sum. If the series diverges, prove it.

$$\sum_{n=2}^{\infty} \frac{5\pi(3^{n-1})}{2^{2n+1}}$$