1. Let $A = \left\{ \frac{1}{n} + \frac{1}{m} \mid m, n \in \mathbb{N} \right\} \cup \{0\}$.
   a. (5 pts) What is the set of all accumulation points of A? (State your reasons.)
   b. (5 pts) Is A a closed set? Why?

2. (10 pts) Let $a \in \mathbb{R}$ and $\{a_n\}_{n=1}^{\infty}$ be a sequence of real numbers. Show that if every subsequence of $\{a_n\}_{n=1}^{\infty}$ has a subsequence that converges to a, then $\lim_{n\to\infty} a_n = a$.

3. a. (8 pts) Let $\varnothing \neq A \subseteq \mathbb{R}^n$ be a closed set. Show that ∂A has no interior points.
   b. (7 pts) Find a set $S \subseteq \mathbb{R}$ such that ∂S is an open set.

4. True or false. In the following statements, if it is true then prove it! If it is false then disprove it or provide a counterexample.
   a. (10 pts) If $f : \mathbb{R}^2 \mapsto \mathbb{R}$ is differentiable at $(0, 0)$ then f is continuous at $(0, 0)$.
   b. (10 pts) If $f : \mathbb{R}^2 \mapsto \mathbb{R}$ satisfies that the directional derivative of f at $(0, 0)$ exists in all directions, then f is continuous at $(0, 0)$.

5. a. (8 pts) Prove that the improper integral $\int_0^{\infty} \frac{\sin x}{x} dx$ exists.
   b. (7 pts) Let $\int_0^{\infty} \frac{\sin x}{x} dx = I$. Evaluate $\int_0^{\infty} \left(\frac{\sin x}{x}\right)^2 dx$.

6. (15 pts) Find the volume of $\Omega = \{(x, y, z) \in \mathbb{R}^3 \mid 3x^2+3y^2+3z^2-2xy-2xz-2yz \leqslant 1\}$.

7. (15 pts) Let $f : [0, \infty) \mapsto \mathbb{R}$ be a non-negative, uniformly continuous function. Assume that the improper integral of f on $[0, \infty)$ exists. Show that $\lim_{t\to\infty} f(t) = 0$.