Below are the problems from the last year's Analysis exam
You can expect something similar.

1. (8 pts) Formulate the Principle of Induction. Prove by induction that for any $a, q \in \mathbb{R}$, $q \neq 1$ and each natural n there is the equality:

$$a + aq + aq^2 + \cdots + aq^{n-1} = a\frac{q^n - 1}{q - 1}.$$

2. (6 pts) Write the definition of the derivative of $f(x)$ at a point x_0. Explain it geometrically. Using the definition of the derivative find the derivative of $f(x) = 2x^2 - x$ at $x = 1$.

3. (8 pts) a) Write the First Derivative Test for extrema.
b) Find the dimensions of the rectangle with largest area that can be inscribed in a semicircle of radius R, if two vertices lie on the diameter. Give comments to the calculations you do.

4. (8 pts) Explain the method of partial fraction decomposition and apply it to $f(x) = \frac{3x^2 + 2x - 2}{x^3 - 1}$.

5. (8 pts) Explain integration by substitution and integration by part. Evaluate $\int x \ln x \, dx$ and $\int (\cos^2 x - 2\cos x) \sin x \, dx$.

6. (6 pts) Draw the region bounded by the curves: $y = x^2$, $y = 2x^2$, $y = 8$ and find its area.

7. (6 pts) What does it mean that a series $\sum_{n=1}^{\infty} a_n$ is convergent? (Give the definition). Determine whether $\sum_{n=1}^{\infty} \frac{n^2 + n}{3^n (n^2 + 3n)}$ is convergent and write full text of the convergence test that you have used.