Calculus 1, 2018/19/I., topics for Part 2 of the Final exam

Part 2 of the Final exam will consist of several exercises to solve. The exercises will be similar to those we have covered in class during the semester.

Possible topics include:

1. Logical symbols: given a statement in words, write it out with logical symbols; given a statement with logical symbols, explain what it means in words. Decide truth values.

2. Mathematical induction. Prove equalities or inequalities by induction.

3. Limit of sequences: calculate the limit of sequences (several types of sequences). The use of monotone convergence, and the sandwich rule.

4. Convergence of series: decide whether a given series converges or diverges (nth term test, ratio test, nth root test, domination test, limit comparison test, integral test, absolute convergence, Leibniz-test).

5. Power-series: decide the radius of convergence of a given power-series.

6. Sum of series: calculate the sum of a given series (geometric series, partial fractions, product series).

7. Differentiation: differentiate a given function

8. Differentiate implicitly given functions.

9. Taylor-polynomials: give the Taylor-polynomial of a certain order of a given function around a point x_0. Calculate error bounds.

10. L'Hospital's rule. Find limits of type "$\frac{0}{0}$" and "$\frac{\infty}{\infty}$", "1^{∞}".

11. Analysis of functions: given a function, plot its graph after determining its properties (zeroes, limits, asymptotes, monotonically increasing and decreasing parts, local maxima and minima, convexity).

12. Optimization problems: e.g. maximize the volume of a cylinder inscribed inscribed in sphere, maximize the profit of a company under given constraints, etc.

13. Functional inequalities: prove that $f(x) \leq g(x)$ by comparing derivatives.

14. Integration: find the indefinite integral (antiderivative) of a given function (integration by parts, substitution, rational functions). Solve initial value problems.

15. Definite integrals: use the Newton-Leibniz forumla

16. Improper integrals: calculating definite integrals of functions on an infinite domain, or an unbounded function on a finite domain.

17. Convergence of improper integral: decide convergence or divergence (limit comparison test, domination test, $\int_0^1 \frac{1}{x^\alpha}$, $\int_1^\infty \frac{1}{x^\alpha}$

18. Calculate area, volume, surface area, arc-length.

19. Differentiating integral expressions