The final exam may verify your understanding and knowledge of anything from the syllabus. But you should start by making sure that you know the fundamentals below very well.

Fundamental concepts

- function, domain, range [p4]
- increasing/decreasing/monotonic function [p6]
- one-to-one function, invertible function, the inverse function [p34, 35, 36]
- polynomial/rational function [p21]
- interval, closed interval, open interval [p2]
- limit [p111]
- continuity [p81]
- derivative (measures rate of change), differentiability [p121, 129, 150, equation (4) on p153]
- absolute minimum/maximum, local minimum/maximum [*see separate definitions*]
- antiderivative/indefinite integral [p275, 276]
- the definite integral [as a signed area p302] (measures net change p322)

Fundamental theorems/facts

- the equation of a line [p16]
- the quadratic function [roots, sign, monotonicity intervals, concavity] [see also "the quadratic function (roots and sign)"]
- trigonometry [Sections 1.4, 1.5, Problem 6(c) on Workshop 1, the second page of the textbook (with formulas)]
- basic limit laws [p 77]
- basic laws of continuity [p 83], continuity of composite functions [*Thm 5*, p 85], continuity of the inverse function [*Thm 4*, p 85]
- Rational functions, trigonometric functions, $x \longrightarrow e^x$, $x \longrightarrow \ln x$, $x \longrightarrow x^a$ are continuous on their domains
- The range (=image) of a continuous function $f : I \longrightarrow \mathbb{R}$ defined on an interval I is an interval. [*The Intermediate Value Thm*]
- The range (=image) of a continuous function $f : [a, b] \longrightarrow \mathbb{R}$ defined on a closed bounded interval $[a, b]$ is a closed bounded interval. [see *Thm 1*, p 216]
- *The Squeeze Thm* [*Thm 1*, p 96].
- $\lim_{\theta \longrightarrow 0} \frac{\sin\theta}{\theta} = 1$ [p96-98]

- $\lim\limits_{x\longrightarrow\infty} x^n = \infty$ if $n>0$, $\lim\limits_{x\longrightarrow\infty} x^{-n} = 0$ if $n>0$[1]
-
$$\lim_{x\longrightarrow-\infty} x^n = \begin{cases} \infty, & \text{if } \; n \; \text{ is an even positive integer,} \\ -\infty, & \text{if } \; n \; \text{ is an odd positive integer,} \end{cases}$$
$$\lim_{x\longrightarrow-\infty} x^{-n} = 0 \quad \text{if} \quad n \quad \text{is a positive integer.}$$
- $\lim\limits_{x\longrightarrow x_0} \frac{1}{f(x)} = \infty$ if $\lim\limits_{x\longrightarrow x_0} f(x) = 0$ and $f(x) > 0$ for all $x \neq x_0$ in some interval $(x_0-\epsilon, x_0+\epsilon)$ around x_0;
  $\lim\limits_{x\longrightarrow x_0^+} \frac{1}{f(x)} = \infty$ if $\lim\limits_{x\longrightarrow x_0^+} f(x) = 0$ and $f(x) > 0$ for all x in some interval $(x_0, x_0+\epsilon)$, $\epsilon>0$;
  (and the analogous statement for the left-hand limit)
- $\lim\limits_{x\longrightarrow x_0} \frac{1}{f(x)} = -\infty$ if $\lim\limits_{x\longrightarrow x_0} f(x) = 0$ and $f(x) < 0$ for all $x \neq x_0$ in some interval $(x_0-\epsilon, x_0+\epsilon)$ around x_0;
  $\lim\limits_{x\longrightarrow x_0^-} \frac{1}{f(x)} = -\infty$ if $\lim\limits_{x\longrightarrow x_0^-} f(x) = 0$ and $f(x) < 0$ for all x in some interval $(x_0-\epsilon, x_0)$, $\epsilon>0$;
  (and the analogous statement for the right-hand limit)
-
$$\lim_{x\longrightarrow-\infty} \mathrm{e}^x = 0, \quad \lim_{x\longrightarrow\infty} \mathrm{e}^x = \infty,$$
$$\lim_{x\longrightarrow 0^+} \ln x = -\infty, \quad \lim_{x\longrightarrow\infty} \ln x = \infty$$
- FIRST AND SECOND LIST OF DERIVATIVES (see website)
- FIRST AND SECOND LIST OF INDEFINITE INTEGRALS (see website)
- the equation of the tangent line to the graph of a differentiable function [*Dfn*, p 121]
- linearity rules for differentiability/derivatives [p 132]; Linearity of the Indefinite/Definite Integrals [p 277, 303]
- differentiability implies continuity [p 136]
- The Chain Rule [p 169], The Substitution Method/Change of Variables Formula [p329, 331]
- product and quotient rules [p 143, 145], the derivative of the inverse function [p 178]
- approximating $f(x)$ by its linearization [p 210]
- *Fermat's thm* on local extrema [p 218]
- *Rolle's thm* [p 220]
- *The Mean Value Thm* [p 226] and its consequences (*Corollary* on p 227 and *The Sign of the Derivative* thm on p 227)
- *First Derivative Test for Critical Points* regarding local extrema [p 229], *Second Derivative Test* for local extrema [p 237]

[1] This is a particular case of
$$\lim_{x\longrightarrow x_0} \frac{1}{f(x)} = 0 \text{ if } \lim_{x\longrightarrow x_0} f(x) = \infty (\text{or } -\infty).$$

- *Test for Concavity/Inflection Points* [p 235]
- *L'Hôpital's Rules* [p 241, 244], $\lim_{x \longrightarrow \infty} \frac{e^x}{x^n} = \infty$ [p245]
- properties of the definite integral (the definite integral as signed area, additivity of adjacent intervals, comparison) [p 302, 304, 305]
- *The Fundamental Theorem of Calculus, Parts I and II* [p 310, 316]