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, \(x \to e^x, x \to \ln x, x \to x^a\) are continuous on their domains
- The range (=image) of a continuous function \(f : I \to \mathbb{R}\) defined on an interval \(I\) is an interval. [The Intermediate Value Thm]
- The range (=image) of a continuous function \(f : [a, b] \to \mathbb{R}\) 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].
- \(\lim_{\theta \to 0} \frac{\sin \theta}{\theta} = 1\) [p96-98]
• $$\lim_{x \to -\infty} x^n = \infty$$ if $$n > 0$$, $$\lim_{x \to -\infty} x^{-n} = 0$$ if $$n > 0$$.

• $$\lim_{x \to -\infty} x^n = \begin{cases} \infty, & \text{if } n \text{ is an even positive integer}, \\ -\infty, & \text{if } n \text{ is an odd positive integer}, \\ 0, & \text{if } n \text{ is a positive integer}. \end{cases}$$

• $$\lim_{x \to -\infty} x^{-n} = 0$$ if $$n$$ is a positive integer.

• $$\lim_{x \to x_0^-} f(x) = \infty$$ if $$\lim_{x \to x_0^-} f(x) = 0$$ and $$f(x) > 0$$ for all $$x \neq x_0$$ in some interval $$(x_0 - \epsilon, x_0 + \epsilon)$$ around $$x_0$$; $$\lim_{x \to x_0^+} f(x) = -\infty$$ if $$\lim_{x \to x_0^+} f(x) = 0$$ and $$f(x) < 0$$ for all $$x \neq x_0$$ in some interval $$(x_0 - \epsilon, x_0)$$, $$\epsilon > 0$$; (and the analogous statement for the left-hand limit)

• $$\lim_{x \to x_0^-} \frac{1}{f(x)} = \infty$$ if $$\lim_{x \to x_0^-} f(x) = 0$$ and $$f(x) > 0$$ for all $$x \neq x_0$$ in some interval $$(x_0 - \epsilon, x_0 + \epsilon)$$ around $$x_0$$; $$\lim_{x \to x_0^+} \frac{1}{f(x)} = -\infty$$ if $$\lim_{x \to x_0^+} f(x) = 0$$ and $$f(x) < 0$$ for all $$x \neq x_0$$ in some interval $$(x_0 - \epsilon, x_0)$$, $$\epsilon > 0$$; (and the analogous statement for the right-hand limit)

• $$\lim_{x \to -\infty} e^x = 0$$, $$\lim_{x \to \infty} e^x = \infty$$,

• $$\lim_{x \to 0^+} \ln x = -\infty$$, $$\lim_{x \to \infty} \ln x = \infty$$

• 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

$$\lim_{x \to x_0} \frac{1}{f(x)} = 0$$ if $$\lim_{x \to x_0} f(x) = \infty$$ (or $$-\infty$$).
• Test for Concavity/Inflection Points [p 235]

• L'Hôpital's Rules [p 241, 244], \( \lim_{x \to \infty} \frac{e^x}{x^n} = \infty \) [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]