

Mathematics 1161: Final Exam Study Guide

1. The Final Exam is on **December 10 at 8:00-9:45pm** in Hitchcock Hall (HI) 031
2. Take your **BuckID** to the exam. The use of notes, calculators, or other electronic devices is forbidden.
3. The exam will be cumulative.
4. Be able to do problems from the previous exams, quizzes, online homework, and written homework.
5. Save time by memorizing the derivatives of common functions.
6. Refer to the midterm study guides to find practice exercises for material covered before Midterm Exam 3.
7. Several practice exercises for material covered after Midterm Exam 3 appear on the pages that follow. Solutions will be available on Carmen in the Modules section. These exercises primarily reinforce computational skills, but keep in mind that the exam will also test conceptual understanding.

What do you need to know?

Refer to the midterm study guides for sections covered before Midterm Exam 3.

- 6.8 Know the properties of logarithmic and exponential functions. You will not be asked to produce proofs from the definitions.
- 6.9 Understand when exponential models are appropriate. Know what growth rate and relative growth rate mean.
- 7.1 Be familiar with and be able to use the algebra techniques used in this section to solve integrals.
- 7.2 Know how to use Integration by Parts for definite integrals and indefinite integrals.
- 7.3 Know the antiderivatives of all six trigonometric functions. Know how to integrate powers of sine or cosine, products of powers of sine and cosine, and products of powers of tangent and secant. You do not need to memorize any of the reduction formulas.
- 7.4 Know how to recognize when to try a trigonometric substitution. Be able to use the trigonometric substitution $x = a \sin \theta$ for integrals involving $a^2 - x^2$, where $-a \leq x \leq a$. Be able to use the trigonometric substitution $x = a \tan \theta$ for integrals involving $a^2 + x^2$. Be able to use the trigonometric substitution $x = a \sec \theta$ for integrals involving $x^2 - a^2$, where $x \leq -a$ or $a \leq x$.
- 7.5 Know the method for integrating rational functions. Know how to find the partial fraction(s) decomposition of a rational function (provided that the degree of its numerator less than the degree of its denominator).
- 7.8 Be able to recognize improper integrals over an infinite interval and improper integrals with an unbounded integrand. Know how to use limits to determine if an improper integral converges or diverges, and know how to evaluate an improper integral if it converges.

1. Evaluate the integrals.

$$(a) \int \frac{3x + 2}{x^2 + 4} dx$$

$$(b) \int_2^4 \frac{x^2 + 2}{x - 1} dx$$

$$(c) \int \frac{1 - x}{1 - \sqrt{x}} dx$$

2. Evaluate the integrals.

(a) $\int 3x \sec^2(x) dx$

(b) $\int x^2 e^{4x} dx$

3. Evaluate the integrals.

(a) $\int x^7 \ln(5x) dx$

(b) $\int e^x \cos(3x) dx$

4. Find the volume of the solid generated when the region bounded by $y = \cos x$ and the x -axis on the interval $[0, \frac{\pi}{2}]$ is revolved about the y -axis.

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5. Find the area of the region bounded by the curves $y = \sin(x)$ and $y = \sin^{-1}(x)$ on the interval $[0, \frac{1}{2}]$.

6. Evaluate the integrals.

(a) $\int \sin^5(x) dx$

(b) $\int \cos^3(10x) dx$

(c) $\int \cos^2(10x) dx$

7. Evaluate the integrals.

(a) $\int 3 \sin^5(x) \cos^8(x) dx$

(b) $\int \sin^\pi(x) \cos^3(x) dx$

8. Evaluate the integrals.

(a) $\int 7 \sec^6(x) \tan^{10}(x) dx$

(b) $\int \tan^3(x) \sec^e(x) dx$

9. Evaluate the integrals.

$$(a) \int \frac{\sqrt{5-x^2}}{x} dx$$

$$(b) \int \frac{1}{\sqrt{x^2+16}} dx$$

10. Evaluate the integrals.

$$(a) \int_3^{3\sqrt{2}} \frac{x}{\sqrt{x^2 - 9}} dx$$

$$(b) \int_1^{\sqrt{2}} \frac{1}{x^2 \sqrt{4 - x^2}} dx$$

11. Write the appropriate form of the partial fraction decomposition for each of the following functions. Do not solve for the unknown constants.

(a) $\frac{5}{x^3 - 6x - 9x}$

(b) $\frac{x^2 - 1}{(x - 1)^2(x + 1)(x^2 + 1)}$

(c) $\frac{5}{x^2(x^2 - x - 12)^3(x^2 + 3x + 4)^2}$

12. Evaluate the integrals.

$$(a) \int \frac{21x^2}{x^3 - x^2 - 12x} dx$$

$$(b) \int \frac{x^2 + x + 2}{(x + 1)(x^2 + 1)} dx$$

13. Evaluate each of the following integrals or state that the integral diverges.

(a) $\int_1^{\infty} \frac{\tan^{-1}(x)}{x^2 + 1} dx$

(b) $\int_{-\infty}^1 e^{-4x} dx$

(c) $\int_{-\infty}^{\infty} x e^{-x^2} dx$

14. Evaluate each of the following integrals or state that the integral diverges.

$$(a) \int_0^8 \frac{1}{\sqrt[3]{x}} dx$$

$$(b) \int_{-\frac{\pi}{2}}^0 \tan(x) dx$$

$$(c) \int_{-1}^1 \frac{1}{\sqrt{1-x^2}} dx$$

15. Evaluate each of the following integrals or state that the integral diverges.

$$(a) \int_0^9 \frac{1}{(x-1)^{\frac{1}{3}}} dx$$

$$(b) \int_{-1}^2 \frac{36}{x^3} \sqrt{\frac{12}{x^2} + 13} dx$$