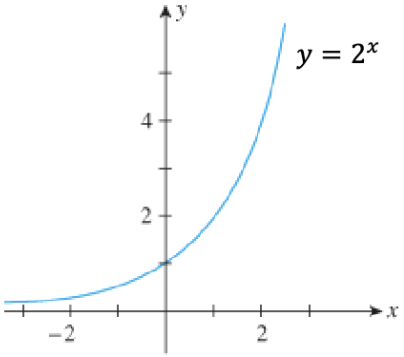
MATH 116 – Exam 3 Overview



1. Exponential Functions

- General form: $f(x) = b^x$
  - If $b > 1$ → growth
  - If $0 < b < 1$ → decay
- Key features:
  - Horizontal asymptote at $y = 0$
  - Graph never touches the x-axis
  - Passes through (0, 1)
- Transformations:
  - $a * b^x$ → vertical stretch or reflection
  - $b^x - h$ → horizontal shift
  - $b^x + k$ → vertical shift (asymptote becomes $y = k$)

2. Logarithms

- General format:
  - $\log_b(x) = y$ means $b^y = x$
  - $\ln(x) = \log_e$
- ***Log rules you must know:***
  - $\ln(ab) = \ln(a) + \ln(b)$
  - $\ln(a/b) = \ln(a) – \ln(b)$
  - $\ln(a^p) = p*\ln(a)$
- Graph features:
  - Vertical asymptote at $x = 0$
  - Domain: $x > 0$
  - Passes through (1, 0)
  - Increasing, but slowly

3. Solving Exponential and Log Equations

- General steps:

1. Isolate the exponential or logarithm
2. Rewrite using log or exponential rules
3. If solving for time (t), you will always use ln
4. Use ln to bring exponents down
5. Solve for the variable

- Key tip:
  - If the bases match, set exponents equal.
  - If they do not match → use ln.

4. Compound Interest

- Compounded annually, quarterly, monthly, etc.:
  - $\mathbf{A = P(1 + \frac{r}{n})^{nt}}$
- Compounded continuously:
  - $\mathbf{A = P*e^{rt}}$
- Variables:
  - P = principal (amount in the beginning)
  - r = annual rate (decimal)
  - n = number of compounds per year
  - t = time in years
  - A = amount (amount coming out, what you "want", end amount)

5. Effective Annual Rate

- If compounded n times/year:
  - $\mathbf{r_{eff} = (1 + \frac{r}{n})^{n-1}}$
- If compounded continuously:
  - $\mathbf{r_{eff} = e^{r-1}}$
- Interpretation:
  - Higher effective rate = better investment.

6. Derivatives of Exponential and Logarithmic Functions

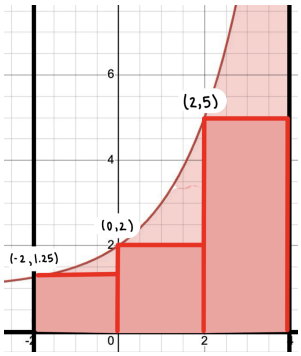
- Basic derivative rules:
  - $\mathbf{(e^x)' = e^x}$
  - $\mathbf{(a^x)' = a^x \ln(a)}$
  - $\mathbf{(\ln(x))' = 1/x}$
- Chain rule forms:
  - $(e^{(g(x))})' = g'(x)\, e^{(g(x))}$
  - $(\ln(g(x)))' = g'(x) / g(x)$
- Expect to use: Just like on Exam 2
  - Product rule
  - Quotient rule
  - Chain rule

7. Antiderivatives (Indefinite Integrals)

- General Formulas
  - $\int x^n \, dx = x^{n+1} / (n+1) + C$
  - $\int e^x \, dx = e^x + C$
  - $\int a^x \, dx = a^x / \ln(a) + C$
  - $\int 1/x \, dx = \ln|x| + C$
- Tip: Take the derivative of your antiderivative to check your work!

8. Approximating Area (Riemann Sums)

- Setup: RECTANGLES
  - Width: $\Delta x = (b - a) / n$
  - Height: depends on if you are using
    - Left endpoints
    - Right endpoints
    - Midpoints
  - Area ≈ height * width



9. Fundamental Theorem of Calculus (FTC)

- FTC Part 2:
  - $\int$ from a to b of f(x) dx = F(b) – F(a)
  - where F is an antiderivative of f.
- Net Change Formula:
  - F(b) = F(a) + $\int$ from a to b of f(x) dx
- Meaning: The integral gives total accumulation (area).