Final Exam: Dec. 12 at 3:30pm in CHBE 101.
(2.5 hours).

- HW10 - Due
- HW11 and solutions posted
  - not for marks for practice.
- Exam Review Posted.
- last year's exam posted
  - Solutions to follow.
- Term Grades will be posted Friday.
- Complete MAPS (survey).
- Course Evals; do them.

How to study and where to get problems?

- Learning Objectives.
- Practice Problems.
- HWs.
- Labs.
- Quiz
- Last year's Exam / review.
- Last year's Labs, HW, Quizzes, Midterm.

Still need to be able to work with these.

Topics:
- Review
  - trig, unit circle
  - e^x, $\ln x$
  - $x^2 \cdot x^3 = x^5$

  } no explicit exam questions

- Limits — limits will enter into the definition of derivative and integral.
- Asymptotes.

  may have to draw or explain but not compute.

- Definition of Derivative.
  - State/explain/compute
- Compute Derivatives
  - power, product, quotient, chain.
- Find Equations of Tangent Lines.
- Related Rates.
- Riemann Sums.
  - state/explain definition of integral
  - approximate area with rectangles
    * right/left endpoints.
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- Definite / Indefinite Integrals.
  - simple integrals
  - Substitution
  - integration by parts.
- Integral "word problems"
- Expect to draw a/some function(s).

Review: Substitution:

- $\int \sin x \cos x \, dx$. — $\cos x$ is derivative of $\sin x$.

take $u = \sin x$

$du = \cos x \, dx$.

- $\int \underbrace{(x^2+1)}_{u}^2 x \, dx$. — kind of derivative of x^2.

take $u = x^2 + 1$.

$\frac{1}{2} du = 2x \, dx$.

Good choices for u include:

function inside another function.
- $\int e^x \sin(\underbrace{2+e^x}_{u}) \, dx$. — u.

Things in denominators.
- $\int \frac{\sin x (\cos x + 1)}{\underbrace{\cos x}_{u}} \, dx$. — u.

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$x = u - 1$.

Things in Square roots

- $\int (x^2+2)\sqrt{x+1}\,dx$.

$x+1$: u.

Integration by Parts.

$$\int u\,dv = uv - \int v\,du.$$

We differentiate u and integrate dv.

Choose u and dv to make the integral easier.

Ex: $\int \overbrace{x}^{u} \underbrace{e^x\,dx}_{dv}$.

$u = x$ ← gets easier.

$du = dx$ ← doesn't change much.

$dv = e^x\,dx$

$v = e^x$ ← doesn't change much.

$= xe^x - \int e^x\,dx$.

$\int e^x\,dx$: easier.

- e^x, $\sin x$, $\cos x$: don't change much.
- x, x^2, x^3 : get easier with diff.
  - but can int. if necessary.
- $\ln x$: gets easier with diff.

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$$I = \sin^2 x - I.$$

$$\Rightarrow \quad 2I = \sin^2 x.$$

Sometimes these can be tricky.

$$+\int \underbrace{\sin x}_{u} \underbrace{\cos x\, dx}_{dv}.$$

$u = \sin x$ $\qquad dv = \cos x\, dx$

$\frac{du}{dx} = \cos x$ $\qquad v = \int \cos x\, dx$

$du = \cos x\, dx$ $\qquad v = \sin x.$

$$= \sin^2 x - \underbrace{\int \sin x \cos x\, dx}_{\text{move to left side}}.$$

$$\int \sin x \cos x\, dx + \int \sin x \cos x\, dx = \sin^2 x.$$

$$2\int \sin x \cos x\, dx = \sin^2 x$$

$$\int \sin x \cos x\, dx = \frac{\sin^2 x}{2}$$

Definite Integrals: anti-derivative.

- $\int_a^b f(x)\,dx = F(b) - F(a)$.

- $\int_{}^{} f(x)\,dx = 0$.