Homework is posted.

Poppers started Monday!!
You must have the correct popper form.

Finish Quiz 2 and Start Quiz 3 asap.

Test 2 registration starts at 12:01am Thursday.

Math 1432 - 13209

Jeff Morgan - jmorgan@math.uh.edu

Read the Syllabus

Use the Discussion Board on CourseWare to get and give help.

Lecture notes/videos, additional help material, course announcements, homework and EMCFs will be posted in the calendar below. **Note:** Practice Tests count the same as online quizzes.

Course Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
January 13 **Note:** Practice Test 1 counts the same as an online quiz. Exam 1 counts as a major exam.	14 **Notes** **Exam 1, PT1 and all Online Quizzes are open**	15 **UH events this week** **Examples from 7.1 that will help with EMCF01**	16 Notes: **pg, 4per** Vid notes: **pg, 4per** **Video** **Homework 1 posted**	17 **EMCF01 due at 9am** **Note:** Use a graphing calculator to solve a complicated equation.	18 Notes: **pg, 2per** Vid notes: **pg, 2per** **Video** Quiz in lab/workshop	19 **EMCF02 due at 9am**
20	21 MLK Day No Class	22. **UH events this week** **Last day to add**	23 **Notes, video notes, video** **EMCF03 due at 9am** **Homework 1 due** in lab/workshop **Homework 2 posted**	24 **Exam 1 and PT1 close**	25 **EMCF04 due at 9am** **Notes, video notes, video** Quiz in lab/workshop	26 **Quiz 1 closes** (7.1-7.2)
27 **Free Access ends today!! Purchase your Access Code!!**	28 **EMCF05 due at 9am** Notes – **page, 4-per** **video notes, video** Homework 2 due in lab/workshop	29 **UH events this week**	30 **EMCF06 due at 9am** Blank slides: **page, 4-per** **Homework 3 posted** **Last day to drop without receiving a W**	31 **Register on CourseWare for Exam 2**	February 1 **EMCF07 due at 9am** Quiz in lab/workshop	2 **Quiz 2 closes** (7.3-7.5) Help with selected problems in 7.7 and 7.8.

Please tell you high school friends
and former teachers about our
High School Mathematics Contest

February 9th
University of Houston

http://mathcontest.uh.edu

Free

Review: What is the solution to $y' = ky$?

constant

$y = Ce^{kt}$

$y(0)$

Give the solution to $u'(t) + 3u(t) = 0,\ u(0) = 2.$

diff. eq.

initial data

initial value problem

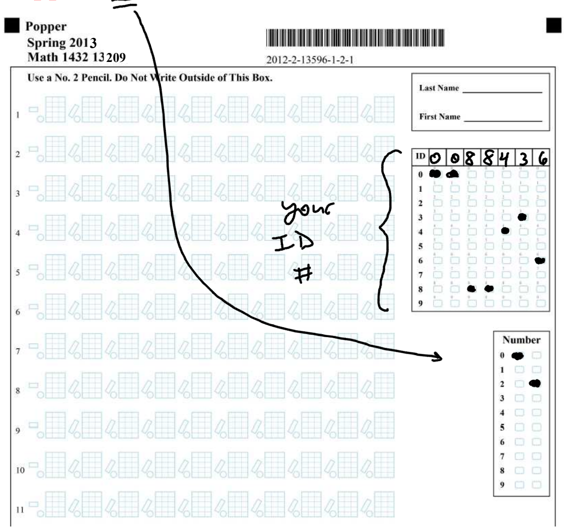
$u'(t) = -3u(t)$

$u(t) = Ce^{-3t}$

$2 = C$

$\Rightarrow u(t) = 2e^{-3t}.$

Popper P02



Popper P02

1. Find the solution to the initial value problem $y' + 2y = 0,\ y(0) = 15$. Give the value of $y(1)$.

2. $\displaystyle\int_0^1 2^{3x}\,dx = \frac{1}{3\ln(2)} 2^{3x}\Big|_0^1 = \frac{1}{3\ln(2)}\left[8 - 1\right] = \frac{7}{3\ln(2)}$

3. Give the slope of the tangent line to $f(x) = \arctan(2x)$ at $x = 1$.

Recall:

Chain Rule Derivative Formulas	Consequences
$\dfrac{d}{dx}\arcsin(u) = \dfrac{1}{\sqrt{1-u^2}}\dfrac{du}{dx}$	$\displaystyle\int \frac{1}{\sqrt{1-u^2}}\,du = \arcsin(u) + C$
$\dfrac{d}{dx}\arctan(u) = \dfrac{1}{1+u^2}\dfrac{du}{dx}$	$\displaystyle\int \frac{1}{1+u^2}\,du = \arctan(u) + C$

Aside on inverse trig integration formulas...

Assume $a > 0$.

$w = \frac{u}{a}$

$dw = \frac{1}{a}\,du$

"Looks like" $\int \frac{1}{1+u^2}\,du$

$$\int \frac{1}{a^2+u^2}\,du = \int \frac{1}{a^2\left(1+\frac{u^2}{a^2}\right)}\,du = \frac{a}{a^2}\int \frac{1}{1+\left(\frac{u}{a}\right)^2}\,\frac{1}{a}\,du$$

$$= \frac{1}{a}\arctan\left(\frac{u}{a}\right) + C$$

$$\int \frac{1}{\sqrt{a^2-u^2}}\,du = \text{similar}$$

$$= \arcsin\left(\frac{u}{a}\right) + C$$

Examples:

$$\int \frac{1}{4+x^2}\,dx = \int \frac{1}{2^2+x^2}\,dx = \frac{1}{2}\arctan\left(\frac{x}{2}\right)+C$$

$$\int \frac{\cos(x)}{\sqrt{3-\sin^2(x)}}\,dx = \int \frac{1}{\sqrt{3-u^2}}\,du$$

$u = \sin(x)$

$du = \cos(x)\,dx$

$$= \int \frac{1}{\sqrt{(\sqrt{3})^2-u^2}}\,du$$

$$= \arcsin\left(\frac{u}{\sqrt{3}}\right)+C$$

$$= \arcsin\left(\frac{\sin(x)}{\sqrt{3}}\right)+C$$

New

Hyperbolic Functions

Definitions

$$\cosh(x) = \frac{e^x+e^{-x}}{2} \qquad \text{"hyperbolic cosine"}$$

$$\sinh(x) = \frac{e^x-e^{-x}}{2} \qquad \text{"hyperbolic sine"}$$

$$\tanh(x) = \frac{\sinh(x)}{\cosh(x)} \qquad \coth(x) = \frac{\cosh(x)}{\sinh(x)}$$

$$\operatorname{sech}(x) = \frac{1}{\cosh(x)} \qquad \operatorname{csch}(x) = \frac{1}{\sinh(x)}$$

$\cosh(x)$ = hyperbolic cosine of x

$\sinh(x)$ = hyperbolic sine of x

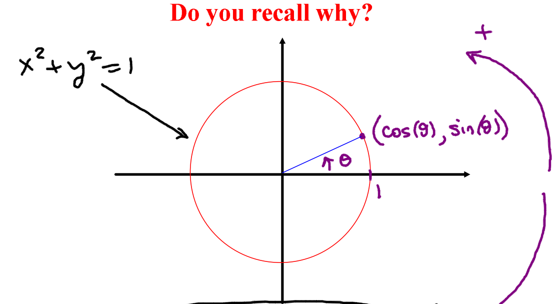
$\tanh(x)$ = hyperbolic tangent of x $\quad$ $\coth(x)$ = hyperbolic cotangent of x

$\operatorname{sech}(x)$ = hyperbolic secant of x $\quad$ $\operatorname{csch}(x)$ = hyperbolic cosecant of x

Where do these names come from?

First, recall that sine and cosine are called circular functions.

Do you recall why?



$$\boxed{\cos^2(\theta)+\sin^2(\theta)=1}$$

Now let's do some computations with cosh and sinh.

$$\cosh^2(t) = \left[\frac{1}{2}\left(e^{t} + e^{-t}\right)\right]^2 = \frac{1}{4}\left(e^{2t} + 2 + e^{-2t}\right)$$

$(a+b)^2 = a^2 + 2ab + b^2$

$$\sinh^2(t) = \left[\frac{1}{2}\left(e^{t} - e^{-t}\right)\right]^2 = \frac{1}{4}\left(e^{2t} - 2 + e^{-2t}\right)$$

$(a-b)^2 = a^2 - 2ab + b^2$

$$\cosh^2(t) - \sinh^2(t) = \frac{2}{4} - \frac{-2}{4} = 1$$

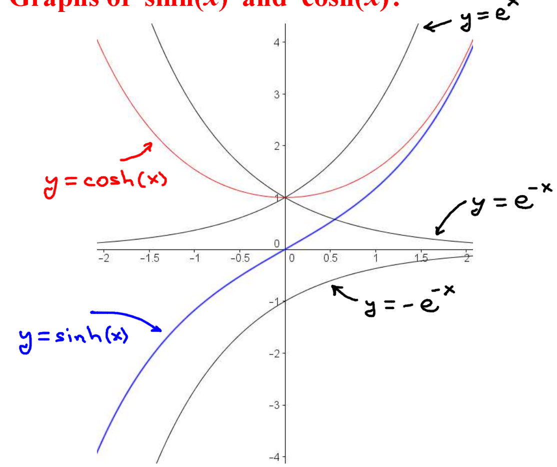
Hyperbolic Identity

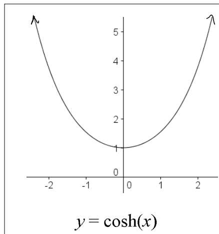
$$\boxed{\cosh^2(t) - \sinh^2(t) = 1}$$

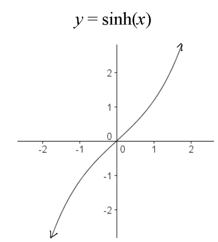
$x = \cosh(t)$, $y = \sinh(t)$

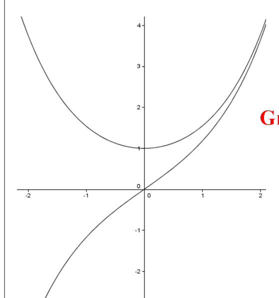
$$\boxed{x^2 - y^2 = 1}$$

Graphs of sinh(x) and cosh(x)?









Graphed together!!

Derivatives

$$\frac{d}{dx}\cosh(x) = \frac{d}{dx}\left(\frac{1}{2}e^{x} + \frac{1}{2}e^{-x}\right) = \frac{1}{2}e^{x} - \frac{1}{2}e^{-x}$$
$$= \sinh(x)$$

$$\frac{d}{dx}\sinh(x) = \frac{d}{dx}\left(\frac{1}{2}e^{x} - \frac{1}{2}e^{-x}\right) = \frac{1}{2}e^{x} + \frac{1}{2}e^{-x}$$
$$= \cosh(x)$$

Chain Rule Formula and Consequences

$\frac{d}{dx}\cosh(u) = \sinh(u)\frac{du}{dx}$	$\int \cosh(u)\,du = \sinh(u) + C$
$\frac{d}{dx}\sinh(u) = \cosh(u)\frac{du}{dx}$	$\int \sinh(u)\,du = \cosh(u) + C$

Learn the derivative formulas for tanh, coth, sech and csch!!

Example: Compute $\frac{d}{dx}\cosh\left(\underbrace{\ln\left(\exp(x) + 2x\right)}_{u}\right)$

$$= \sinh(u)\boxed{\frac{du}{dx}}$$

$$= \sinh\left(\ln\left(e^{x} + 2x\right)\right) \cdot \frac{1}{e^{x} + 2x} \cdot \left(e^{x} + 2\right)$$

Popper P02

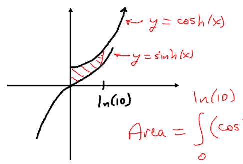
4. Give the slope of the tangent line to $f(x) = \cosh(2x) + \sinh(-3x)$ at $x = 0$.

-3

5. The answer is 1/2.

6. The answer is -13/7.

Example: Find the area bounded by the graphs of $f(x) = \cosh(x)$ and $g(x) = \sinh(x)$ for $0 \le x \le \ln(10)$.



$$\text{Area} = \int_0^{\ln(10)} \left(\cosh(x) - \sinh(x)\right) dx$$

$$= \left(\sinh(x) - \cosh(x)\right)\Big|_0^{\ln(10)}$$

$\sinh(x) = \frac{1}{2}e^x - \frac{1}{2}e^{-x}$

$\cosh(x) = \frac{1}{2}e^x + \frac{1}{2}e^{-x}$

$$= -e^{-x}\Big|_0^{\ln(10)}$$

$$= -\left(e^{-\ln(10)} - e^0\right)$$

$$= -e^{\ln(\frac{1}{10})} + 1$$

$$= -\frac{1}{10} + 1 = \frac{9}{10}.$$