Math 1432 - 13209

Jeff Morgan - 651 PGH - 11-noon MWF

http://www.math.uh.edu/~jmorgan/Math1432

Test 2 is will be given in CASA starting February 14. Start registering on January 31st at 12:01am.

Homework 2 is posted and due on Monday.

EMCF04 was due this morning at 9am. **EMCF05** is due Monday morning at 9am.

Online Quizzes 1 and 2 are Available on CourseWare, and **Quiz 1** expires tomorrow tonight.

Poppers start next Monday! Get your forms from the UC Book Store.

Access Codes are due on Sunday! Get yours from the UC Book Store.

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Read the Syllabus

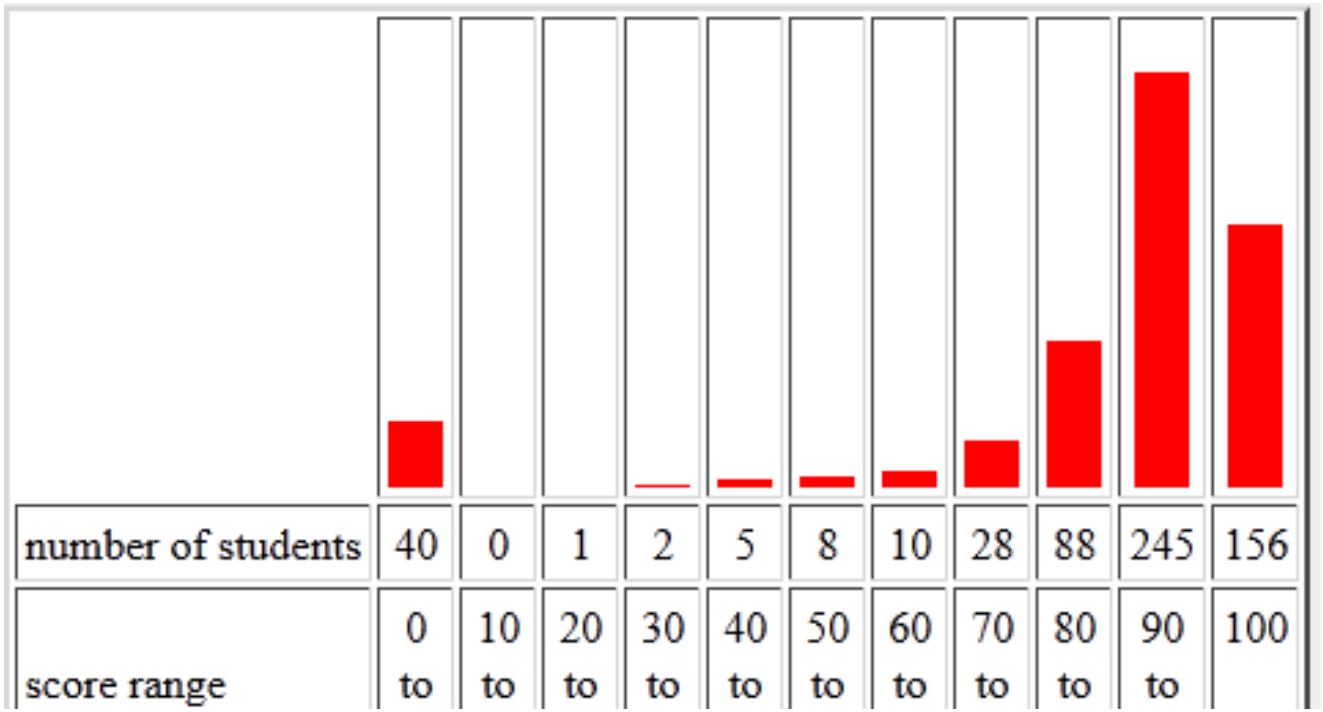
Use the Discussion Board on CourseWare to get and give help.

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** Blank slides: **page, 4-per** 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** Homework 2 due in lab/workshop	29 **UH events this week**	30 **EMCF06 due at 9am** 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)

Test 1 Scores



number of students	40	0	1	2	5	8	10	28	88	245	156
score range	0 to	10 to	20 to	30 to	40 to	50 to	60 to	70 to	80 to 89	90 to 99	100

Please tell you high school friends and former teachers about our

High School Mathematics Contest

February 9th

University of Houston

Free

http://mathcontest.uh.edu

Review Examples: $\dfrac{d}{dx}\left(2+\sin(x)\right)^{3x} = \left(2+\sin(x)\right)^{3x}\left[\dfrac{3x\cos(x)}{2+\sin(x)} + 3\ln\left(2+\sin(x)\right)\right]$

$y = \left(2+\sin(x)\right)^{3x} \Rightarrow \ln(y) = \ln\left(\left(2+\sin(x)\right)^{3x}\right)$

logarithmic differentiation.

$\Rightarrow \ln(y) = 3x\ln\left(2+\sin(x)\right)$

diff wrt x

$\frac{1}{y}y' = \frac{3x\cos(x)}{2+\sin(x)} + 3\ln\left(2+\sin(x)\right)$

$$\frac{d}{dx}\ln\left(\cos(2x)+3\right) =$$

$$= \frac{-2\sin(2x)}{\cos(2x)+3}$$

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

$u = \cos(3x)$

$du = -3\sin(3x)\,dx$

$$= -\frac{1}{3}\ln\left(|u|\right) + C$$

$$= -\frac{1}{3}\ln\left(|\cos(3x)|\right) + C$$

$$\int \tan(x) = -\ln\left(|\cos(x)|\right) + C \quad (*)$$

$$= \ln\left(|\sec(x)|\right) + C$$

$$\int \cot(x)\,dx = \int \frac{\cos(x)}{\sin(x)}\,dx$$

$$= \ln\left(|\sin(x)|\right) + C \quad (*)$$

$$= -\ln\left(|\csc(x)|\right) + C$$

Other

Consequences of $\int \frac{1}{u}du = \ln(|u|) + C.$

$$\int \tan(x)dx = \ln(|\sec(x)|) + C$$

$$\int \cot(x)dx = -\ln(|\csc(x)|) + C$$

$$\int \sec(x)dx = \int \sec(x)\,\frac{\sec(x)+\tan(x)}{\sec(x)+\tan(x)}\,dx$$

$$\int \csc(x)dx = \int \frac{\sec^2(x)+\sec(x)\tan(x)}{\sec(x)+\tan(x)}\,dx$$

$$= \ln(|\sec(x)+\tan(x)|) + C$$

$$= -\ln(|\csc(x)+\cot(x)|) + C$$

u substitution versions:

$$\int \tan(u)\,du = \ln\left(|\sec(u)|\right) + C$$

$$\int \cot(u)\,du = -\ln\left(|\csc(u)|\right) + C$$

$$\int \sec(u)\,du = \ln\left(|\sec(u) + \tan(u)|\right) + C$$

$$\int \csc(u)\,du = -\ln\left(|\csc(u) + \cot(u)|\right) + C$$

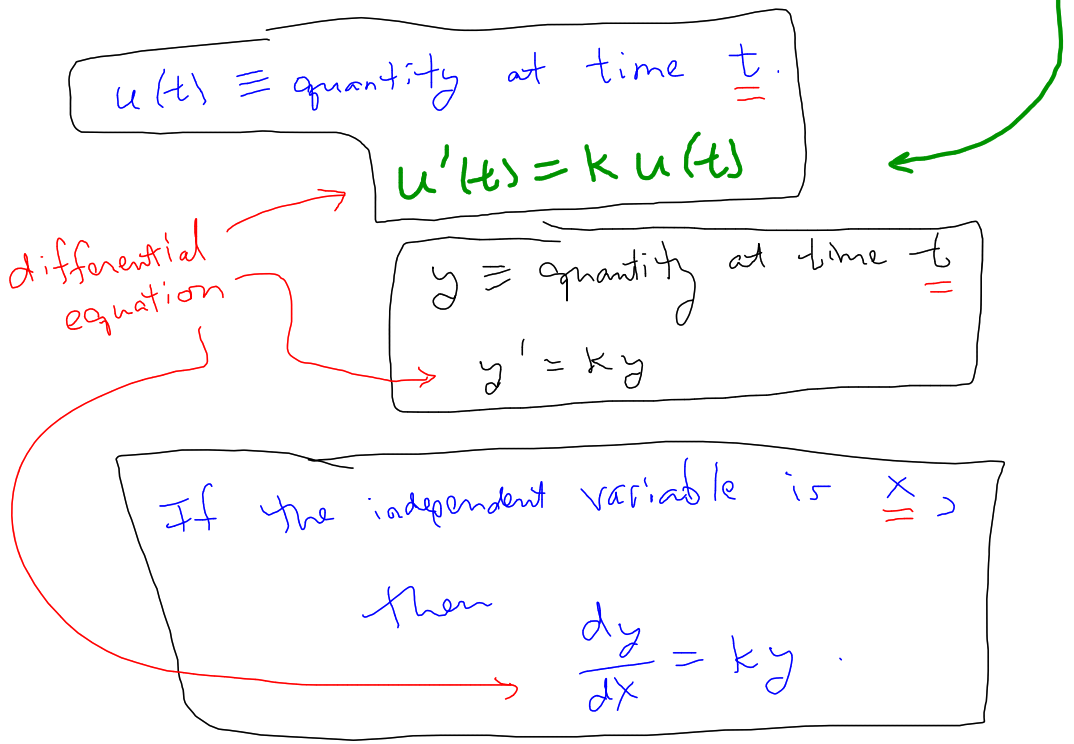
New

Exponential Growth and Decay

Introduction:

- Population Growth
- Radioactive Decay
- Investment
- Mixing Problems

Common Theme: There is a quantity that changes at a rate proportional to the amount present.



How do we solve $u'(t) = k\,u(t)$?

(k: constant)

→ Find $u(t)$.

One approach:

$$u'(t) + (-k)\,u(t) = 0$$

$$e^{-kt}\,u'(t) + e^{-kt}(-k)\,u(t) = 0$$

$$\frac{d}{dt}\left(e^{-kt}\,u(t)\right) = 0$$

$$\Rightarrow \quad e^{-kt}\,u(t) = C \qquad (C: \text{constant})$$

$$u'(t) = k\,u(t) \iff \boxed{u(t) = C\,e^{kt}}$$

$$\frac{dy}{dx} = k\,y \iff y = C\,e^{kx}$$

$$y' = 3y \iff y = C\,e^{3t}$$

(ind. variable is t)

$$w'(x) = -2\,w(x) \iff w(x) = C\,e^{-2x}$$

Example: Find a function that satisfies $y' = -2y$ and $y(0) = 3.$ ← initial data

Use x as the independent variable (or what ever you want)

$\Downarrow$

$y = Ce^{-2x}$ → $3 = Ce^{0} = C$

$\Rightarrow$ $\boxed{y = 3e^{-2x}}$

Example: Find a function that satisfies $y'(x) - 3y(x) = 0$ and $y(0) = 2.51.$

$y'(x) = 3y(x) \Rightarrow y(x) = Ce^{3x}$ → $2.51 = C$

$\Rightarrow$ $\boxed{y(x) = 2.51e^{3x}}$

Example: Give all functions that satisfy $u'(t) = 0.3u(t).$

$\Downarrow$

$\boxed{u(t) = Ce^{0.3t}}$

Examples: Suppose a culture of bacteria is growing in such a way that the change in the number of bacteria is proportional to the number present. The number of bacteria double every 200 minutes and there are currently 5,000 bacteria in the culture. How many bacteria were present 2 hours ago?

Radio-active substances change at a rate proportional to the amount present. What is the half-life of a radio-active substance if it takes 10 years for 28% of the substance to decay?

After 3 days a sample of radon-222 decayed to 58% of its original amount. What is the half-life of radon-222? How long would it take the sample to decay to 10% of its original amount?

Suppose a culture of bacteria is growing in such a way that the change in the number of bacteria is proportional to the number present. The number of bacteria double every 200 minutes and there are currently 5,000 bacteria in the culture. How many bacteria were present 2 hours ago?

local in time

$u(t) \equiv$ # of bacteria at time t (hours)

$u'(t) = k\,u(t)$

$\Downarrow$

$u(t) = Ce^{kt}$

Currently $\equiv$ "$t = 0$"

- $u(0) = 5000$
- # of bacteria double every $\frac{10}{3}$ hours.

Find $u(-2)$.

$5000 = C$

$\Rightarrow u(t) = 5000\,e^{kt}$

$10{,}000 = 5{,}000\,e^{\frac{10}{3}k}$

$2 = e^{\frac{10}{3}k} \Rightarrow \ln(2) = \frac{10}{3}k$

$\Rightarrow k = \frac{3}{10}\ln(2)$.

$u(t) = 5000\,e^{\frac{3}{10}\ln(2)\,t} = 5000 \cdot 2^{\frac{3}{10}t}$

$\Rightarrow u(-2) = 5000 \cdot 2^{-6/10}$

$= 3298.769\ldots$

≈ 3299 bacteria

Radio-active substances change at a rate proportional to the amount present. What is the half-life of a radio-active substance if it takes 10 years for 28% of the substance to decay?

Half-Life ≡ amount of time it takes for ½ to decay.

$u(t) \equiv$ amount of the radio-active substance at time t (years)

$u'(t) = k\,u(t)$

$\Rightarrow u(t) = Ce^{kt}$

Find ½ life, given $u(10) = .72\,u(0)$

$Ce^{10k} = .72\,C$

$\Rightarrow e^{10k} = .72 \Rightarrow 10k = \ln(.72)$

$\Rightarrow k = \frac{1}{10}\ln(.72)$.

$u(t) = Ce^{\frac{\ln(.72)}{10}t}$

Half-Life: Call it T. $u(T) = \frac{1}{2}u(0)$

$Ce^{\frac{\ln(.72)}{10}T} = \frac{1}{2}C$

$\frac{\ln(.72)}{10}T = \ln(.5)$

$\Rightarrow T = \frac{10\ln(.5)}{\ln(.72)}$

$= 21.1\ldots$ years

After 3 days a sample of radon-222 decayed to 58% of its original amount. What is the half-life of radon-222? How long would it take the sample to decay to 10% of its original amount?

See the video notes and video.