Derivatives

Examples have been given

Position – velocity (derivative of position) – acceleration (derivative of velocity)

Exponential function

y(x)=exp(x)

y(x)=ex

23=2\*2\*2

e=2,718281828459

e=2.7

e3=2.72\*2.72\*2.72

e3.12

The derivative of an exponential function is an exponential function

(ex)’=ex

(eax)’= eax \*(ax)’=aeax

Radioactive Decay

When one nucleus transforms into another by emitting radiation, we say it undergoes radioactive decay. All nuclei with Z> 82 and some unstable isotopes with Z <83 undergo this decay.

**The rate of decay is proportional to the number N of initial nuclei (which have not yet decayed) in the substance.**

N0- initial number of nuclei, *t*=0

After some time *t*, the number of nuclei is N(*t*)

0min 1 min 2 min 3 min 4 min

N0 N(1) N(2)

N(2)<N(1)

N(1)-N(2) is proportional to N(1)

N(2)-N(3) is proportional to N(2)

N(t)/N0

The number of the nuclei which disappeared during the time period from t to t+

is proportional to the number of nuclei at time t

When goes to zero becomes o derivative N’(t)

*N’(t)=-*

Please try to figure out how N(t) look like

(ex)’=ex

(eax)’= eax \*(ax)’=aeax

==

t=0 N(t)=N0

The half-life time of a radioactive substance is defined as the time it takes for half the original number of nuclei to decay.

T – half-life time

– 5730 years

There is an old building for which it has been concluded that 34% of the original amount of is left. How old is this building?

0.34=exp(-ln2\*t/5730)

ln(0.34)=-ln2\*t/5730

t=-5730\*ln(0.34)/ln2

– 28.8 years

Reproduction of populations

The population has very good development conditions, expressed mainly in such a way that each individual has unlimited access to food and breeding sites and that we are only observing the process of reproduction.

- each individual produces offspring every time τ, τ is fixed and the same

for all individuals

- each parent has λ descendant individuals

In the time interval (t, t + ∆t) there is ∆t/ τ reproduction acts. The average number of descendants in this time is (∆t/τ)\* λ per a parent.

Absorption of electromagnetic waves

a beam of monochromatic radiation after passing through a homogeneous solution of an absorbing substance at a concentration c it weakens according to the equation

I = I0 · exp( -kbc)

b- thickness of the layer

c-molar concentration

k-absorption constant

Harmonic oscillator

harmonic oscillator is a system that, when displaced from its [equilibrium](https://en.wikipedia.org/wiki/Mechanical_equilibrium) position, experiences a [restoring force](https://en.wikipedia.org/wiki/Restoring_force) F [proportional](https://en.wikipedia.org/wiki/Proportionality_(mathematics)) to the displacement x

F=m\*a=m\*x’’(t)=-kx(t)

x(t) – position x’’(t) is acceleration

k- proportionality constant

x’’(t)=(-k/m)\*x(t)

Please try to figure out how x(t) look like

cos(x)

First derivative -sin(x)

Second derivative –cos(x)

(cos(x))’=-sin(x)

(sin(x))’=cosx

[{\displaystyle {\vec {F}}=-k{\vec {x}},}](https://en.wikipedia.org/w/index.php?title=Special:MathWikibase&qid=Q170282)