UNIT7-DAY3-LaB1230

Wednesday, March 20, 2013
4:29 PM

Thinking Like a Geologist
About Nuclear Change III

UNIT7 DAY3

What are we going to learn today?

Quantify Nuclear Decay

Rate of Change

IMPORTANT INFORMATION

LM27 due Tue 9AM
HW8 due Tue 9 AM

Learning Assistant/Undergraduate TA
Register CH372C
Must have A or B in CH301

app on website

QUIZ: Clicker Question 1

If Beta – ASSUMED Negative need to say if positive

The following is an example of:

$^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + {}^{0}_{1}e$ (positive charge)

"Beta decay" without any other info ⇒ β or $^{0}_{-1}e$ or $^{0}_{-1}\beta$

Best answer

a) Fission
b) Fusion
c) Alpha decay
d) Beta decay
e) positron decay

Positively charge - positron

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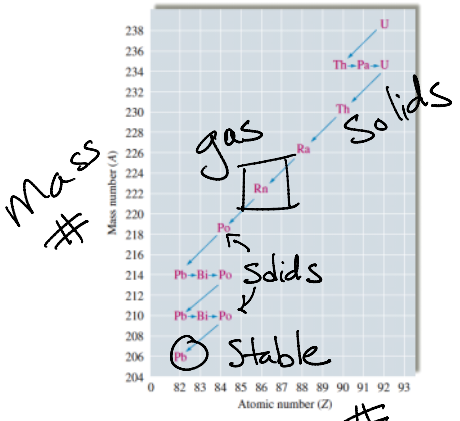
Radioactive Decay – just happens

spontaneously



gas

Solids

Solids

Stable

Mass #

Atomic #

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REVIEW BAND OF STABILITY

http://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html

Use this to review what we did on Tuesday

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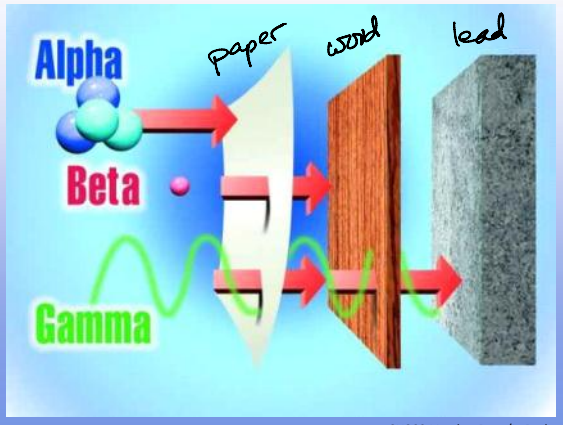
Effects Are Different – RATE of Decay also IMPORTANT



How much radiation?
Amt that came off
- amt
How much damage?
- type
- amt

RADIOACTIVITY DEMO

KCl salt:	K-40, g
Lantern mantle:	Th-232 and daughters, a b g
Monazite Rock:	Th-232 and daughters, a b g
Demo Button 1:	Cs-137, g
Demo Button 2:	Ra-226, g

10 pts EACH TIME

POLL: Clicker 2 LOTS OF CLICKERING!

Radioactive Decay Activity!

Read Introduction. Gather activity sheet, coin and I-clicker.

A) Standing (Po-210) Heads
B) Sitting (Pb-206) Tails

↳ once you sit, you stay sitting

POLL: Clicker Question 3

8. Most of the Po is lost:

A) during first event
B) same at each event
C) during the last event

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POLL: Clicker Question 4

10. What is the relationship between the amount of Po that decays in a given time period with the amount of Po that you have at the beginning of that time period.

A) not predictable from data
B) the more Po you have, the more Po decays
C) the less Po you have, the faster it decays

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$^{210}_{84}Po \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}\alpha$

1 : 1 : 1 ratio

POLL: Clicker Question 5

11. The relationship between the amount of Po lost and the amount of Pb gained is:

A) not predictable from data
B) Po decreases by the same amount that Pb increases
C) cannot make an interpretation

Rate of decrease of Reactant is equal

$$-\frac{\Delta Po}{\Delta t} = \frac{\Delta Pb}{\Delta t}$$

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change ← distance

$$\text{Speed} \quad \frac{\Delta d}{\Delta t}$$

change ← time

$$-\frac{\Delta Po}{\Delta t} = \frac{\Delta Pb}{\Delta t} = \frac{\Delta \alpha}{\Delta t}$$

$$\frac{\Delta Po}{\Delta t} \propto Po_{initial}$$

Δt Δt

$\frac{\Delta Po}{\Delta t} \propto Po_{initial}$

$\frac{\Delta Po}{\Delta t} = k\, Po_{initial}$

Super Important

First Order Kinetics

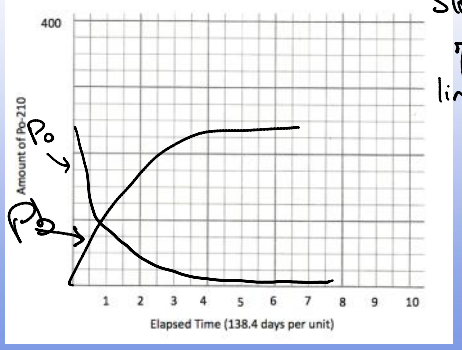
constant

What is "REACTION RATE"?

Rate is change in amount per change in unit time

rate can be calculated from slope of line!

Rate is the slope of the graph of amount vs time



If you know the rate of one reactant or product you know them all

How does Rate Depend on ~~Concentration?~~ AMOUNT
RATE LAW

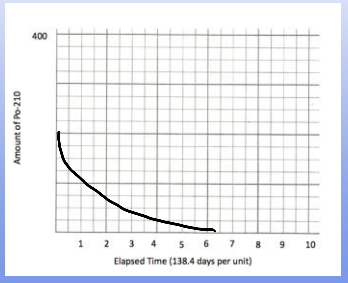
$\frac{\Delta Po}{\Delta t} = k\, Po_{initial}$

Note on your graph: Rate is changing with concentration

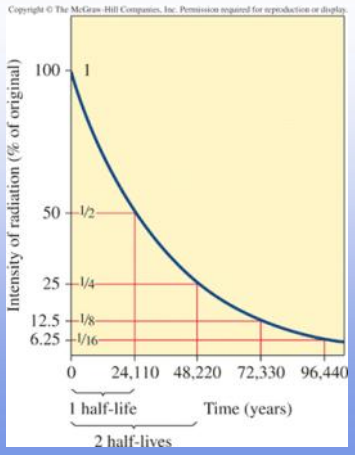
How does the rate depend on the amount of Po-210?

Rate is some function of the amount of the reactant molecules

Do an experiment to directly measure how the rate varies with amount



Pu-239 Radioactive Decay – Kinetics of Decay



Half life
amount of
time it takes
for 1/2 amount
to decay

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POLL: Clicker Question 7

15. Start with 96 student isotopes. How many events would have to occur to end up with 6 student isotopes?

A) 1
B) 2
C) 3
D) 4
E) 5

$96 \div 2$
$48 \div 2$
$24 \div 2$
$12 \div 2 = 6$

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Half-life: the time required for the level of radioactivity to fall to one-half of its value. Half-life – indication of stability of isotope.

Table 7.5 Half-Lives for Selected Isotopes

Radioisotope	Half-life
Uranium-238	4.5×10^9 years
Potassium-40	1.3×10^9 years
Plutonium-239	24,110 years
Carbon-14	5715 years
Cesium-137	30.2 years
Strontium-90	29.1 years
Thorium-234	24.1 days
Radon-222	3.82 days
Iodine-131	8.04 days
Plutonium-231	8.5 minutes
Polonium-214	0.00016 seconds

long

Short

POLL: Clicker Question 7

17. P-32 has a half-life of 14 days. After 3 months what would be the residual radioactivity of 1 millicurie of ATP labeled with P-32?

A) 62.5 microcuries
B) 6.25 microcuries
C) 15.6 microcuries
D) 1.56 microcuries

How many $t_{1/2}$? → 6 events

$$\frac{1\ mC}{2^6} = 0.0156\ mC$$

$15.6\ \mu C$

Human Made Radioactive Isotopes- byproducts of fission

Cs-137 - ½ life 30 years, beta emitter
I-131 - ½ life 8 days, beta emitter
Sr-90 – ½ life 29 years, beta emitter

Children exposed to Sr-39 can have been shown to have a higher % of bone and blood cancers, because:
a)Sr is similar to Fe
b)Sr is radioactive
c)Sr is similar to Ca
d)Sr has a ½ life which is longer that of childhood

What did we learn today?

Rate of Radioactive Decay
- Varies with Isotope
- Similar type of Rate – 1st Order
- 1st Order – Depends on amount of starting reactant
- Half Life – $t_{1/2}$