South Pasadena • AP Chemistry Name _____ Period ___

Ch 24 • Radioactivity—Nuclear Chemistry

STATION 1—QUIZ ON PEOPLE

Match the people with the following ideas. Each name may be used once, more than once, or not at all.
a) Albert Einstein b) Marie Curie c) Henri Becquerel

___ 1. Discovered two new radioactive elements.
___ 2. Was looking for a source of x-rays.
___ 3. Theorized that mass could be turned into energy.
___ 4. Earned two Nobel prizes for work on radioactivity.
___ 5. First used the term "radioactivity".
___ 6. Discovered radioactivity.
___ 7. Invented $E=mc^2$.
___ 8. Died of leukemia.

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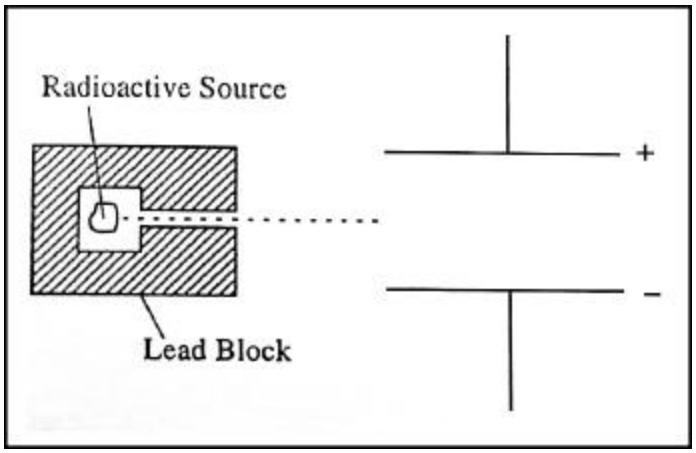
STATION 2—BECQUEREL RAYS

Show how α, β, and γ rays each behave when they pass through an electric field. Use the diagram below to illustrate your answer. What direction does each particle travel and what bending occurs.



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STATION 3—QUIZ ON RAYS

Match the rays with the following ideas. Each ray may be used once, more than once, or not at all.

a) alpha b) beta c) gamma

___ 1. Two protons and two neutrons

___ 2. High speed electron

___ 3. α

___ 4. $^{4}_{2}\mathrm{He}$

___ 5. Higher energy than x-rays

___ 6. β^{-}

___ 7. Helium nucleus

___ 8. $^{0}_{-1}\mathrm{e}$

___ 9. Most easily stopped.

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STATION 4—NUCLEAR EQUATIONS

Complete the following nuclear equations:

1. $^{59}_{27}\mathrm{Co} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{56}_{25}\mathrm{Mn} +$ ☐

2. $^{14}_{6}\mathrm{C} \rightarrow {}^{14}_{7}\mathrm{N} +$ ☐

3. $^{99}_{42}\mathrm{Mo} \rightarrow$ ☐ $+ {}^{0}_{-1}\mathrm{e} + {}^{0}_{0}\gamma$

4. (alpha decay of U-235)

5. $^{40}_{19}\mathrm{K} +$ ☐ $\rightarrow {}^{40}_{18}\mathrm{Ar}$

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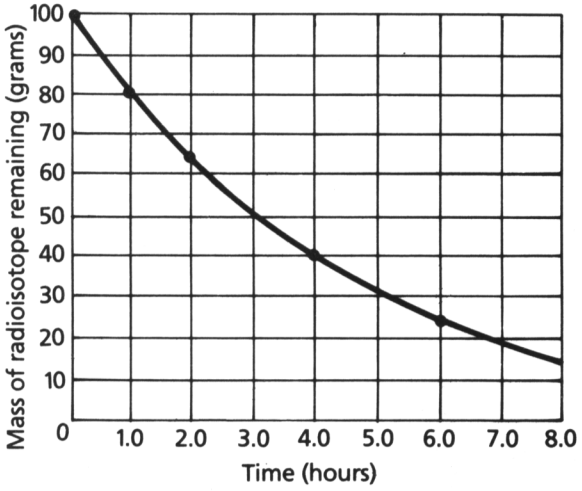
STATION 5—HALF LIFE GRAPHS



1. What is the half life of the graphed material? ____
2. What mass of radioisotope will remain after 12.0 hours? _____
3. Plot the data from a substance with a half-life of 1.5 hours.

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STATION 6—HALF LIFE PROBLEMS

1. Lr-257 has a half life of 8 seconds. What % of a sample will remain 32 seconds after it is made?

2. Na-24 has a half life of 15 hours. What is the rate constant, k, for Na-24 (include units)?

3. A 64 gram sample of I-131 is tested after 40 days and is found to contain only 2 grams of I-131. What is the half life of I-131?

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STATION 7—USES OF RADIOACTIVITY

Decide whether each of the following "uses" of radioactivity is True or False:

____ 1. Even after it has been packaged, gamma rays can be used to kill bacteria, mold and insects in food.

____ 2. The age of fossils can be found by measuring the amount of Carbon-14 that is left.

____ 3. Radioisotopes can be used for medical purposes, such as checking for a blocked kidney.

____ 4. Radioisotopes are used in industry to detect leaking pipes. A small amount is injected into the pipe. It is then detected with a Geiger counter above ground.

____ 5. Cancer treatment because gamma rays can kill living cells. Cancer cells can't repair themselves when damaged by gamma rays, as healthy cells can.

____ 6. A gamma source is placed on one side of welded metal and a photographic film on the other side. Weak points or air bubbles will show up on the film, like an X-ray.

____ 7. Am-241 (half life 460 years) keeps air ionized in a smoke detector.

____ 8. In paper mills, the thickness of the paper can be controlled by measuring how much beta radiation passes through the paper to a Geiger counter. Beta radiation is used because alpha particles do not penetrate paper.

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STATION 8—ENERGY FROM NUCLEAR CHANGES

The mass of an atom is not exactly the sum of the nucleons (neutrons & protons) and electrons.

The sum of 2 protons, 2 neutrons, and 2 electrons is 4.0322980 amu; however, the measured mass of He is only 4.00260 amu. What happens to this mass?

Match the types of nuclear changes with the equations:

___1. Fission
(occurs in nuclear reactors & atomic bombs)

___2. Fusion
(occurs in the Sun & hydrogen bombs)

___3. Neutron Bombardment

___4. Electron Capture

a) $^{238}_{92}U + ^{1}_{0}n \rightarrow ^{239}_{92}U$

b) $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{139}_{56}Ba + ^{94}_{36}K + 3^{1}_{0}n$

c) $^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$

d) $^{1}_{1}p + ^{0}_{-1}e \rightarrow ^{1}_{0}n$

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STATION 9—MORE HALF-LIFE PROBLEMS

Iodine-130 has a half-life of 8.0 days.

What is the value of the rate constant, k, for I-130?

What percentage of a sample of I-130 remains after 35 days?

What sort of decay would you predict for I-130? _____ (alpha, beta, positron)

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