Name:_____Class:_____Date:_____

The Case of Kirsten K.:
Nuclear Radiation

All Reports are to be filed using the correct format, following the Lab Report Style Guide

Part I: Crime Scene Soil Sample Evidence

Case Background

Finally, with your help, police were able to find the body of the victim, Kirsten K., and now consider this a murder investigation. When the police found the body, the victim was missing her left ring finger. Police have gathered evidence from the crime scene, including: shoe prints, soil samples, and bones fragments found near the crime scene. A medical tracer was also found in the victim's body which should help put a timeline and a cause of death to the disappearance and the murder of Kirsten K. Shoes were collected from each of the suspects' homes along with the shoes from the victim's body and taken to the lab to be analyzed for a specific nitrate found in the soil around the crime scene. Police are hoping that this evidence will narrow the suspect list down to those suspects who specifically had this soil nitrate compound in the soil sample on their shoes.

Purpose

To use the nitrates calibration curve to see which nitrate samples from the suspects match the crime scene sample.

Procedure

1. Test the nitrate soil samples taken from each suspect's shoe and from the crime scene.
2. Set the spec-20 to the wavelength of maximum absorbance = 400nm.
3. Record results of absorbance from the Spec-20 for each of the 4 samples from each of the 4 suspects in a data table in the data section.

Materials

- Spec-20 and supplies
- Nitrate samples from suspects #1-4 and victim
- Calibration curve

Data

Table #1: Concentration of Crime Scene Sample

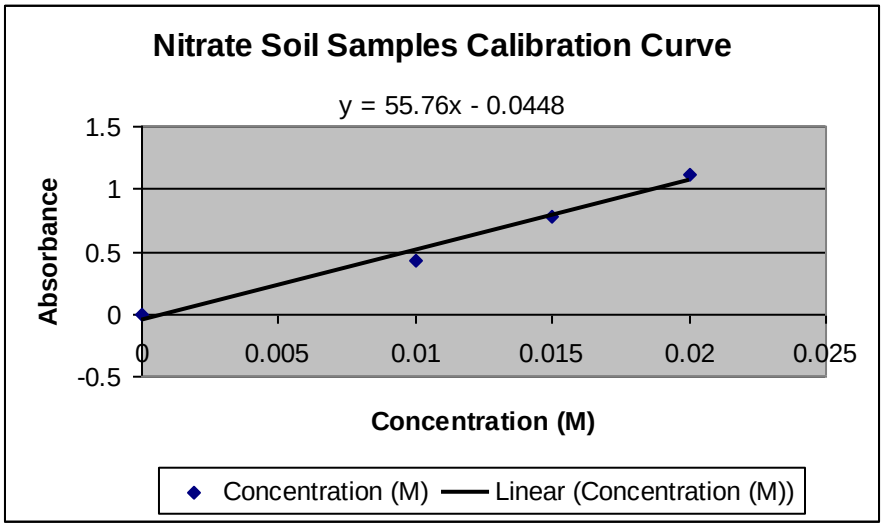
Location of Sample	Concentration (M)
Crime Scene	0.015M

Create a data table below to record the absorbance from each of the suspect samples in the data table format.

Analysis-Calculations

Police need the concentration for each of the 4 suspect samples to prove the match since the crime scene soil nitrate sample is given as a concentration in the data section.

Use the graph given below and/or the equation for the slope of the line to extrapolate and/or calculate the concentration for each of the suspect samples.



Calculations (if the equation for the slope of the line was used to find concentration, show calculations below)

Conclusion

Which of the suspects were present at the crime scene? How did the Spec-20 absorbance data help determine the suspects who were or were not present? Who are the lead suspects at this time and why?

Part II: The Shoeprint Evidence

Background Information

Shoeprints are found at the scene of a crime. The design of the shoe can often allow police to link a particular shoeprint with a given shoe type. While the shoe and owner cannot directly be linked in this manner, determining which suspects have similar shoes to the prints found at the crime scene may provide further evidence linking the suspects to the victim.

Purpose

To record evidence for the shoeprints made by each of the suspects' shoes and the victim's shoes to see if they match the prints found at the crime scene. Crime scene prints are in the sealed envelope marked with an evidence tag. ONLY view the evidence prints after making impressions of each of the suspect's shoes.

Procedure

Record the procedure in a numbered list of steps for recording the shoe print evidence.

Materials

List the materials used to complete the procedure.

Data

1. Create a data table to compare any quantitative and/or qualitative data from the shoe prints of the suspects and victim to those found at the crime scene.

2. Check the evidence file for shoe prints that were found at the crime scene and record your findings in the data table above **OR** create a new table to identify any matches.

Conclusion

What connections can be made, if any, between the crime scene shoe prints and the shoe prints from the suspects and victim? Does this help to narrow the suspect list, if so how? If not, why not?

Part III: The Bone Age Evidence

Background Information

Since discovering that the victim was missing her left ring finger, police have decided to scan the area, specifically the lake to find it. Police have found four total pieces of bone that they believe could be the finger of the victim. The police need to find out which piece of bone, if any, could belong to the victim for further testing.

Purpose

To determine which bone fragment(s) could have possible belonged to the victim by using radioactive isotope dating.

Data

Table #1: Bone Fragment #1

Isotopes Present	Amount (moles)
Calcium-40	0.561
Iron-56	0.003
Carbon-14	5.669
Rhodium-103	9.321
Nitrogen-14	6.003
Scandium-45	1.056

Table #2: Bone Fragment #2

Isotopes Present	Amount (moles)
Uranium-235	9.632
Nitrogen-14	3.000
Carbon-14	1.575
Lead-206	2.595
Rubidium-87	7.667
Scandium-45	8.531

Table #3: Bone Fragment #3

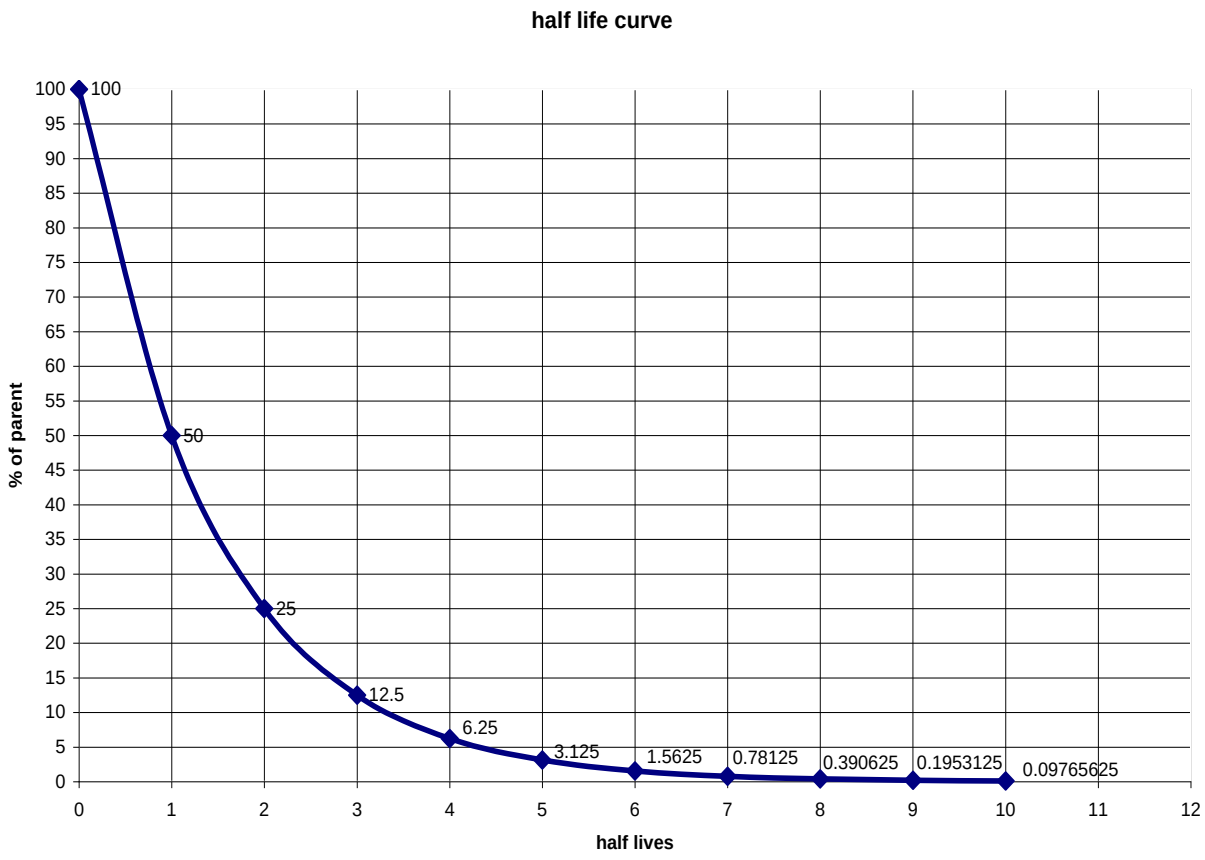
Isotopes Present	Amount (moles)
Lead-208	3.250
Nitrogen-14	0.000
Argon-40	0.001
Scandium-45	1.376
Uranium-235	11.125
Carbon-14	0.008

Table #4: Bone Fragment #4

Isotopes Present	Amount (moles)
Carbon-14	5.320
Iron-56	1.500
Potassium-40	2.678
Thorium-232	9.381
Lead-206	1.333
Nitrogen-14	2.054

Analysis—Graphing

Identify the % of parent and % of daughter isotopes for each sample on the half-life curve provided:



Parent Isotopes	Daughter Isotopes	Half-life of Parent (years)	Effective Dating Range (years)	Minerals and other materials that can be dated
Uranium-238 Uranium-235 Thorium-232	Lead-206 Lead-207 Lead-208	4.5 billion 710 million 14 billion	10million-4.5 billion	Zircon, Uraninite, and pitchlende
Potassium-40	Argon-40 Calcium-40	1.3 billion	100,000-4.6 billion	Muscovite, Biotite, Hornblende, whole volcanic rock
Rubidium-87	Strontium-87	47 billion	10-million-4.6billion	Muscovite, Biotite, Potassium-feldspar, whole metamorphic or igneous rock
Carbon-14	Nitrogen-14	5,730	100-50,000	Wood, charcoal, peat, grain, and other plant material; bone, tissue, and other animal material; cloth, shell, groundwater, ocean water, and glacier ice

Analysis—Calculations

Show calculations for each of the bone fragments to prove the age and whether or not it belongs to the victim:

Bone Fragment #1

Bone Fragment #2

Bone Fragment #3

Bone Fragment #4

Conclusion

Which of the bone fragments, if any, belongs to the victim? How can the others be ruled out? Is this test conclusive, why or why not?

Part IV: The Medical Tracer Evidence

Background Information

After further testing was done on the finger of the victim, it was found that the victim had the medical tracer, I-131, in her system. The medical tracer iodine-131 is known to have a half-life of 8.04 days and goes through beta decay. When the bone marrow from the victim's finger was tested, it was found to have the isotope $^{131}_{56}Ba$.

Purpose

To determine the time frame in which the murder took place by figuring out how long ago the body was exposed to the medical tracer.

Analysis—Calculations

A. Show all work for the reverse decay pattern for the $^{131}_{56}Ba$.

B. Using the time frame determined from the medical tracer data, calculate the amount of medical tracer (I-131) that was given to the victim prior to her death if 4.35g was calculated to remain in the body when it was found by police. The lethal dose of medical tracer is 30.0g.

Conclusion

What is the time frame of the murder, starting from the victim's reported disappearance up to the murder?

Who are the lead suspects at this point? Don't forget to look at the suspect files. Can you determine any motives of any of the prime suspects at this point?