Name ________________ per___ due date_______ mail box _____

RADIOACTIVE ISOTOPE M&M'S LAB

Background reading - Consider how scientists determine the age of things.

Many of the earth's geological processes such as the eruption of volcanoes or earthquakes, the drifting of the continents, and erosion or deposition of lands, occur at irregular intervals. There can be spurts of activity and then long durations of inactivity. These processes often reveal *relative time* which can help provide science with a timeline for the age of the earth but not *absolute time*. Geologists that study the age of the earth and its rock layers need ways to accurately or *absolutely* determine their age. Likewise, in biology, biologists need ways to actively date ancient samples of human, animal or plant remains. The answer to how science can accurately date and determine the age of things, lays squarely in the realm of another science discipline, physical science or physics. And, what is the answer to absolute time dating for determining the age of substances on earth?

1.Write→____

____

Testing radioactive minerals in rocks best determines absolute time. Radioactive decay goes on like clockwork at an even and continuous pace. The nuclei of radioactive atoms break down releasing particles and radiation. Finally, the radioactive element changes to a stable new element. The radioactive element is called the parent, and the stable, new element is called the daughter.

The rate of radioactive decay is measured by half-life. Half-life is the time it takes for the atoms of a parent element to change into atoms of the daughter element. Consider the element radium 226, which has a half-life of 1,622 years. What happens to 10 grams of radium after 1,622 years? Five grams of radium remain, and five grams will have changed to lead.

Vocabulary-

Word bank: Radioactive Decay - Half-life - Radiation - Isotope -

2.______________ each of two or more forms of the same element that contain equal numbers of protons but different numbers of neutrons in their nuclei, and hence differ in relative atomic mass, but not in chemical properties; in particular, a radioactive form of an element.

3.______________ the amount of time taken for the radioactive decay of a specific isotope to fall to half its original value.

4.______________ the emission of radiation specifically in the form of particles (protons or neutrons) from the nucleus of an atom. This reduces the atomic mass and potentially even the elements identity.

5.______________ the emission of energy as electromagnetic waves or as moving subatomic particles, especially high-energy particles that cause ionization, such as the case with the sun's energy in our atmosphere.

Materials -

- M&Ms
- Container with a lid (petri dish)

Rules -

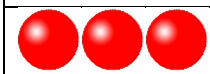
- No throwing M&Ms, no fighting over M&Ms, you must share M&Ms with lab partner, no touching of other person's M&Ms and DO NOT eat the M&Ms until the end (no you cannot have more M&Ms and no stealing M&Ms from others)
- Any infraction of the above mentioned rules will result in minus one (-1) on your lab paper.
- Second infraction you sit out and forfeit your M&Ms.
- Have fun, behave

NOTES:

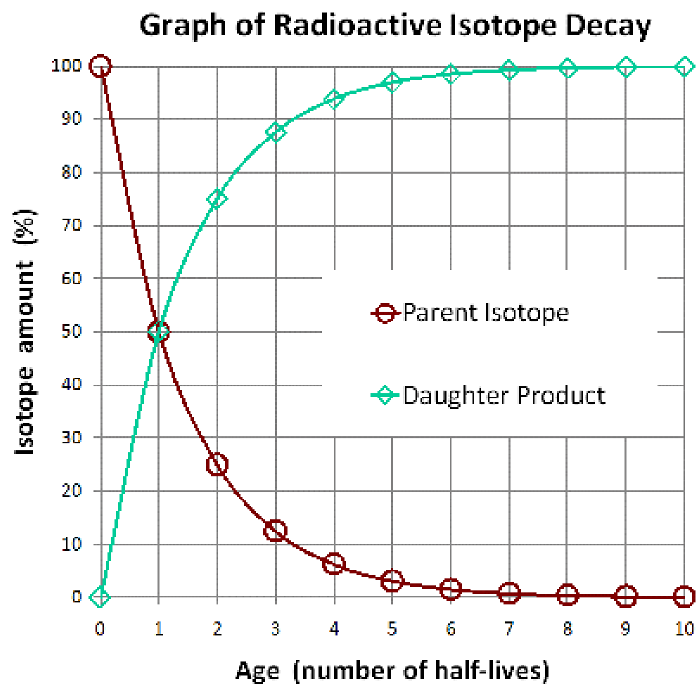
Procedure –

1. Place the candies **m** side down.
2. Count how many atoms of the ***parent*** radioactive element you have. (number of M&Ms) ________ ←write
3. The element Mm has a ***half-life*** of 10 seconds. Watch the clock /count to ten and then shake your atoms up.
4. Remove the **m** sides up M&Ms. RECORD this data in the table.
   Recall these are now a more stable ***daughter*** -isotope. They may be safe to eat now.
5. Shake – Eat – Count **<u>unchanged</u>** M&Ms (**m** side down). RECORD this data in the table.
6. Shake – Eat – Count **<u>unchanged</u>** M&Ms (**m** side down). RECORD this data in the table.
7. Keep going through half-life counts until all of the radioactive parent isotope M&Ms have decayed into their daughter (**m** side up) stable isotope form.

6. Data Table –

Half-life cycles (10sec.)	**0**									
 # of **<u>changed</u>** atoms										**M&Ms that you can eat but record the data first. N-14**
 # of **<u>Unchanged</u>** atoms										**Don't Eat! These are a radioactive isotope. C-14**

7. Build a line graph -



Take a look at the graph to the right of your own. The parent isotope represents unchanged atoms of carbon-14 (facedown M&Ms). The daughter product represents an increasing number of nitrogen atoms M&Ms, M side up that you ate, over time (half-lives).

Did the number of M&Ms, M side up, that you got to eat increase or decrease over time (half-lives).

8. Circle one → **increase** or **decrease**

Explain why. ____

____

____

____

9. What do these two lines (from the graph) represent? How do you know this? Discuss and use at least **2** of the following vocabulary words: **radioactive, isotope, parent and daughter isotope, half-life, radioactive - decay**

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____.

Multiple Choice -

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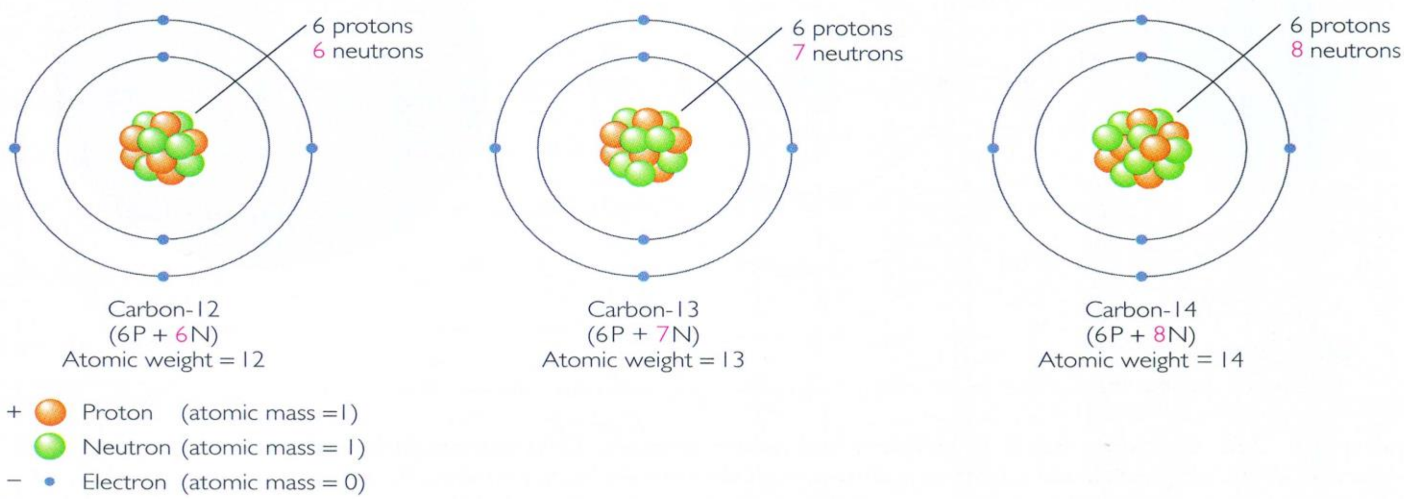
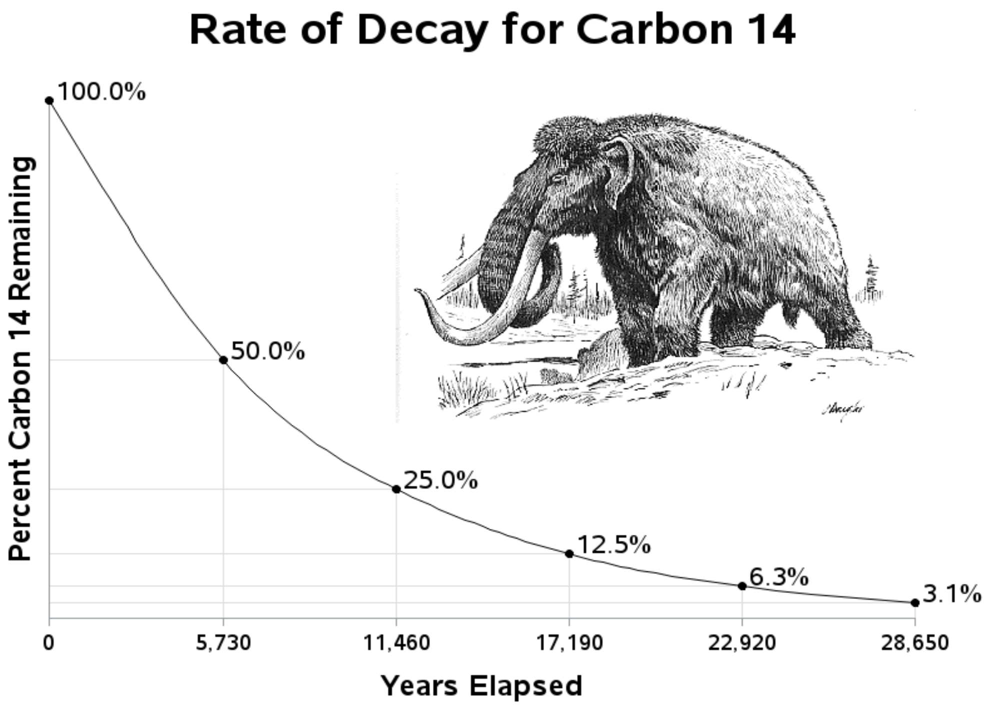


FIGURE 2.3 These three carbon isotopes all have the same number of protons and thus the same atomic number, 6. Their atomic masses differ, however, because they have slightly different numbers of neutrons. The atomic mass of any element is the average of the weighted sum of the atomic masses of its various isotopes. One isotope of an element—for example, carbon-12—is far more abundant than the others because natural processes favor that particular isotope.

1. Base your answers (1-3) on the above diagram. Which isotope of carbon has the greatest atomic mass?
   a. Carbon 12
   b. Carbon 13
   c. Carbon 14
   d. Cannot be determined

2. Which atomic particle gives carbon or any atom it identity?   (What makes carbon, carbon?)
   a. protons
   b. neutrons
   c. electrons
   d. quarks

3. Which atomic particle causes an isotopes mass or “weight” to vary?
   a. protons
   b. neutrons
   c. electrons
   d. quarks



Carbon-14 has a *half-life* of 5730 years. This means that statistically speaking if you had 100 carbon-14 atoms about ½ will have decayed into the more stable parent element nitrogen-14 from which they came every 5730yrs. Base your answers to the follow based on the above diagram. Imagine your M&Ms represent the atoms from samples at a paleontologist's dig site.

4. About half or 50% of your M&Ms remain unchanged, indicating the sample age to be about what age?
   a) 5730 yrs.
   b) 11460 yrs.
   c) 17190 yrs.
   d) 22920 yrs.

5. About 3/4 or 75% of your M&Ms have changed, meaning they have radioactively decayed in the daughter element nitrogen and 25% of the C-14 remains. What is the age of the sample?
   a) 5730 yrs.
   b) 11460 yrs.
   c) 17190 yrs.
   d) 22920 yrs.

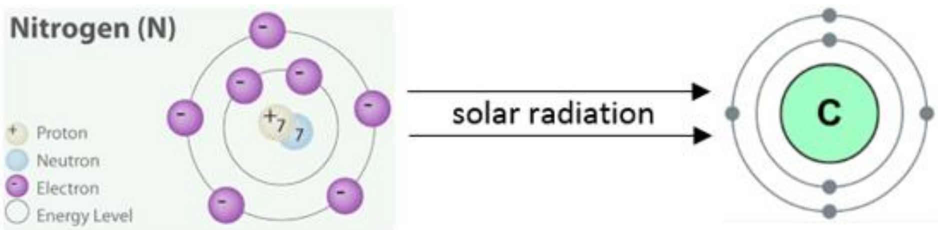
6. If your M&Ms represented the atoms in bones of an ancient Wholly Mammoth and only 1 or 2 M&Ms remained un-flipped after 5 tosses of the paper plate, how long ago did your sample roam the earth.
   a) 5730 yrs.
   b) 11460 yrs.
   c) 17190 yrs.
   d) 22920 yrs.

(hint) Note samples from question 5 & 6 are likely not wholly mammoth remains as they existed more in the 25k to 30k years ago range prior to and during the last ice age.

Where carbon-14 comes from:

7. Carbon is a common component of our atmosphere bound to oxygen in the form of carbon-dioxide or carbon- monoxide. Radiation from the sun interacts with these atmospheric gases and others the most of which is nitrogen. Nitrogen when bombarded by the sun's radiations can turn into carbon-14. The majority of the carbon in our atmosphere is carbon-12. Carbon-14 is small percentage of the atmosphere that has remained relatively consistent throughout our planet's recent history. The ratio of carbon-14 is changing however, due to carbon inputs to the

8. atmosphere from the combustion of fossil fuels.



Select the best answer based on your knowledge and the above passage.

a. Carbon-14 comes from carbon-12
b. Carbon-14 is a product of solar radiation in our atmosphere.
c. Carbon-14 comes from Santa Clause
d. Carbon-14 has 7 electrons

Multiple Choice – ANSWER SHEET fill it along with a compete header and receive a 2 points.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____