Atomic Theory Instructional Design

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EDTL 7100

Rationale

With the time spent reading articles and completing the field experience portion for EDTL 7100, it is obvious that my chemistry lessons are in need of a technology overhaul. Each article read reiterates the benefits of using technology in the classroom. Students of today constantly use technology. Computers, DVD players, and cell phones have surrounded them since birth. Today's students, having grown up immersed in technology, are considered digital natives (Sprenger, 2009). A digital native is one who has grown up using and surrounded by technology. These students attend school where the most common teaching methods were developed prior to the electronic age and have changed little since the Industrial Revolution (Cookson, 2009). Even though employers, politicians, and universities demand students acquire the skills for 21st Century jobs, too often, teaching is rooted in 20th or even 19th Century methods. As students receive instruction at low-level cognition levels, they are unable to make the connections between class content and life outside the classroom.

Jobs in the 21st Century call for a set of skills not entirely different than the skills needed in the past: critical thinking, collaboration, and problem solving (Rotherham and Willingham, 2009). Today, an emphasis must be placed on using teaching methods that promote the development of these skills. These skills must be developed in a manner that is relevant to students beyond the classroom. Technology use in the classroom promotes student learning for the 21st Century. The use of technology during instruction will provide students with guidance on how technology can be used in a responsible manner both in and out of the classroom.

Individuals learn best when what they learn through authentic, real-world contexts. In order to contextualize learning in the classroom, technology must be incorporated. Lemke and Coughlin (2009) propose four ways that technology can enhance learning for the 21st century.

Technology allows for the democratization of knowledge. The information is readily available to all. Teachers no longer need to be the gatekeepers. The second way technology can enhance learning is by improving participatory learning. Students have the ability to interact with their classmates, students from other countries, and experts in the field through internet based applications. Teachers can use technology to develop authentic learning scenarios for students by revising their current curriculums. The fourth way technology can enhance learning is through the creation of technology-based presentations.

"Students should be able to comprehend the news on the day they graduate." (Trefil & O'Brien-Trefil, 2009). In their article, *The Science Students Need to Know*, the authors stress the need for a new goal for science education. Too often, science instruction attempts to mold students into miniature scientists. Instead, the focus must be on making students scientifically literate so they can understand scientifically related issues in the world around them. Students in this physics and all science classrooms need to see how their daily lesson translates into something meaningful beyond the classroom walls. This need for finding meaning in lessons is echoed in the call for contextualized teaching and learning (CTL). CTL emphasizes authentic, active learning from students' experiences (Chiarelott, 2006, p.6).

In order to incorporate technology into my chemistry lessons, I chose to use the 5-E learning cycle model. According to Chiarelott (2006, p.90), the 5-E model has been used successfully in science classrooms from kindergarten to college. With its basics components being to engage, explore, explain, extend, and evaluate, it seems as if it was designed specifically for science instruction. It is highly adaptable to lessons of various lengths in the chemistry discipline. The 5-E model will help move the chemistry lessons from teacher directed to more student centered and guided.

Works Cited

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Sprenger, M. (2009). Focusing the Digital Brain. *Educational Leadership*, *67*(1), 34-39.

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Unit Outcomes

Subunit 1: Discovery and Theories

1. Students will state the significant contributions made to the atomic theory by each scientist. *[Memory/Recall]*

2. Students will describe the atomic theory and model proposed by each atomic theorist. *[Memory/ Recall]*

3. Students will create and present iMovie presentations detailing the timeline of atomic theory study. *[Synthesis]*

4. Students will demonstrate that electromagnetic radiation is a form of energy (PS-G-9-18) *[Application]*

5. Students will recognize that light acts as a wave. (PS-G-9-18) [*Comprehension*]

6. Students will show that light is part of the electromagnetic spectrum (i.e. radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays). (PS-G-9-18) [*Comprehension*]

7. Students will define concepts of wavelength and frequency in their own words. [*Comprehension*]

8. Students will calculate wavelength and frequency then identify the type of electromagnetic radiation given specific values. [*Analysis*]

9. Students will use historical examples to explain how new ideas are often initially rejected by the scientific establishment. (PS-H-9-26) [*Comprehension*]

10. Students will use historical examples to explain how new ideas sometimes spring from unexpected findings. (PS-H-9-26) [*Analysis*]

11. Students will use historical examples to explain how new ideas usually grow slowly through contributions from many investigators. (PS-H-9-26) [*Analysis*]

12. Students will explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined. (ST-A-9-3) [*Evaluation*]

13. Students will cite examples of ways that scientific inquiry is driven by the desire to understand the natural world and how technology is driven by the need to meet human needs and solve human problems. (ST-B-10-1) [*Memory/Recall*]

14. Students will develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology. (SI-A-9-5) [*Analysis/Synthesis*]

15. Students will present scientific findings using clear language, accurate data, appropriate graphs, tables, maps, and available technology. (SI-A-10-2) [*Analysis/Synthesis*]

16. Students will explain how new scientific data can cause any existing scientific explanation to be supported, revised or rejected (SI-A-10-5) [*Application*]

17. Students will comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose – to better understand a portion of our universe. (SWK-A-9-1) [*Comprehension*]

18. Students will recognize that science is a systematic method of continuing investigation, based on the observation, hypothesis testing, measurement, experimentation, and theory building, which lead to more adequate explanations of natural phenomena. (SWK-A-10-3) [*Comprehension*]

19. Students will justify that scientific theories are explanations of large bodies of information and/or observations that withstand repeated testing. (SWK-B-9-5). [*Comprehension*]

20. Students will recognize that scientific knowledge and explanations have changed over time, almost always building on earlier knowledge. (SWK-B-9-7) *[Analysis]*

21. Students will illustrate that much can be learned about the internal workings of science and the nature of science from the study of scientists, their daily work an their efforts to advance scientific knowledge in their area of study. (SWK-D-9-8) *[Application]*

22. Students will investigate how the knowledge, skills and interests learned in science class apply to careers students plan to pursue. (SWK-D-9-9) & (SWK-D-10-7) *[Synthesis]*

Works Cited

(2006). *Science Academic Content Standards.* Retrieved May 20, 2010, from Ohio Department of Education, Columbus, OH. Web site: http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?page=3&TopicRelationID=1705&ContentID=834&Content=72481.

Preassessment

Name: ____________________ **Class:** ________________ **Date:** ________ **ID: A**

Atomic Theory Unit Preassessment

Using what you already know (Prior Knowledge), answer the following questions to the best of your ability. The purpose of this activity is to determine what you already know. Since this is a preview exercise, it will not be graded based on correct answers. Giving your best effort is very important though.

Other

1. Draw a picture of an atom showing as much detail as possible.

Short Answer

2. List the 3 subatomic particles.

3. The periodic table is organized in horizontal arrangements of elements called ______________ and in vertical arrangements of elements called ______________.

4. What is an isotope?

5. Balance the following formula equation:

$$H_2 + O_2 \longrightarrow H_2O$$

6. In the chemical formula $C_6H_{12}O_6$, what are the numbers called and what do they indicate?

7. What do the elements Uranium and Plutonium have in common?

8. Explain the difference between the two nuclear processes of fission and fusion.

Pre and Post Assessments constructed using the application *ExamView Test Generator*

Lessons

All lessons are structured for 50-minute class periods. Lessons provided are for the 9-day Subunit 1: Discoveries and Theories.

Lesson 1 Where did the idea of the atom start?

Key Questions to Learn

1. What did the Ancient Greeks believe all matter was made of?
2. How did the atomic theories of Democritus and Aristotle differ? Who was correct?

Learner Outcomes (Numbers reference student outcomes on pages 5-6)

1, 2, 3, 9, 14, 15

Materials

Modern Chemistry Textbook, Preassessment sheet for Atomic Theory Unit, MacBooks with iMovie application, Internet, classroom projector, Remote Desktop application

Time Requirements

2 days

Engagement

Day 1: Students will take the Atomic Theory Unit Preassessment. Since this assignment is not graded, a discussion about the answers will occur immediately after completion. Attention will be given to the drawings the students made of the atom. *(25 minutes)*

Day 2: Students will be shown an iMovie video made by the teacher. The video incorporates multiple features available on the iMovie software. Students will get back into groups formed during Day 1. Students will log onto a MacBook and access iMovie, and the internet. Students will follow the teacher's lead in making the basic structure of their Atomic Timeline. *(25 minutes)*

Exploration

Day 1: Students will be split into groups of three students. Each student will log onto a MacBook and access the internet. Students will research matter based on the ideas of the

Ancient Greeks, Democritus, and Aristotle. Students will type information they find including URLs into a word document for use in Day#2 *(25 minutes*).

Day 2: Students will continue constructing their Atomic Timelines incorporating information reviewed from Day 1. *(25 minutes)*

Explanation

Day 2: Students will compare and contrast the theories of Aristotle and Democritus. These ideas will be incorporated into the iMovie project. *(25 minutes – at same time as exploration)*

Extension

Extension of Lesson #1 will occur in Lesson #3 as all atomic theories are combined.

Evaluation

Evaluation of the Atomic Timeline from Lesson #1 will occur at the conclusion of Lesson #3 as all groups will present their findings to the class. Lesson #1 will also be evaluated with a test over the Atomic Theory unit.

Teacher Notes

Lesson 2 Discovering the pieces of the atom.

Key Questions to Learn

1. Why is it important to learn all five parts to Dalton's atomic theory even though some aspects of his theory are incorrect?
2. Why was Thomson's discovery of the electron so significant?
3. How was Rutherford able to discover the nucleus and therefore the proton?
4. What are the three subatomic particles and where are they located?

Learner Outcomes (Numbers reference student outcomes on pages 5-6)

1, 2, 3, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21

Materials

Modern Chemistry Textbook, MacBooks with iMovie application, Internet, classroom projector, Remote Desktop application, Flinn Scientific *Atomic Target Practice* lab, cardboard squares, wooden objects, cork stoppers, push pins, tape, marbles

Time Requirements

3 days

Engagement

<u>Day 1</u>: The lesson begins as students are told some discoveries, including scientific discoveries, were made accidentally. Students log onto MacBooks and access the internet. Students are instructed to search for accidental discoveries. Teacher will recommend sites to students who unable to find anything: Discovery Channel and the Science Channel. Students will be selected at random to share their accidental discoveries. These accidental discoveries will also help in the discussion about how the atomic theory has changed with time and improved technology. *(15 minutes)*

<u>Day 2</u>: Students will be shown a cardboard square with a wooden shaped attached to the underside. Students are asked, "How can be figure out what the hidden shape is if we

aren't allowed to look at it?" Students will offer various methods. Rutherford was able to discover the structure of the atom even though he couldn't see it. Today, students will be using the Flinn Scientific activity *Atomic Target Practice (5 minutes)*

Exploration

Day 1: Students will reform groups from Lesson #1. Each student in the group of three will be assigned one of the following scientists: Dalton, Thomson, or Rutherford. Students will research the scientist finding each scientist's atomic theory and pertinent experiments or accidents that helped each develop his atomic theory. Students will also find pictures that best describe the model according to the assigned scientist. This information will be saved in a Word document. The activity will continue in Day 3 of the lesson. *(35 minutes*)

Day 2: Students will roll marbles underneath the cardboard square tracing the assumed path of the object on a piece of paper. After rolling the marble multiple times, the shape of the hidden object should be revealed. *(25 minutes)*

Explanation

Day 2: Students will answer postlab questions from Flinn Scientific *Atomic Target Practice (10 minutes*)

Day 3: Students in each group will share what each learned about his or her assigned scientist. *(10 minutes)*

Extension

Day 2: Students will compare and contrast the materials used in completion of the lab to the materials that Rutherford used to discover the nucleus and structure of his atom in the Gold Foil Experiment. *(20 minutes)*

Day 3: Students will add information about the scientists' models to their Atomic Timeline placing them in the correct order. Students will emphasize how the model of the atom has changed since the time of Democritus. Students will also highlight errors in each atomic theory. *(40 minutes*).

Evaluation

Evaluation of the Atomic Timeline from Lesson #2 will occur at the conclusion of Lesson #3 as all groups will present their findings to the class. Lesson #2 will also be evaluated with a test over the Atomic Theory unit.

Teacher Notes

Details about the subatomic particles are covered in Subunit 2 as the Periodic Table is introduced.

Atomic Target Practice is adapted from *Flinn Chemtopic Labs*, Volume 3, Atomic and Electron Structure; Cesa, I., Ed; Flinn Scientific: Batavia, IL, 2003

Lesson 3 Improving and understanding the atomic model

Key Questions to Learn

1. What is the electromagnetic spectrum?
2. What is the relationship between the speed of light (c), frequency (ν), and wavelength (λ)?
3. How was Bohr able to develop his atomic model based on the emission spectra of hydrogen?
4. How is light given off by atoms?
5. Why is the Quantum Model described as the cloud model?

Learner Outcomes (Numbers reference student outcomes on pages 5-6)

1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22

Materials

Modern Chemistry Textbook, MacBooks with iMovie application, Internet, classroom projector, Remote Desktop application, emission spectra tubes of various elements (Hydrogen is a must), power source for spectra tubes, spectroscopes for each student, wooden splints, solutions of the following nitrates: Lithium, Copper, Potassium, Strontium, Sodium, Calcium, Barium, 100-mL beakers, Bunsen burners, sparkers, goggles, colored pencils.

Time Requirements

4 days

Engagement

Day 1: Once everyone is seated in the room, a spectroscope will be handed out to each student. Students will be instructed to look through the viewing end while pointing the small slit at the receiving end towards the light source. One window in the room will be opened so students can observe the spectrum produced by the white light of the sun (full rainbow). The window will be closed then students will observe the light from the hydrogen emission tube through their spectroscopes. Using colored pencils, the students will record hydrogen's emission spectrum. No continuous spectrum will be observed rather distinct, bright lines are produced that are the characteristic emission spectrum for hydrogen. *(10 minutes*)

Day 2: Students will be asked how fireworks get their colors. Students will likely come to the conclusion that different compounds or elements are used. *(5 minutes)*

Exploration

Day 1: Students will research the Bohr model to determine how the emission spectrum of hydrogen allowed Bohr to produce his model. *(20 minutes)*

Day 2: Students will complete the Flame Test lab. Wooden splints soaked in nitrate solutions of various elements will be inserted into a blue flame resulting in a change of the flames color. Students will take pictures of the resulting flames using digital cameras *(15 minutes*)

Day 3: Students will be presented with notes on Planck, Einstein, Bohr, and the Quantum theory. Students will build on these notes using reading from the textbook and online exploration. These final concepts will be explored and information recorded in the Word document. *(20 minutes*)

Explanation

Day 1: Students will successfully explain that the lines in the spectrum are due to electrons falling from higher energy levels to lower energy levels. *(5 minutes)*

Day 2: Students, using concepts from the previous day, will explain the various colors using Bohr's concept of falling electrons. Multiple electrons falling from different energy levels results in the various colors. *(10 minutes*)

Day 3: Students will incorporate the newly found information about Planck, Einstein, Bohr, and the Quantum model into the Atomic Timeline iMovie. Movies will be compressed into QuickTime format and submitted to the teacher's drop box. *(30 minutes)*

Extension

Day 1: Students will be asked to predict what will happen as electricity is passed through other emission tubes of various elements. Each element gives a characteristic spectra. An emission spectra is like a fingerprint for an element. Students will observe other elements and record their emission spectra using colored pencils. *(15 minutes*)

Day 2: Students will load flame images from camera into iPhoto on the MacBooks. Students will find emission spectra for the particular element showing how each element has a different spectrum and a different resultant color. *(20 minutes*)

Evaluation

Day 2: Students receive a worksheet relating wavelength, speed of light, and frequency.

Day 4: Student groups will present their Atomic Timeline iMovies to the class.

Teacher Notes

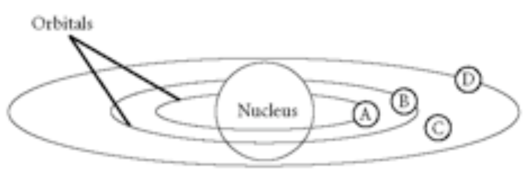
Postassessment

Name: ____________________ **Class:** ________________ **Date:** ________ **ID: A**

10th Grade Chemistry Atomic Theory Unit

Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. Dalton incorporated the law of conservation of mass into his atomic theory by asserting that
   A. atoms are indivisible.
   B. atoms of different elements have different properties.
   C. matter is composed of atoms.
   D. atoms can be destroyed in chemical reactions.
2. What are often used to monitor the approximate radiation exposure of people working with radioactive materials?
   A. film badges
   B. X-ray films (radiographs)
   C. scintillation counters
   D. radioactive tracers
3. What is the mass number of deuterium?
   A. 1
   B. 2
   C. 3
   D. 4
4. The formula for carbon dioxide, CO_2, can represent
   A. one molecule of carbon dioxide.
   B. 1 mol of carbon dioxide molecules.
   C. the combination of 1 atom of carbon and 2 atoms of oxygen.
   D. all of the above.
5. According to the law of conservation of mass, when sodium, hydrogen, and oxygen react to form a compound, the mass of the compound is ____ the sum of the masses of the individual elements.
   A. equal to
   B. greater than
   C. less than
   D. either greater than or less than
6. According to Bohr, electrons cannot reside at ____ in the figure below.



   A. point A
   B. point B
   C. point C
   D. point D
7. Because any element used in the cathode produced electrons, scientists concluded that
   A. all atoms contained electrons.
   B. only metals contained electrons.
   C. atoms were indivisible.
   D. atoms carried a negative charge.
8. A negative ion is known as a(n)
   A. ionic radius.
   B. valence electron.
   C. cation.
   D. anion.
9. In Rutherford's experiments, alpha particles
   A. passed through a tube containing gas.
   B. were used to bombard a cathode plate.
   C. collided with electrons.
   D. were used to bombard thin metal foil.

ame: ______________________ **ID: A**

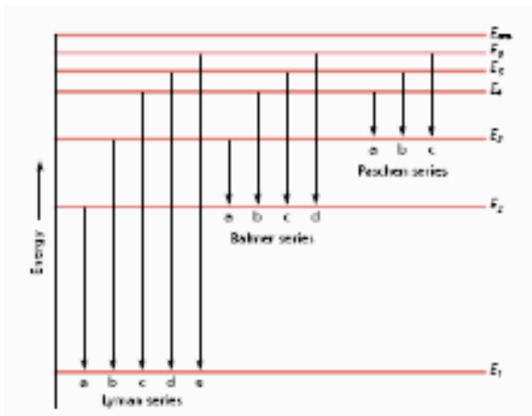
10. According to the Bohr model of the atom, the single electron of a hydrogen atom circles the nucleus
    A. in specific, allowed orbits.
    B. in one fixed orbit at all times.
    C. at any of an infinite number of distances, depending on its energy.
    D. counterclockwise.
11. A positively charged particle with mass 1.673×10^{-24} g is a(n)
    A. proton.
    B. neutron.
    C. electron.
    D. positron.
12. The empirical formula may not represent the actual composition of a unit of a(n)
    A. ionic compound.
    B. molecular compound.
    C. salt.
    D. crystal.
13. Because the first energy level contains only the 1*s* sublevel, the number of elements in this period is
    A. 1.
    B. 2.
    C. 4.
    D. 8.
14. Which of the following instruments detect radiation by converting light produced in a radioactive process to an electric signal?
    A. film badges
    B. Geiger-Müller counters
    C. scintillation counters
    D. radioactive tracers
15. For groups 13 through 18, the total number of electrons in the highest occupied level equals the group number
    A. plus 1.
    B. minus 1.
    C. plus 5.
    D. minus 10.
16. According to the Quantum Model, a three-dimensional region around a nucleus where an electron may be found is called a(n)
    A. spectral line.
    B. electron path.
    C. orbital.
    D. orbit.
17. According to the table below, if a rock contains 25% as much uranium-235 as rocks being formed today, how old is the rock?

Nuclide	Half-Life (years)
carbon-14	5.71×10^3
potassium-40	1.26×10^9
radium-226	1.60×10^3
thorium-230	7.54×10^4
uranium-235	7.04×10^8

    A. 7.04×10^8 years
    B. 3.55×10^8 years
    C. 2.84×10^9 years
    D. 1.41×10^9 years
18. If 4.0 g of element A combine with 10. g of element B, then 12 g of element A combine with ____ g of element B.
    A. 10.
    B. 12
    C. 24
    D. 30.
19. Which of the following has the greatest penetrating ability?
    A. alpha particles
    B. beta particles
    C. gamma rays
    D. All have the same penetrating ability.

Name: ______________________

20. Visible light, X rays, infrared radiation, and radio waves all have the same
    A. energy.
    B. wavelength.
    C. speed.
    D. frequency.
21. Which energy-level change shown in the diagram below emits the highest energy?



    A. an electron moving from E_6 to E_5
    B. an electron moving from E_2 to E_4
    C. an electron moving from E_2 to E_3
    D. an electron moving from E_2 to E_1
22. All isotopes of hydrogen contain
    A. one neutron.
    B. two electrons.
    C. one proton.
    D. two nuclei.
23. Most of the volume of an atom is occupied by the
    A. nucleus.
    B. nuclides.
    C. electrons.
    D. protons.
24. For an electron in an atom to change from the ground state to an excited state,
    A. energy must be released.
    B. energy must be absorbed.
    C. radiation must be emitted.
    D. the electron must make a transition from a higher to a lower energy level.
25. Which block in the periodic table contains the alkali metals?
    A. *s*
    B. *p*
    C. *d*
    D. *f*
26. Which concept in Dalton's atomic theory has been modified?
    A. All matter is composed of atoms.
    B. Atoms of different elements have different properties and masses.
    C. Atoms can combine in chemical reactions.
    D. Atoms cannot be divided.
27. As the mass number of an element's isotopes of an element increases, the number of protons
    A. decreases.
    B. increases.
    C. remains the same.
    D. doubles each time the mass number increases.
28. What is the formula for the compound formed by lead(II) ions and chromate ions?
    A. $PbCrO_4$
    B. Pb_2CrO_4
    C. $Pb_2(CrO_4)_3$
    D. $Pb(CrO_4)_2$

Name: ______________________ **ID: A**

29. The nucleus of an atom has all of the following characteristics *except* that it
    A. is positively charged.
    B. is very dense.
    C. contains nearly all of the atom's mass.
    D. contains nearly all of the atom's volume.

30. Balance the following equation: $^{239}_{93}\text{Np} \rightarrow$ ____ + $^{0}_{-1}e$
    A. $^{239}_{90}\text{Th}$
    B. $^{239}_{92}\text{U}$
    C. $^{239}_{94}\text{Pu}$
    D. $^{238}_{94}\text{Pu}$

31. The most characteristic property of the noble gases is that they
    A. have low boiling points.
    B. are radioactive.
    C. are gases at ordinary temperatures.
    D. are largely unreactive.

32. Isotopes are atoms of the same element that have different
    A. principal chemical properties.
    B. masses.
    C. numbers of protons.
    D. numbers of electrons.

33. Which of the following is *not* part of Dalton's atomic theory?
    A. Atoms cannot be divided, created, or destroyed.
    B. The number of protons in an atom is its atomic number.
    C. In chemical reactions, atoms are combined, separated, or rearranged.
    D. All matter is composed of extremely small particles called atoms.

34. Because most particles fired at metal foil passed straight through, Rutherford concluded that
    A. atoms were mostly empty space.
    B. atoms contained no charged particles.
    C. electrons formed the nucleus.
    D. atoms were indivisible.

35. Name the compound $Ni(ClO_3)_2$.
    A. nickel(II) chlorate
    B. nickel(II) chloride
    C. nickel(II) chlorite
    D. nickel(II) peroxide

Short Answer

36. Briefly describe alpha particles, beta particles, and gamma rays.

37. Why do elements such as radium, polonium, and uranium expose photographic film, kill bacteria, and warm the surrounding air?

38. In terms of the periodic law, explain which two of these elements are most similar: sodium (element 11), phosphorus (element 15), and sulfur (element 16).

39. Draw a Bohr Model for an atom of ^{45}Sc (3 pts)

Name: ____________________ **ID: A**

40. What can you predict about the properties of xenon and helium, both in Group 18 in the periodic table? Why?
41. Explain how Rutherford developed his "Empty Space Model"using the results from the Gold Foil Experiment. (4 points)

Problem

42. Phosphorus-32 has a half-life of 14.3 days. How many milligrams of phosphorus-32 remain after 71.5 days if you start with 4.00 mg of the isotope?
43. What is the half-life of an isotope if after 2.00 weeks you have 31.25 g remaining from a 250.0 g starting sample size?
44. Calculate the mass defect and the binding energy/nucleon of the nuclide $^{9}_{4}Be$, which has a mass of 9.012 182 24 amu. The mass of a proton is 1.007 276 47 amu and the mass of a neutron is 1.008 664 90. One amu = 1.6605×10^{-27} kg and the speed of light is 3.00×10^{8} m/s.
45. Write the nuclear equation for each of the following reactions. Refer to a periodic table.
    a. the alpha decay of $^{226}_{88}Ra$
    b. the beta decay of $^{39}_{17}Cl$
    c. the positron emission of $^{30}_{15}P$
46. The molar mass of aluminum is 26.98 g/mol and the molar mass of fluorine is 19.00 g/mol. Calculate the molar mass of aluminum trifluoride, AlF_3.

Completion
Complete each statement.

47. The critical mass is the minimum mass of a fissionable isotope that provides the number of neutrons needed to sustain a(n) ____________________.

Name: ______________________ **ID: A**

48. Complete the blank cells in the following table (5 pts)

Symbol	Isotope Name	Atomic #	# p^+	# n^0	# e^-	Mass #
^{56}Fe						56
		16		14		

49. A nucleus of an atom with a specific number of protons and neutrons is called a(n) ____________________.

50. The nuclide $^{125}_{53}I$ contains ____________________ protons.

51. The name for the CrO_4^{2-} ion is ____________________.

Essay

52. Explain the process of radioactive dating.

53. Compare and contrast a nuclear power plant and a nuclear bomb.

Pre and Post Assessments constructed using the application *ExamView Test Generator*