LIFEPAC®

SCIENCE

TEACHER'S GUIDE

9th Grade

Alpha Omega
PUBLICATIONS

SCIENCE 900
Teacher's Guide

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Alpha Omega
PUBLICATIONS

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LIFEPAC®
Management

STRUCTURE OF THE LIFEPAC CURRICULUM

The LIFEPAC curriculum is conveniently structured to provide one teacher handbook containing teacher support material with answer keys and ten student worktexts for each subject at grade levels two through twelve. The worktext format of the LIFEPACs allows the student to read the textual information and complete workbook activities all in the same booklet. The easy to follow LIFEPAC numbering system lists the grade as the first number(s) and the last two digits as the number of the series. For example, the Language Arts LIFEPAC at the 6th grade level, 5th book in the series would be LAN0605.

Each LIFEPAC is divided into 3 to 5 sections and begins with an introduction or overview of the booklet as well as a series of specific learning objectives to give a purpose to the study of the LIFEPAC. The introduction and objectives are followed by a vocabulary section which may be found at the beginning of each section at the lower levels, at the beginning of the LIFEPAC in the middle grades, or in the glossary at the high school level. Vocabulary words are used to develop word recognition and should not be confused with the spelling words introduced later in the LIFEPAC. The student should learn all vocabulary words before working the LIFEPAC sections to improve comprehension, retention, and reading skills.

Each activity or written assignment has a number for easy identification, such as 1.1. The first number corresponds to the LIFEPAC section and the number to the right of the decimal is the number of the activity.

Teacher checkpoints, which are essential to maintain quality learning, are found at various locations throughout the LIFEPAC. The teacher should check 1) neatness of work and penmanship, 2) quality of understanding (tested with a short oral quiz), 3) thoroughness of answers (complete sentences and paragraphs, correct spelling, etc.), 4) completion of activities (no blank spaces), and 5) accuracy of answers as compared to the answer key (all answers correct).

The self test questions are also number coded for easy reference. For example, 2.015 means that this is the 15th question in the self test of Section II. The first number corresponds to the LIFEPAC section, the zero indicates that it is a self test question, and the number to the right of the zero the question number.

The LIFEPAC test is packaged at the centerfold of each LIFEPAC. It should be removed and put aside before giving the booklet to the student for study.

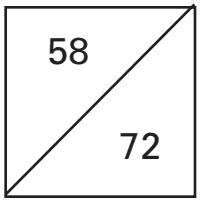
Answer and test keys have the same numbering system as the LIFEPACs and appear at the back of this handbook. The student may be given access to the answer keys (not the test keys) under teacher supervision so that he can score his own work.

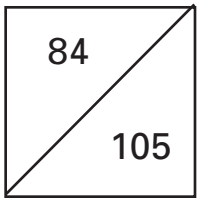
A thorough study of the Curriculum Overview by the teacher before instruction begins is essential to the success of the student. The teacher should become familiar with expected skill mastery and understand how these grade level skills fit into the overall skill development of the curriculum. The teacher should also preview the objectives that appear at the beginning of each LIFEPAC for additional preparation and planning.

TEST SCORING and GRADING

Answer keys and test keys give examples of correct answers. They convey the idea, but the student may use many ways to express a correct answer. The teacher should check for the essence of the answer, not for the exact wording. Many questions are high level and require thinking and creativity on the part of the student. Each answer should be scored based on whether or not the main idea written by the student matches the model example. "Any Order" or "Either Order" in a key indicates that no particular order is necessary to be correct.

Most self tests and LIFEPAC tests at the lower elementary levels are scored at 1 point per answer; however, the upper levels may have a point system awarding 2 to 5 points for various answers or questions. Further, the total test points will vary; they may not always equal 100 points. They may be 78, 85, 100, 105, etc.

ex. 1 

ex. 2 

A score box similar to ex.1 above is located at the end of each self test and on the front of the LIFEPAC test. The bottom score, 72, represents the total number of points possible on the test. The upper score, 58, represents the number of points your student will need to receive an 80% or passing grade. If you wish to establish the exact percentage that your student has achieved, find the total points of his correct answers and divide it by the bottom number (in this case 72.) For example, if your student has a point total of 65, divide 65 by 72 for a grade of 90%. Referring to ex. 2, on a test with a total of 105 possible points, the student would have to receive a minimum of 84 correct points for an 80% or passing grade. If your student has received 93 points, simply divide the 93 by 105 for a percentage grade of 89%. Students who receive a score below 80% should review the LIFEPAC and retest using the appropriate Alternate Test found in the Teacher's Guide.

The following is a guideline to assign letter grades for completed LIFEPACs based on a maximum total score of 100 points.

LIFEPAC Test	=	60% of the Total Score (or percent grade)
Self Test	=	25% of the Total Score (average percent of self tests)
Reports	=	10% or 10* points per LIFEPAC
Oral Work	=	5% or 5* points per LIFEPAC

*Determined by the teacher's subjective evaluation of the student's daily work.

Example:

LIFEPAC Test Score	=	92%	92	x	.60	=	55 points
Self Test Average	=	90%	90	x	.25	=	23 points
Reports						=	8 points
Oral Work						=	4 points
TOTAL POINTS						=	90 points

Grade Scale based on point system:				
100	–	94	=	A
93	–	86	=	B
85	–	77	=	C
76	–	70	=	D
Below		70	=	F

TEACHER HINTS and STUDYING TECHNIQUES

LIFEPAC Activities are written to check the level of understanding of the preceding text. The student may look back to the text as necessary to complete these activities; however, a student should never attempt to do the activities without reading (studying) the text first. Self tests and LIFEPAC tests are never open book tests.

Language arts activities (skill integration) often appear within other subject curriculum. The purpose is to give the student an opportunity to test his skill mastery outside of the context in which it was presented.

Writing complete answers (paragraphs) to some questions is an integral part of the LIFEPAC Curriculum in all subjects. This builds communication and organization skills, increases understanding and retention of ideas, and helps enforce good penmanship. Complete sentences should be encouraged for this type of activity. Obviously, single words or phrases do not meet the intent of the activity, since multiple lines are given for the response.

Review is essential to student success. Time invested in review where review is suggested will be time saved in correcting errors later. Self tests, unlike the section activities, are closed book. This procedure helps to identify weaknesses before they become too great to overcome. Certain objectives from self tests are cumulative and test previous sections; therefore, good preparation for a self test must include all material studied up to that testing point.

The following procedure checklist has been found to be successful in developing good study habits in the LIFEPAC curriculum.

1. Read the introduction and Table of Contents.
2. Read the objectives.
3. Recite and study the entire vocabulary (glossary) list.
4. Study each section as follows:
    a. Read the introduction and study the section objectives.
    b. Read all the text for the entire section, but answer none of the activities.
    c. Return to the beginning of the section and memorize each vocabulary word and definition.
    d. Reread the section, complete the activities, check the answers with the answer key, correct all errors, and have the teacher check.
    e. Read the self test but do not answer the questions.
    f. Go to the beginning of the first section and reread the text and answers to the activities up to the self test you have not yet done.
    g. Answer the questions to the self test without looking back.
    h. Have the self test checked by the teacher.
    i. Correct the self test and have the teacher check the corrections.
    j. Repeat steps a–i for each section.

5. Use the SQ3R* method to prepare for the LIFEPAC test.
6. Take the LIFEPAC test as a closed book test.
7. LIFEPAC tests are administered and scored under direct teacher supervision. Students who receive scores below 80% should review the LIFEPAC using the SQ3R* study method and take the Alternate Test located in the Teacher Handbook. The final test grade may be the grade on the Alternate Test or an average of the grades from the original LIFEPAC test and the Alternate Test.

*SQ3R: **S**can the whole LIFEPAC.
Question yourself on the objectives.
Read the whole LIFEPAC again.
Recite through an oral examination.
Review weak areas.

GOAL SETTING and SCHEDULES

Each school must develop its own schedule, because no single set of procedures will fit every situation. The following is an example of a daily schedule that includes the five LIFEPAC subjects as well as time slotted for special activities.

Possible Daily Schedule

8:15	–	8:25	Pledges, prayer, songs, devotions, etc.
8:25	–	9:10	Bible
9:10	–	9:55	Language Arts
9:55	–	10:15	Recess (juice break)
10:15	–	11:00	Mathematics
11:00	–	11:45	Social Studies
11:45	–	12:30	Lunch, recess, quiet time
12:30	–	1:15	Science
1:15	–		Drill, remedial work, enrichment*

* Enrichment: Computer time, physical education, field trips, fun reading, games and puzzles, family business, hobbies, resource persons, guests, crafts, creative work, electives, music appreciation, projects.

Basically, two factors need to be considered when assigning work to a student in the LIFEPAC curriculum.

The first is time. An average of 45 minutes should be devoted to each subject, each day. Remember, this is only an average. Because of extenuating circumstances a student may spend only 15 minutes on a subject one day and the next day spend 90 minutes on the same subject.

The second factor is the number of pages to be worked in each subject. A single LIFEPAC is designed to take 3 to 4 weeks to complete. Allowing about 3-4 days for LIFEPAC introduction, review, and tests, the student has approximately 15 days to complete the LIFEPAC pages. Simply take the number of pages in the LIFEPAC, divide it by 15 and you will have the number of pages that must be completed on a daily basis to keep the student on schedule. For example, a LIFEPAC containing 45 pages will require 3 completed pages per day. Again, this is only an average. While working a 45 page LIFEPAC, the student may complete only 1 page the first day if the text has a lot of activities or reports, but go on to complete 5 pages the next day.

Long range planning requires some organization. Because the traditional school year originates in the early fall of one year and continues to late spring of the following year, a calendar should be devised that covers this period of time. Approximate beginning and completion dates can be noted on the calendar as well as special occasions such as holidays, vacations and birthdays.

Since each LIFEPAC takes 3-4 weeks or eighteen days to complete, it should take about 180 school days to finish a set of ten LIFEPACs. Starting at the beginning school date, mark off eighteen school days on the calendar and that will become the targeted completion date for the first LIFEPAC. Continue marking the calendar until you have established dates for the remaining nine LIFEPACs making adjustments for previously noted holidays and vacations. If all five subjects are being used, the ten established target dates should be the same for the LIFEPACs in each subject.

FORMS

The sample weekly lesson plan and student grading sheet forms are included in this section as teacher support materials and may be duplicated at the convenience of the teacher.

The student grading sheet is provided for those who desire to follow the suggested guidelines for assignment of letter grades found on page 3 of this section. The student's self test scores should be posted as percentage grades. When the LIFEPAC is completed the teacher should average the self test grades, multiply the average by .25 and post the points in the box marked self test points. The LIFEPAC percentage grade should be multiplied by .60 and posted. Next, the teacher should award and post points for written reports and oral work. A report may be any type of written work assigned to the student whether it is a LIFEPAC or additional learning activity. Oral work includes the student's ability to respond orally to questions which may or may not be related to LIFEPAC activities or any type of oral report assigned by the teacher. The points may then be totaled and a final grade entered along with the date that the LIFEPAC was completed.

The Student Record Book which was specifically designed for use with the Alpha Omega curriculum provides space to record weekly progress for one student over a nine week period as well as a place to post self test and LIFEPAC scores. The Student Record Books are available through the current Alpha Omega catalog; however, unlike the enclosed forms these books are not for duplication and should be purchased in sets of four to cover a full academic year.

WEEKLY LESSON PLANNER			
			Week of:
Subject	Subject	Subject	Subject
Monday			
Subject	Subject	Subject	Subject
Tuesday			
Subject	Subject	Subject	Subject
Wednesday			
Subject	Subject	Subject	Subject
Thursday			
Subject	Subject	Subject	Subject
Friday			

WEEKLY LESSON PLANNER			
			Week of:
Subject	Subject	Subject	Subject
Monday			
Subject	Subject	Subject	Subject
Tuesday			
Subject	Subject	Subject	Subject
Wednesday			
Subject	Subject	Subject	Subject
Thursday			
Subject	Subject	Subject	Subject
Friday			

Student Name _____ Year _____

Bible

LP #	Self Test Scores by Sections 1	2	3	4	5	Self Test Points	LIFEPAC Test	Oral Points	Report Points	Final Grade	Date
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

History & Geography

LP #	Self Test Scores by Sections 1	2	3	4	5	Self Test Points	LIFEPAC Test	Oral Points	Report Points	Final Grade	Date
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

Language Arts

LP #	Self Test Scores by Sections 1	2	3	4	5	Self Test Points	LIFEPAC Test	Oral Points	Report Points	Final Grade	Date
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

Student Name _____ Year _____

Mathematics

LP #	Self Test Scores by Sections 1	2	3	4	5	Self Test Points	LIFEPAC Test	Oral Points	Report Points	Final Grade	Date
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

Science

LP #	Self Test Scores by Sections 1	2	3	4	5	Self Test Points	LIFEPAC Test	Oral Points	Report Points	Final Grade	Date
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

Spelling/Electives

LP #	Self Test Scores by Sections 1	2	3	4	5	Self Test Points	LIFEPAC Test	Oral Points	Report Points	Final Grade	Date
01											
02											
03											
04											
05											
06											
07											
08											
09											
10											

Teacher Notes

INSTRUCTIONS FOR SCIENCE

The LIFEPAC curriculum from grades two through twelve is structured so that the daily instructional material is written directly into the LIFEPACs. The student is encouraged to read and follow this instructional material in order to develop independent study habits. The teacher should introduce the LIFEPAC to the student, set a required completion schedule, complete teacher checks, be available for questions regarding both content and procedures, administer and grade tests, and develop additional learning activities as desired. Teachers working with several students may schedule their time so that students are assigned to a quiet work activity when it is necessary to spend instructional time with one particular student.

The Teacher Notes section of the Teacher's Guide lists the required or suggested materials for the LIFEPACs and provides additional learning activities for the students. The materials section refers only to LIFEPAC materials and does not include materials which may be needed for the additional activities. Additional learning activities provide a change from the daily school routine, encourage the student's interest in learning and may be used as a reward for good study habits.

If you have limited facilities and are not able to perform all the experiments contained in the LIFEPAC curriculum, the Science Project List may be a useful tool for you. This list prioritizes experiments into three categories: those essential to perform, those which should be performed as time and facilities permit, and those not essential for mastery of LIFEPACs. Of course, for complete understanding of concepts and student participation in the curriculum, all experiments should be performed whenever practical. Materials for the experiments are shown in Teacher Notes – Materials Needed.

A suggested support item for this course is the 9th Grade Science Experiments video, SD0901. The video includes presentations of many of the experiments in this course. Several of the experiments that require special equipment or materials are demonstrated on these videos. They can either be used for answering the questions of the lab report or as a demonstration of the procedure prior to performing the experiment. A notice is included with each experiment in the LIFEPAC where the video is available.

Science Projects List

Key

(1) = Those essential to perform for basic understanding of scientific principles.

(2) = Those which should be performed as time permits.

(3) = Those not essential for mastery of LIFEPACs.

S = Equipment needed for home school or Christian school lab.

E = Explanation or demonstration by instructor may replace student or class lab work.

H = Suitable for homework or for home school students. (No lab equipment needed.)

V = This experiment is available on the Science Experiments video.

Science 901

pp	8	(1)	H
	9	(2)	H
	12	(1)	S&V
	18	(1)	H or S&V

Science 902

pp	7	(1)	S&V
	12	(2)	S
	20	(1)	S&V
	24	(1)	S
	29	(1)	S
	35	(1)	H
	39	(2)	S&V
	41	(2)	H
	44	(1)	S&V

Science 903

pp	12	(1)	S&V
	38	(1)	S&V

Science 904

pp	15	field trip

Science 905-908

None

Science 909

pp	8	(1)	H
	12	(2)	H
	15	(2)	H
	17	(1)	H&V
	20	(1)	H
	31	(1)	S&V
	41	(3)	H

Science 910

none

Materials Needed for LIFEPAC

Required:
masking tape
two magnets marked with north and south poles
one small piece of wood about the size of the magnets
clay — two colors ($\frac{1}{2}$ cup each)

Suggested:
pencil, block, ice cube
a balloon
9th grade Science Experiments video

Additional Learning Activities

Section I Structure of Matter

1. Help the student to research the size of atoms and compute the relative size of hydrogen, oxygen, and sulfur atoms.
2. Discuss the three phases of matter. Have the students give examples for each phase. Write the examples on the board.
3. Have the students make flash cards containing the elements. Have them drill each other on the atomic number for each of the elements.
4. Make a chart showing the different phases of matter. Cut out pictures or draw pictures representing the different phases for your chart.

Section II Radioactivity

1. Demonstrate the use of a Geiger counter, if one is available.
2. Have the students plot intensity and distance on a graph similar to the one on Section III of LIFEPAC 901. Use the following numbers:

Intensity	Distance
6,572	1 cm
4,398	2 cm
3,221	4 cm
2,000	8 cm
1,582	16 cm
984	32 cm

3. Research the lives and discoveries of Marie and Pierre Curie. Have the students write a one-page report on their discoveries and read it to the class.

Section III Atomic Nuclei

1. Explain the following formula:
   number of neutrons = atomic mass - atomic number.
   Work several problems on the board.
2. Have the students make a bulletin board that lists the seven particles and one ray that make up a complex nucleus.
3. Have the students draw and label a diagram of an atom.
4. Research Carl Anderson's life and discoveries and have the students give an oral report to the class.

Section IV Nuclear Energy

1. Discuss fission and fusion. Write these words on the blackboard and ask the students to describe and compare the two.
2. Research the life and discoveries of Enrico Fermi. Have the students write a one-page paper on the importance of Fermi's discoveries to nuclear science.
3. Make a chart showing the advantages and disadvantages of nuclear power.

Section V Nuclear Applications and Environmental Hazards

1. Visit a nuclear generating plant with a friend.
2. Have the students write down several ways in which atomic energy can be used for good purposes, as well as how atomic power can be used for destructive purposes. Discuss your lists with the class. Do they agree with you? Ask your students to add to both lists.

Alternate Tests

Reproducible Tests
for use with the Science 900
Teacher's Guide

Name _____

Answer *true* or *false* (each answer, 1 point).

1. _____ A solid has definite shape, size, and mass.
2. _____ Neutrons are found in the atomic nucleus.
3. _____ Electrons and positrons are the same.
4. _____ Isotopes all have the same atomic mass.
5. _____ Gamma rays are not affected by a magnet.
6. _____ Neutrinos have been examined by scientists under microscopes.
7. _____ Enrico Fermi received a Nobel Prize for identifying new elements and discovering nuclear reactions.
8. _____ Cadmium is used to make control rods in fission reactors.
9. _____ Fission involves producing heavier elements and energy.
10. _____ Fossil fuels are plentiful today, and nuclear generating plants are not needed.

Match these items (each answer, 2 points).

11. _____ neutral particle
12. _____ uranium
13. _____ negative particle
14. _____ CO_2
15. _____ bent toward South Pole

a. electron
b. proton
c. neutron
d. element
e. compound
f. alpha particle

Write the letter for the correct answer on each line (each answer, 2 points).

16. The least dense form of matter is _____ .
    a. gas b. liquid c. solid
17. Radium was discovered by _____ .
    a. Fermi b. Becquerel c. Madame Curie
18. The intensity of a radioactive sample is measured by _____ .
    a. a cloud chamber b. a Geiger counter c. an x-ray
19. $^{226}_{88}$Ra has _____ neutrons.
    a. 314 b. 138 c. 88
20. An atom of the element nitrogen, whose atomic number is 7, contains _____ electrons.
    a. 7 b. 14 c. 5

21. In a nuclear reactor the fuel contains a fissionable material which _____ .
    a. provides unstable nuclei
    b. cools the heat
    c. moderates
22. Energy use per capita in the United States is increasing _____ .
    a. slower than the population
    b. the same as population growth
    c. more rapidly than population growth
23. The symbol for sodium is _____ .
    a. S b. So c. Na
24. The smallest of the three major particles of the atom is the _____ .
    a. electron b. neutron c. proton
25. The strongest in penetration of the three types of particles is _____ .
    a. alpha b. beta c. gamma

Complete these statements (each answer, 3 points).

26. The element fermium was named after _____ .
27. Marie Curie named _____ for the country of her birth.
28. The amount of material which, when brought together, would react spontaneously, is called _____ .
29. A spontaneous reaction that continues to feed itself and keep going is a _____ .
30. The unit of measurement of radiation biological material absorbs is the _____ .
31. Radioactive wastes are stored in abandoned _____ mines.
32. The nucleus of the atom is made up of the a. _____ , and b. _____ , and the c. _____ orbits around the nucleus.
33. Stars are examples of a. _____ reactors; a nuclear reaction producing lighter elements and energy is b. _____.
34. A particle like an electron with a positive charge is a _____ .
35. Members of each element that have differing atomic masses are _____.
36. The scientist who determined that uranium gives off rays was _____ .
37. Three phases of matter are a. _____ , b._____ , and c. _____ .

73/91

Date _____
Score _____

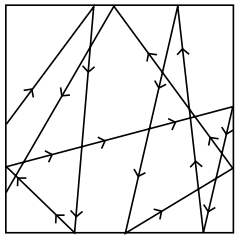
Answer Keys

SECTION ONE

1.1 Example:

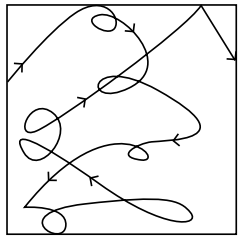
It has shape, size and mass. It does not move around. It stays where you put it.

1.2 a.



b. Moved in straight lines; had little freedom to move, turn, or change direction; motion very restricted.

1.3 a.



b. Can now move from place to place and turn (rotate) as I move; have more freedom, also move faster than as a solid.

1.4 Liquids must be restrained to remain in one spot. Liquids flow easily. Liquids take on the shape of the container. Liquids are soft. Liquids have mass. Liquids have a flat-topped surface.

1.5 The molecules press against the sides, hitting the sides and pushing them back. The more gas, the more push.

1.6 The balloon flies around because the gas escapes, lowering the pressure on the outlet side which forces the balloon forward.

1.7 Gases occupy the entire container and must be totally covered or they will escape. The distance between particles is great because even when packed into a balloon they can't be seen. The density is very low. There is mass (because gas is matter) but the amount and volume is less than that of solids or liquids.

1.8 I have freedom of movement in all directions without restrictions. I collide infrequently with other particles. My speed is greatly increased.

1.9 parent check

1.10 repel

1.11 a. repel
b. repel
c. repel
d. repel
e. attract
f. attract

1.12 nothing

1.13 nothing

1.14 no

1.15 a. repel
b. repel
c. attract
d. neither
e. no
f. Because the n behaves like the wood and is not affected by the charged particles.

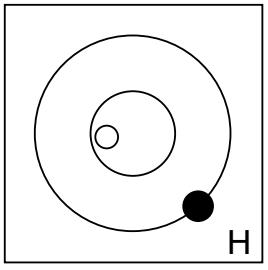
1.16 a. 1
b. 6
c. 7
d. 8
e. 12
f. 13
g. 16
h. 20
i. 26
j. 53

1.17 H = 1
C = 6
N = 7
O = 8
Mg = 12
Al = 13
S = 16
Ca = 20
Fe = 26
I = 53

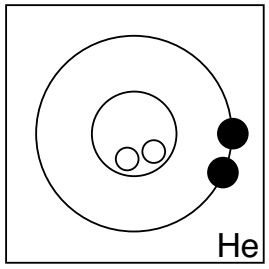
1.18 H = 1
C = 6
N = 7
O = 8
Mg = 12
Al = 13
S = 16
Ca = 20
Fe = 26
I = 53

1.19 Note: Placement of electrons on a particular ring may be done in any location on that ring or shell.

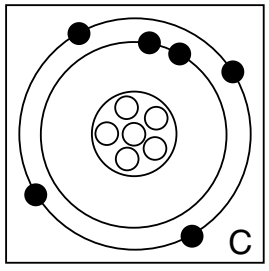
a.



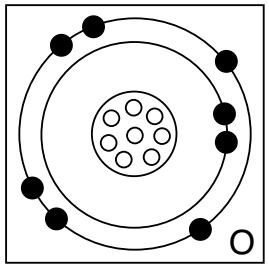
b.



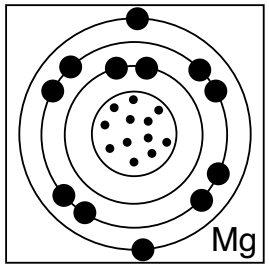
c.



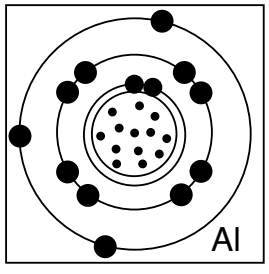
d.

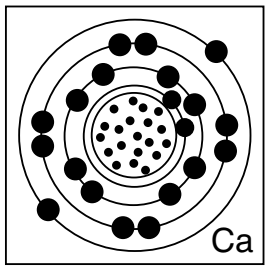


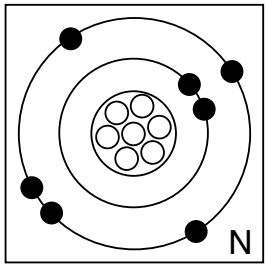
e.



f.



g. 

h. 

1.20 two thousand

1.21 Either order: (for a and b)

a. protons

b. neutrons

c. electrons

1.22 electrons

1.23 a. proton

b. electron

c. neutron

1.24 1

2

5

29

13

47

14

17

82

SECTION TWO

2.1 Either order:

a. photographic plates

b. the magnet

2.2 Any order:

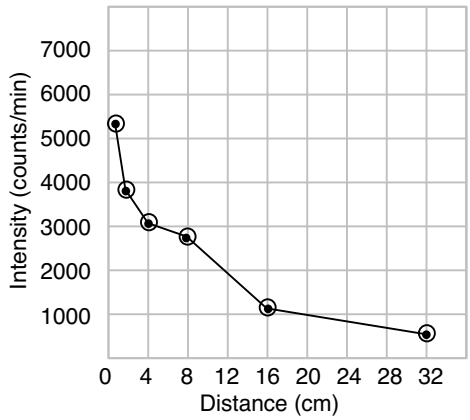
a. Beta particles are bent sharply toward the North Pole.

b. Alpha particles are slightly bent to the South Pole.

c. Gamma rays are not affected.

2.3 Example:

Becquerel wrapped some uranium ore in papers and set it in a drawer. Unknowingly, he had set it on an undeveloped photographic plate. He discovered later that in the places where he had laid the ore, the plate developed as if it had been exposed to light.

2.4 

2.5 The intensity decreases because the further you get from the source, the chance of being hit decreases.

2.6 The Wilson cloud chamber detects the presence of radioactive materials as well as speed and mass. The Geiger counter measures the quantity (intensity) of radiation striking a certain area of space.

SECTION THREE

3.1
a. 1
b. 6
c. 7
d. 8
e. Na
f. Al
g. Ni
h. Fe

3.2
a. oxygen
b. atomic mass
c. number of protons (atomic number)

3.3
a. $^{1}_{1}H$
b. $^{12}_{6}C$
c. $^{35}_{17}Cl$
d. $^{2}_{1}H$
e. $^{13}_{6}C$
f. $^{37}_{17}Cl$

3.4
a. 2
b. 8
c. 7
d. 10
e. 12
f. 146
g. 138
h. 124
i. 0
j. 5

3.5
a. β
b. α
c. ϒ
d. near speed of light, very fast (301,320 km.sec. 186,000 mps)
e. very fast (21,00 km/sec. or 13,010 mps)
f. at speed of light
g. stopped by 1 mm of skin
h. stopped by a few layers of skin
i. strong - can pass through body

3.6 Any order:
a. electrons
b. neutrinos
c. mesons
d. protons
e. neutrons
f. positrons
g. alpha particles

3.7 gamma ray

3.8
a. 75
b. 77
c. 78
d. 80

3.9 One model has the glue of the nucleus, the buffer between the protons, being the neutrons and other particles of the nucleus. Gamma rays result when proton or neutron drops to a lower level in the nucleus.

3.10 When the protons and neutrons increase and the n:p ratio is greater than 1.5, the nucleus is not balanced and flies apart.

SECTION FOUR

4.1 1938 for identifying new elements and discovering nuclear reactions.

4.2 Sample outline:

I. The Setting
  A. Time reference
    1. 8:30 A.M.
    2. Wednesday
  B. Place
    1. Squash court
    2. Stagg Field Stadium

II. The Experiment Part 1
  A. Rods withdrawn
    1. Counters click faster
    2. Pen moves up
    3. Levels off
  B. Zip withdrawn
    1. Counters click faster
    2. Pen moves up
    3. Levels off
  C. Lunch break

III. The Experiment Part 2
  A. Zip withdrawn
    1. Counters click faster
    2. Pen moves up
    3. Levels off
  B. Zip withdrawn
    1. Levels off
    2. Self-sustaining

IV. Results
  A. Nuclear reaction
    1. Sustained
    2. Stopped
  B. Code given
    1. Mission performed
    2. Mission successful

4.3 The breaking of heavy, complex nuclei into smaller masses (atoms or particles).

4.4 ${}^{1}_{0}\text{n}$, ${}^{90}_{38}\text{Sr}$

4.5 A chain reaction is a nuclear reaction in which one of the products of nuclear decay initiates the decay of another atom. This can be controlled or stopped by inserting a substance that will absorb or buffer the decay products from the unstable nuclei.

4.6 Critical mass is the amount of mass of a substance that if brought together in one pile will self destruct by a spontaneous chain reaction.

4.7 teacher check

4.8 a. Fuel rods provide the unstable nuclei.

b. Moderator slows the neutrons so they are correct energy for fission.

c. Control rods control the number of neutrons available to collide and fission the U-235.

d. Coolant is a liquid that absorbs the heat of a fission and heats the water for the steam turbine.

e. Shielding is concrete or lead that shields the environment from radiation.

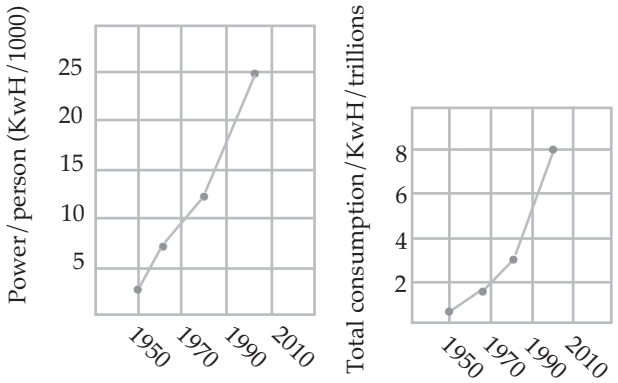
4.9 teacher check

4.10 Fusion is the combining of light nuclei to form heavier atoms and release energy. Fission is a process of decay (tearing down) while fusion is a process of building. Much energy is produced by both reactions.

4.11 Our knowledge of the destructive power of nuclear energy makes it easier to comprehend the judgement of God upon the earth. We have concrete examples of the type of burning that can destroy trees, grass and mountains as referenced by the passage in Revelation.

SECTION FIVE

5.1



5.2 Both curves indicate an increase in the rate of consumption and the rate continues to be greater than linear.

5.3 Either order:

a. increasing population

b. increasing use of electricity

5.4 quadrupled

5.5 Either order:

a. use up oxygen

b. add heat and chemicals

5.6 a. waste (heat)

b. low levels of radioactivity

5.7 teacher check

Examples:

a. How did you feel?

b. Were you afraid?

c. Did the treatments make you sick?

d. What did the doctors do?

e. How does this affect your relationship to God?

f. What does the treatment do to cancer?

g. How frequently are you treated?

h. What is your diet?

5.8 teacher check

5.9 Either order:

a. curie

b. roentgen

5.10 Materials are concentrated and made into solids, then placed in mines. Mines are safe because they're geologically stable, not connected to water sources, and water safe (water can't get in).

5.11 The effect heated water has on the original source when it is returned.

5.12 Either order:

a. irrigation of crops, keep oceans from freezing, and

b. prolongs shipping seasons, promotes growth in the oceans

5.13 teacher check

Self Test 1

1.01 a

1.02 b

1.03 b

1.04 a

1.05 c

1.06 a

1.07 c

1.08 b

1.09 a

1.010 c

1.011 Any order:

a. solid

b. liquid

c. gas

1.012 back and forth or vibrating

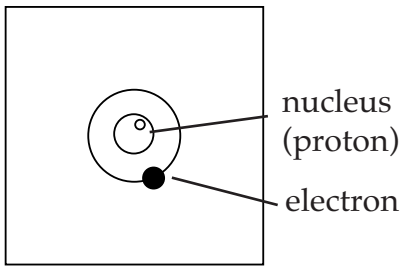
1.013 Either order:

a. back and forth or vibrating

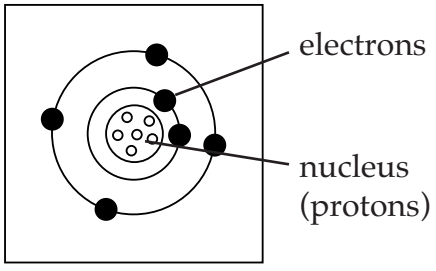
b. turning around or flowing

1.014 unrestricted

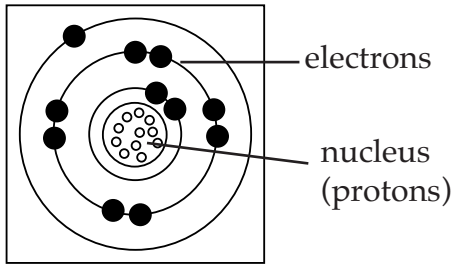
1.015 H = 1



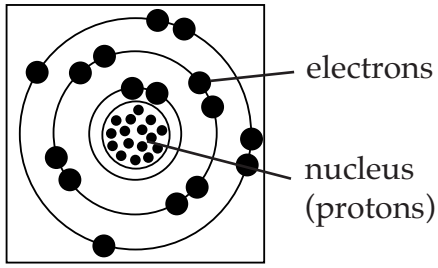
1.016 C = 6



1.017 Na = 11



1.018 S = 16



1.019 Examples, any order:

a. A solid has mass and takes up space.

b. A solid has definite shape and size.

c. It is not free to move around and stays put when set down.

1.020 Examples, any order:

a. They can move back and forth and turn around.

b. They have no definite shape.

c. Liquids have mass and density.

1.021 Examples, any order:

a. Gases have unrestricted movement.

b. Gases take shape of container.

c. Gases have mass and low density.

Self Test 2

2.01 d

2.02 b

2.03 e

2.04 g

2.05 a

2.06 b

2.07 e

2.08 h

2.09 b

2.010 f

2.011 Any order:

a. has mass

b. has fixed shape

c. has volume (or restricted movement)

2.012 Either order:

a. Geiger counter

b. Wilson cloud chamber

2.013 atomic number

2.014 26

2.015 An accidental exposure of photographic film to radioactive materials caused the film to be exposed. Becquerel discovered through further research that the unseen rays were causing the photographic exposure.

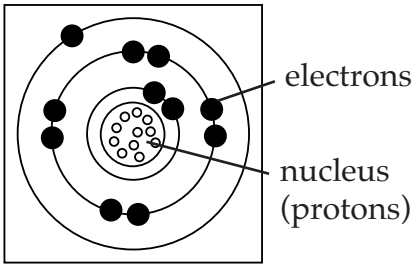
2.016 Suggested answers:
Photographic film is exposed by radioactive materials. Magnetic fields deflect the particles given off by radioactive materials. A Wilson cloud chamber is a chamber of vapor. When radiation passes through the chamber, it interacts with the vapor and leaves a vapor trail that scientists can use to study the mass and speed of the radiation going through. The Geiger counter counts radiation passing through an area of paper.

2.017 a. Beta particles are bent sharply toward the North Pole.

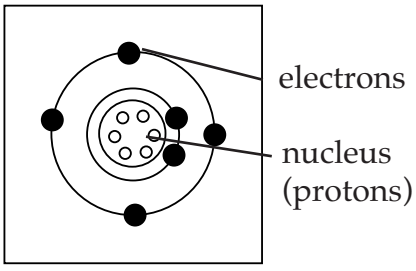
b. Alpha particles are slightly toward the South Pole.

c. Gamma rays are not affected.

2.018 Na = 11



2.019 C = 6



Self Test 3

3.01 h

3.02 j

3.03 e, f

3.04 g

3.05 d

3.06 b

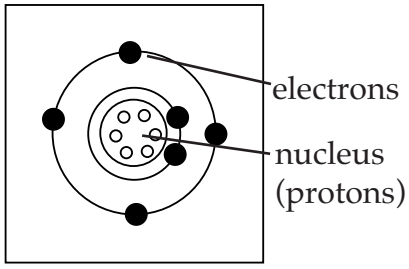
3.07 k

3.08 e, f

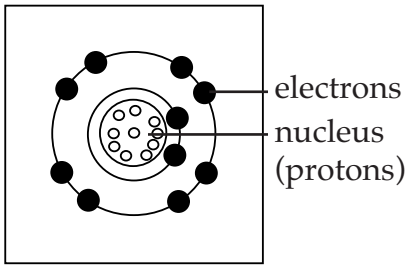
3.09 a

3.010 c

3.011 a. C = 6



b. Ne = 10



3.012 Any order:

a. proton

b. neutron

c. electron

d. positron

e. neutrino

f. gamma ray

g. meson

h. alpha

3.013 The nucleus is a series of energy levels. When neutrons and/or protons fall to a lower level, a gamma ray is emitted.

3.014 Two basic methods detect radiation – photographic film and magnetic fields. The Geiger counter and Wilson cloud chamber are two instruments used to measure the amount and intensity of radiation.

3.015 a. electron = small mass, negative charge circles atom in levels around nucleus

b. proton = 2,000 times mass of electron, positive charge, located in nucleus

c. neutron = no charge, equals mass of proton, located in nucleus

3.016 a. solid – specific shape, size and mass; molecules have restricted motion which is basically back and forth

b. liquid – free to move and flow; has mass, takes shape of container, occupies space, particles move freely but are restricted to back and forth and rotation

c. gas – no restriction on movement, fills entire container, has mass, low density

Self Test 4

4.01 d

4.02 f

4.03 h

4.04 a

4.05 j

4.06 b

4.07 i

4.08 e

4.09 g

4.010 c

4.011 back and forth and turning around

4.012 Any order:

a. protons

b. neutrons

c. electrons

4.013 Any order:

a. solid

b. liquid

c. gas

4.014 a. repel

b. attract

4.015 gas

4.016 a. control rod; made of cadmium or boron steel. Used to control the rate of neutron flow; absorb free neutrons to prevent chain reaction.

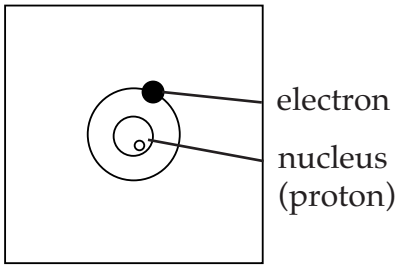
b. coolant outlet; to keep reactor cool flows through and absorbs heat for use in generating steam for electricity.

c. shielding; made of concrete and lead. Protects environment from dangerous radiation.

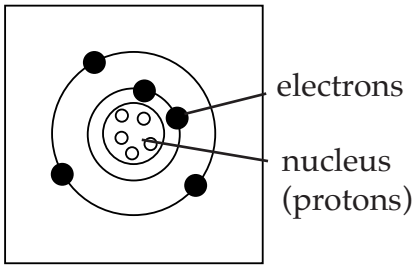
d. fuel rods (fissionable material); Example: contains fissionable material – enough to cause a nuclear reaction but less than critical mass point.

e. moderator; placed between fuel rods to slow down but not stop the neutrons produced in decay process. Usually graphite.

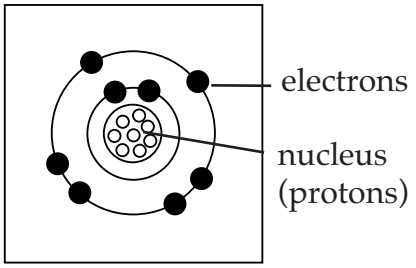
4.017 H = 1



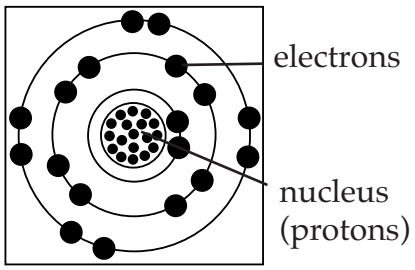
4.018 B = 5



4.019 O = 8



4.020 Ar = 18



4.021 Becquerel placed radioactive material on unexposed photographic film. The material exposed the film. He continued to experiment with the effects of radioactive materials on photography film.

4.022 He identified and named some elements, headed group that built first nuclear reactor. Developed science of irradiation and bombardment.

4.023 One model has the nucleus as a series of levels in which protons and neutrons are located. The movement of a p or n down the levels emits radiation (gamma). Several particles are subatomic to a nucleus and contain positrons (positive electrons). Neutrinos (zero particles of little mass), and particles ($^4_2$ He or helium nuclei).

4.024 Fission breaks down into smaller masses; fusion builds up heavier nuclei from light ones. Both release energy and lose mass. Fission is controllable; fusion is uncontrollable.

Self Test 5

5.01 e

5.02 g

5.03 j

5.04 h

5.05 d

5.06 i

5.07 a

5.08 c

5.09 b

5.010 f

5.011 Either order:

a. curie

b. roentgen

5.012 Any order:

a. proton

b. neutron

c. electron (beta)

d. neutrino

e. positron

f. alpha

g. meson

5.013 Any order:

a. solid

b. liquid

c. gas

5.014 a. solid: retains shape, has mass, limited particle movement, occupies space

b. liquid: occupies space, has mass, free to flow, takes shape of container

c. gas: unrestricted movement, occupies entire container, has mass, occupies space

5.015 a. f
b. b

5.016 a. e
b. a

5.017 a. d
b. c

5.018 To treat illness (chemotherapy)
to detect illness (x-ray)

5.019 Keeps it in concentrated solid form and buried in salt mines because it is dangerous to people and environment.

5.020 Either order:
a. produce heat (thermal effect)
b. produce radiation

5.021 increased population and increased consumption

Test Keys

1. false
2. true
3. false
4. false
5. true
6. true
7. false
8. true
9. true
10. true

11. c
12. d
13. f
14. a
15. b
16. a
17. b
18. c
19. c
20. a
21. a
22. c
23. a
24. b
25. c

26. a. energy or speed, distance, direction
    b. intensity
27. fermium
28. a. underground tanks
    b. salt mines
29. Any order:
    a. mesons
    b. positrons
    c. neutrinos
30. Marie and Pierre Curie
31. Any two; any order:
    a. irrigation of crops, prolonged shipping season,
    b. increased growth in ocean
32. a. protons
    b. neutrons
    c. electrons
33. Any order:
    a. curie
    b. roentgen
34. critical mass
35. radiation biological material absorbs
36. inserting a substance that will absorb or buffer the decay products of unstable nuclei
37. electron

1. true
2. true
3. false
4. false
5. true
6. false
7. true
8. true
9. false
10. false
11. c
12. d
13. a
14. e
15. f
16. a
17. b
18. b
19. b
20. a
21. a
22. c
23. c
24. a
25. c
26. Enrico Fermi
27. polonium
28. critical mass
29. chain reaction
30. roentgen
31. salt
32. Any order (a. and b.):
    a. proton
    b. neutron
    c. electron
33. a. fusion
    b. fission
34. positron
35. isotopes
36. Becquerel
37. Any order:
    a. solid
    b. liquid
    c. gas

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