

Chapter 2--Science, Systems, Matter, and Energy 3 copy

Student: _____

1. Discovering and formulating scientific laws requires
 - A. logic.
 - B. imagination.
 - C. use of scientific methods.
 - D. All of these answers.
 - E. None of these answers.
2. Which of the following statements does *not* describe the scientific enterprise?
 - A. Science is the acceptance of what works and the rejection of what does not.
 - B. Established scientific theories are not challenged and continue to hold true.
 - C. Advances in science are often based on disagreement, speculation, and controversy.
 - D. Scientific laws and theories are based on statistical probabilities, not certainties.
 - E. Science attempts to reduce the degree of uncertainty and lack of objectivity.
3. Which of the following is *least* likely to be said by a working scientist?
 - A. That seems a plausible model of the system we are studying.
 - B. I'd like to offer an alternative hypothesis to explain the data.
 - C. Perhaps you are right. But I think the data more strongly supports a different view.
 - D. Eureka! We've got the answer!
 - E. We should design an experiment to test this hypothesis.
4. Which of the following behaviors would be *least* appreciated by the scientific community?
 - A. observing patterns in nature
 - B. hypothesizing about evidence
 - C. overstating a claim
 - D. arguing over alternative interpretations
 - E. doing multiple experiments
5. Scientists try to reduce errors in their observations and measurements by
 - A. using standard procedures.
 - B. repeating measurements several times and taking the average value.
 - C. testing measuring devices against known samples.
 - D. All of these answers.
 - E. None of these answers.
6. At the meat counter in the grocery store, the server consistently weighed out one-pound samples of lunch meat. When the scale was tested with a known one-pound sample, it was found that the scale actually measured 1.1 pounds. The measurements that had been made with this scale could be described as
 - A. both accurate and precise.
 - B. accurate but not precise.
 - C. precise but not accurate.
 - D. neither accurate nor precise.
 - E. Almost accurate but not precise.
7. Which of the following questions is a working scientist *least* likely to ask?
 - A. How can this data be used to formulate a scientific law?
 - B. What new experiments can be done to test this hypothesis?
 - C. What is the meaning of life for humans?
 - D. What is a good question to ask about nature?
 - E. How many times should we run this experiment?

8. To explore what scientists generally agree about you would most likely turn to
 - A. the newspaper headlines.
 - B. CNN.
 - C. *Popular Science*.
 - D. U.S. National Academy of Sciences publications.
 - E. PBS.
9. An idea that has been tested widely, is supported by extensive evidence, and is accepted by most scientists in a particular field of study is called a(an)
 - A. hypothesis
 - B. scientific law
 - C. scientific variable
 - D. theory
 - E. natural law
10. Frontier science
 - A. is used in remote places.
 - B. often deals with well documented data.
 - C. often deals with untested models and hypotheses.
 - D. can lead the public to think that science has all the answers.
 - E. None of these answers.
11. When new information of ideas can disprove or overthrow a well-accepted scientific theory it is called
 - A. a paradigm shift
 - B. consensus science
 - C. frontier science
 - D. a scientific law
 - E. a deductive conclusion
12. Technology
 - A. always applies scientific knowledge to solve a problem.
 - B. always gives rise to better scientific understanding.
 - C. is the creation of new products that generally improve the quality of life.
 - D. is similar to science in that knowledge is passed around freely in order to be verified.
 - E. None of these answers.
13. The theory that in medicine antibiotics act to kill off bacteria in someone who has an infection would be an example of
 - A. junk science
 - B. consensus science
 - C. frontier science
 - D. an inductive conclusion
 - E. a scientific law
14. Environmental science integrates knowledge from the disciplines of
 - A. chemistry and physics.
 - B. ecology.
 - C. demography.
 - D. economics and politics.
 - E. All of these answers.
15. Compared to the other natural sciences, environmental science focuses more on
 - A. reductionistic thinking.
 - B. comparing experimental groups to control groups.
 - C. connections and interactions.
 - D. isolating one variable for study.
 - E. a and b only.

16. The type of model *least* likely to be used in the scientific process is a
- A. mathematical model.
 - B. theological model.
 - C. conceptual model.
 - D. physical model.
 - E. biological model.
17. A model airplane is an example of a
- A. mathematical model.
 - B. mental model.
 - C. conceptual model.
 - D. physical model.
 - E. biological model.
18. The colored bars showing kilocalories used per person per day in different societies through the course of history form a
- A. mathematical model.
 - B. mental model.
 - C. conceptual model.
 - D. graphic model.
 - E. None of these answers.
19. Weather forecasters rely on complicated
- A. mathematical models.
 - B. mental models.
 - C. conceptual models.
 - D. physical models.
 - E. theological models.
20. Human mental models tend to be unreliable when
- A. there are few interacting variables.
 - B. we attempt to extrapolate from many experiences to a general case.
 - C. the consequences occur immediately following causal events.
 - D. consequences of one event lead to other consequences.
 - E. responses do not vary from one time to the next.
21. Mathematical models are useful when
- A. controlled experiments are impossible.
 - B. responses to causing events are highly variable.
 - C. controlled experiments are too slow or expensive.
 - D. there are many interacting variables.
 - E. All of these answers.
22. Human events which affect the environment are generally characterized by
- A. predictability in what happens because the environment is diverse.
 - B. many experiences upon which to base our generalizations.
 - C. long delays between events and responses.
 - D. immediate feedback.
 - E. None of these answers.
23. The type of model most useful in helping us to perceive and predict events in the environmental arena is a
- A. mathematical model.
 - B. mental model.
 - C. conceptual model.
 - D. physical model.
 - E. None of these answers.

24. Which of the following is a property of a system?
- A. functions in a regular and predictable manner
 - B. highly random in its function
 - C. cannot be accurately modeled
 - D. consists solely of inputs and outputs
 - E. All of these answers.
25. A positive feedback loop is illustrated by all of the following *except*
- A. compound interest in a savings account.
 - B. exponential population growth.
 - C. a thermostat.
 - D. the greenhouse effect.
 - E. None of these answers.
26. Positive feedback loops
- A. accelerate change and go on infinitely.
 - B. accelerate change and are finite.
 - C. slow down change and go on infinitely.
 - D. slow down change and are finite.
 - E. does not affect a change.
27. A negative feedback loop is illustrated by all of the following *except*
- A. decelerating loss of heat as a pan of hot water is removed from the stove.
 - B. exponential population growth.
 - C. sweating to cool your body down during and after vigorous exercise.
 - D. a thermostat to maintain a certain temperature in your house.
 - E. None of these answers.
28. A negative feedback loop keeping a store stable is
- A. homeostasis.
 - B. a synergistic interaction.
 - C. leverage.
 - D. chaos.
 - E. All of these answers.
29. A thermostat keeping your house within a certain acceptable temperature range is an example of
- A. homeostasis.
 - B. synergistic interaction.
 - C. leverage.
 - D. chaos.
 - E. All of these answers.
30. Which one of the following does *not* illustrate a time delay?
- A. A smoker develops lung cancer.
 - B. A fox eats a rabbit.
 - C. CFCs deplete the ozone layer.
 - D. Increased carbon dioxide levels enhance the greenhouse effect.
 - E. None of these answers.
31. Examples of a situation where a long time delay results in environmental degradation include
- A. clear-cutting a forest.
 - B. building new four-lane highways.
 - C. depletion of the ozone layer.
 - D. fish kills from oil spills.
 - E. All of these answers.

32. When time delays allow a problem to build up until there is a fundamental shift in the behavior of a system, it is called
- A. a positive feedback loop
 - B. a negative feedback loop
 - C. a synergistic effect
 - D. a throughput
 - E. a tipping point
33. A synergistic effect
- A. results in a time delay.
 - B. occurs when two or more factors interact to produce a greater effect than each would have separately.
 - C. induces a positive feedback loop and results in continued interaction.
 - D. occurs when two or more factors interact to produce a lesser effect than each would have separately.
 - E. induces a negative feedback loop and results in continued interaction.
34. Two or more processes interacting such that the combined effect is greater than the sum of the individual effects is called
- A. homeostasis.
 - B. a synergistic interaction.
 - C. negative feedback.
 - D. chaos.
 - E. model.
35. When Jeffrey and Lynn drove to a trailhead in Colorado, they were stopped by a fallen birch tree across the road. Jeffrey could not move the tree by himself. Lynn could not move the tree by herself. Together they could move the tree. Their solution illustrates the concept of
- A. homeostasis.
 - B. a synergistic interaction.
 - C. leverage.
 - D. positive feedback.
 - E. chaos.
36. Which of the following is an example of synergism?
- A. The combined effects of alcohol and a depressant produce a greater effect than would be expected from adding their individual effects.
 - B. When the exponential growth of the human population exceeds the carrying capacity, a massive dieback will occur.
 - C. The use of alcohol reduces the effectiveness of a blood thinner.
 - D. Secondary smoke may increase chances of lung cancer in a nonsmoker.
 - E. Urbanization.
37. The community knew the effects of Chemical X alone. They set a safe limit for its use. The community knew the effects of Chemical Z alone. They set a safe limit for its use. Unfortunately, both chemicals were released into the environment at their safe levels and there were massive fish kills. The most probable explanation was the occurrence of
- A. homeostasis.
 - B. a synergistic interaction.
 - C. negative feedback.
 - D. positive feedback.
 - E. chaos.
38. Matter is anything that
- A. has mass and occupies space.
 - B. has the capacity to do work.
 - C. can be changed in form.
 - D. can produce change.
 - E. moves mass.

39. A distinctive building block of matter is called a(an)
- A. mixture.
 - B. compound.
 - C. isotope.
 - D. element.
 - E. atom.
40. All of the following are elements *except*
- A. water.
 - B. oxygen.
 - C. nitrogen.
 - D. hydrogen.
 - E. carbon.
41. Liquid, solid, and gas are
- A. physical forms of matter.
 - B. chemical forms of matter.
 - C. mixtures.
 - D. compounds.
 - E. molecules.
42. N_2 and O_2 are examples of
- A. compounds consisting of two different elements.
 - B. elements consisting of a compound and an ion.
 - C. molecules consisting of two elements of the same compound.
 - D. molecules consisting of two atoms of the same element.
 - E. molecules consisting of two atoms of different elements.
43. Protons, neutrons, and electrons are all
- A. forms of energy.
 - B. equal in mass.
 - C. subatomic particles.
 - D. negative ions.
 - E. charged particles.
44. The volume of an atom is mostly
- A. electrons.
 - B. protons.
 - C. neutrons.
 - D. free space.
 - E. with other atoms.
45. The atomic number is the number of
- A. atoms in a molecule.
 - B. protons in an atom.
 - C. neutrons in a molecule.
 - D. electrons in an atom.
 - E. protons, electrons, and neutrons.
46. The atomic mass is equal to the sum of the
- A. neutrons and isotopes.
 - B. neutrons and electrons.
 - C. neutrons and protons.
 - D. protons, neutrons, and electrons.
 - E. isotopes, protons, and electrons.

47. Isotopes differ from each other by their number of
- ions.
 - protons.
 - atoms.
 - neutrons.
 - isotopes.
48. Covalent compounds
- are held together by ionic bonds.
 - consist of networks of oppositely charged ions.
 - share electrons between their constituent atoms.
 - include ordinary table salt.
 - are held together by very weak bonds.
49. The measurement of the concentration of hydrogen ions in a solution is called
- ionization
 - pH
 - alkalinity
 - acidity
 - synergism
50. An example of an organic compound would be
- H₂O
 - NaCl
 - H₂SO₄
 - N₂O
 - CO₂
51. A eukaryotic cell contains
- a membrane-bound nucleus.
 - organelles.
 - genetic material.
 - All of the above.
 - None of the above.
52. Which of the following sources of iron would be of the highest quality?
- iron deposits on the ocean floor
 - a field of spinach
 - a large, scrap metal junkyard
 - a one-half-mile-deep deposit of iron ore
 - None of these answers.
53. The macromolecules that make up living organisms are
- proteins
 - lipids
 - carbohydrates
 - nucleic acids
 - All of the above.
54. Genetic material is packaged in units called
- chromosomes
 - genes
 - DNA
 - nucleotides
 - plasma

55. A parent and a kindergartener spent a half hour picking up all the toys and placing them on the shelves and in the drawers. The next evening, most of the toys were back on the floor. The concept which best describes this observation is
- conservation of matter.
 - conservation of energy.
 - entropy.
 - kinetic energy.
 - enthalpy.
56. In order to make one plastic soda bottle, approximately 100 liters of crude oil are used (including raw materials for plastic, fuel, etc.), 100 kilograms of steel, 100 liters of water, and various amounts of other materials. Which of the following describes this situation?
- plastic bottles have a high resource productivity
 - plastic bottles have a low material efficiency
 - plastic bottles represent an efficient use of resources
 - most of the matter used to manufacture plastic bottles ends up in the bottle
 - None of these answers.
57. Which of the following statements is *not* an example of a physical change?
- Confetti is cut from pieces of paper.
 - Water evaporates from a lake.
 - Ice cubes are formed in the freezer.
 - A plant converts carbon dioxide into carbohydrate.
 - A tree is cut down.
58. All of the following statements can be concluded from the law of conservation of matter *except*
- We can't throw anything away because there is no away.
 - We'll eventually run out of matter if we keep consuming it at current rates.
 - There will always be pollution of some sort.
 - Everything must go somewhere.
 - We do not consume matter.
59. Physical and chemical reactions
- always require energy.
 - sometimes give off energy.
 - involve changes in matter, but not energy.
 - involve changes in energy, but not in matter.
 - never require energy.
60. Earth is essentially a closed system for
- matter.
 - energy.
 - matter and energy.
 - neither matter nor energy.
 - None of these answers.
61. Our capability to measure pollutants in the environment has steadily increased over the decades. It is important for us to understand the meaning of our increased capabilities. We once measured in parts per million (ppm). We measured one drop in 1,000 liters. Now we can measure in parts per trillion (ppt), or one drop in
- 1,000,000 liters.
 - 10,000,000 liters.
 - 100,000,000 liters.
 - 1,000,000,000 liters.
 - 10,000,000,000 liters.

62. All of the following are broken down by biological action *except*
- A. sewage.
 - B. litter in the environment.
 - C. lead and mercury.
 - D. organic garbage.
 - E. litter and sewage.
63. Of the following options to deal with nondegradable pollutants, the *least* effective is to
- A. remove them from contaminated air, water, or soil.
 - B. reuse them.
 - C. recycle them.
 - D. refrain from introducing them into the environment.
 - E. reuse and recycle.
64. Which of the following involves changes of mass into energy?
- A. chemical changes
 - B. energy changes
 - C. physical changes
 - D. nuclear changes
 - E. All of these answers.
65. Nuclear changes are governed by
- A. the law of conservation of matter.
 - B. the law of conservation of energy.
 - C. the law of conservation of matter and energy.
 - D. the law of entropy.
 - E. the law of enthalpy.
66. The amount of time it takes for radioactive decay to change an element into a nonradioactive stable isotope is called
- A. nuclear fission
 - B. nuclear fusion
 - C. critical mass
 - D. half-lives
 - E. nuclear change
67. Which of the following statements is *true*?
- A. Exposure of a substance to alpha, beta, or gamma radiation makes it radioactive.
 - B. All isotopes are radioactive.
 - C. Radioactive isotopes give off radiation at a fixed rate.
 - D. Only naturally occurring substances are radioactive.
 - E. Radioactive isotopes give off radiation at a variable rate.
68. Radioisotopes have been used to
- A. treat cancer.
 - B. to detect pollution.
 - C. to determine the age of fossils.
 - D. All of these answers.
 - E. None of these answers.
69. The fuel used in a nuclear reactor is
- A. gamma rays.
 - B. uranium-235.
 - C. alpha particles.
 - D. beta particles.
 - E. delta particles.

70. Multiple nuclear fissions
- A. occur when two nuclei hit each other.
 - B. require isotopes with small mass numbers.
 - C. occur best with a small mass of isotopes.
 - D. may result in chain reactions.
 - E. occur when multiple nuclei hit each other.
71. Which of the following comparisons of nuclear fission and nuclear fusion is correct?
- A. Nuclear fusion is harder to initiate than nuclear fission.
 - B. Nuclear fusion produces less energy than nuclear fission.
 - C. Nuclear fusion occurs in atomic bombs, whereas nuclear fission occurs in hydrogen bombs.
 - D. Nuclear fusion occurs in nuclear power plants, whereas nuclear fission occurs in the sun.
 - E. Nuclear fusion produces the same energy as nuclear fission.
72. Which of the following statements about nuclear fusion is *false*?
- A. During nuclear fusion, two nuclei of isotopes of light elements are forced together at high temperatures until they fuse and release energy.
 - B. Fusion is the source of energy in the sun.
 - C. High-temperature fusion is much harder to initiate but releases more energy per unit of fuel than fission.
 - D. Controlled nuclear fusion reactors are being tested in California and will probably be ready to come on-line by the year 2000.
 - E. None of these answers.
73. Energy can be formally defined as
- A. the random motion of molecules.
 - B. the ability to do work and transfer heat.
 - C. a force that is exerted over some distance.
 - D. the movement of molecules.
 - E. the loss of matter.
74. Scientists classify energy as either
- A. chemical or physical.
 - B. kinetic or mechanical.
 - C. potential or mechanical.
 - D. potential or kinetic.
 - E. chemical or kinetic.
75. All of the following are examples of kinetic energy *except*
- A. a speeding bullet.
 - B. a stick of dynamite.
 - C. a flow of electric current.
 - D. a falling rock.
 - E. flowing water.
76. An example of potential energy is
- A. electricity flowing through a wire.
 - B. the chemical energy in a candy bar.
 - C. a bullet fired at high velocity.
 - D. a leaf falling from a tree.
 - E. water flowing.
77. All of the following are examples of ionizing radiation *except*
- A. cosmic rays.
 - B. gamma rays.
 - C. microwaves.
 - D. X rays.
 - E. Y rays.

78. Which of the following is an example of low-quality energy?
- A. electricity
 - B. heat in the ocean
 - C. nuclei of uranium-235
 - D. coal
 - E. food
79. High-quality energy is needed to do all of the following *except*
- A. run electric lights.
 - B. run electric motors.
 - C. run electric appliances.
 - D. heat the White House.
 - E. run automobiles.
80. The relative quality of electricity is
- A. very high.
 - B. high.
 - C. moderate.
 - D. low.
 - E. very low.
81. The relative quality of normal sunlight is
- A. very high.
 - B. high.
 - C. moderate.
 - D. low.
 - E. very low.
82. High-temperature industrial heat is *least* likely to be provided by
- A. nuclear fission.
 - B. concentrated sunlight.
 - C. dispersed geothermal energy.
 - D. burning natural gas.
 - E. oceans.
83. Earth is essentially an open system for
- A. matter.
 - B. energy.
 - C. matter and energy.
 - D. neither matter nor energy.
 - E. None of these answers.
84. Which of the following statements is *false*?
- A. Energy can be converted from one form to another.
 - B. Energy and matter can generally be converted into each other.
 - C. Energy input always equals energy output.
 - D. The laws of thermodynamics can be applied to living systems.
 - E. Energy conversion results in higher quality energy.
85. The first law of energy tells us that
- A. doing work always creates heat.
 - B. altering matter is the best source of energy.
 - C. energy cannot be recycled.
 - D. energy is neither created nor destroyed.
 - E. energy cannot be converted.

86. Which of the following statements does *not* apply to the second law of energy?
- A. Energy conversion results in lower-quality energy.
 - B. Energy can neither be created nor destroyed.
 - C. Energy conversion results in more-dispersed energy.
 - D. Heat is usually given off from energy conversions.
 - E. None of these answers.
87. Energy input is
- A. usually greater than energy output.
 - B. always greater than energy output.
 - C. always equal to energy output.
 - D. usually less than energy output.
 - E. always less than energy output.
88. The energy "lost" by a system is
- A. converted into an equal amount of matter.
 - B. equal to the energy the system creates.
 - C. converted to lower-quality energy.
 - D. returned to the system eventually.
 - E. converted to higher-quality energy.
89. Which of the following energy sources has the lowest quality?
- A. high-velocity water flow
 - B. fuelwood
 - C. food
 - D. dispersed geothermal energy
 - E. nuclear
90. In an energy transformation, some of the energy usually ends up as
- A. heat energy that flows into the environment.
 - B. mechanical energy that performs useful work.
 - C. chemical energy that performs useful work.
 - D. electrical energy that performs useful work.
 - E. molecular energy that performs useful work.
91. In any heat-to-work conversion, the quality of the energy available after the work is performed will always be ____ the initial energy quality.
- A. equal to
 - B. greater than
 - C. equal to or greater than
 - D. less than
 - E. slightly greater than
92. The matter and energy laws tell us that we can recycle
- A. both matter and energy.
 - B. neither matter nor energy.
 - C. matter but not energy.
 - D. energy but not matter.
 - E. None of these answers.
93. Earth's supply of concentrated, usable energy is being steadily
- A. depleted.
 - B. replenished.
 - C. converted to more usable forms.
 - D. converted to higher-quality forms.
 - E. maintained stable.

94. Which of the following statements is *not* an observation derived from applying the second law of thermodynamics to living systems?
- Life is a formation and maintenance of ordered structures.
 - High-quality energy sources are required to maintain life.
 - Living things give off heat.
 - Cooking foods turn them into high-quality energy sources.
 - None of these answers.
95. "You are a raft of order floating on the high seas of entropy." Which scientific law is best described by this analogy?
- Law of Conservation of Matter
 - Law of Conservation of Energy
 - Law of Conservation of Matter and Energy
 - Second Law of Thermodynamics
 - First Law of Thermodynamics
96. A high-throughput economy sustains economic growth by
- minimizing the rate of energy resource use.
 - minimizing the rate of energy and matter resource use.
 - maximizing the rate of energy resource use.
 - maximizing the rate of energy and matter resource use.
 - maximizing the rate of matter resource use.
97. Which of the following statements is the *most* logical way to cope with the problem of limitations imposed by the three basic physical laws governing matter?
- Use and waste less energy and matter.
 - Shift to nonpolluting nuclear fusion power.
 - Increase the output of low-quality heat.
 - Increase the input of high-quality energy.
 - All of these answers.
98. Which of the following statements about a matter-recycling economy is *false*?
- The goal of a matter-recycling society is to allow economic growth to continue without depleting matter resources and without producing excessive pollution and environmental degradation.
 - One limit of a matter-recycling society is dependence on high-quality energy to recycle materials.
 - A matter-recycling society is limited by the environment's capacity to absorb and disperse waste heat and to dilute and degrade waste matter.
 - A matter-recycling society becomes independent of high-quality matter because materials can continue to be recycled indefinitely.
 - None of these answers.
99. A low-throughput economy would do all of the following *except*
- use energy more efficiently.
 - shift to perpetual and renewable energy sources.
 - recycle and reuse most matter that is now discarded.
 - create goods with a short life cycle to increase recycling.
 - None of these answers.
100. Atoms only occur in living organisms.
True False
101. According to the Law of Conservation of Matter, a chemical change in the atoms causes some destruction in the atom.
True False
102. The amount of energy a person uses each day is approximately the same throughout the world.
True False

103. A nuclear change in which two isotopes of light elements are forced together, releasing huge amounts of energy, is called nuclear fission.
True False
104. All cells contain a nucleus.
True False
105. Chromosomes are contained in genes.
True False
106. Organic compounds contain carbon combined with other atoms such as hydrogen, oxygen and nitrogen.
True False
107. Energy flow can be used to diagram the ecological interdependence of species.
True False
108. In a chemical change, matter may be moved by kinetic energy.
True False
109. Scientific hypotheses are laws that explain natural processes.
True False
110. Energy cannot be recycled.
True False
111. Burning coal demonstrates the first law of thermodynamics.
True False
112. An atom of sodium has eleven protons and therefore has eleven _____.

113. When ice melts into liquid water a(an) _____ has occurred.

114. Before an interpretation of an observation can become a theory, it must first be a testable _____.

115. When you release an object from a high altitude, the object's potential energy converts to _____.

116. A feather and a brick both fall to the earth due to _____.

117. _____ explains why a barrel of oil can be used only once as fuel.

Chapter 2--Science, Systems, Matter, and Energy 3 copy **Key**

1. Discovering and formulating scientific laws requires
 - A. logic.
 - B. imagination.
 - C. use of scientific methods.
 - D.** All of these answers.
 - E. None of these answers.
2. Which of the following statements does *not* describe the scientific enterprise?
 - A. Science is the acceptance of what works and the rejection of what does not.
 - B.** Established scientific theories are not challenged and continue to hold true.
 - C. Advances in science are often based on disagreement, speculation, and controversy.
 - D. Scientific laws and theories are based on statistical probabilities, not certainties.
 - E. Science attempts to reduce the degree of uncertainty and lack of objectivity.
3. Which of the following is *least* likely to be said by a working scientist?
 - A. That seems a plausible model of the system we are studying.
 - B. I'd like to offer an alternative hypothesis to explain the data.
 - C. Perhaps you are right. But I think the data more strongly supports a different view.
 - D.** Eureka! We've got the answer!
 - E. We should design an experiment to test this hypothesis.
4. Which of the following behaviors would be *least* appreciated by the scientific community?
 - A. observing patterns in nature
 - B. hypothesizing about evidence
 - C.** overstating a claim
 - D. arguing over alternative interpretations
 - E. doing multiple experiments
5. Scientists try to reduce errors in their observations and measurements by
 - A. using standard procedures.
 - B. repeating measurements several times and taking the average value.
 - C. testing measuring devices against known samples.
 - D.** All of these answers.
 - E. None of these answers.
6. At the meat counter in the grocery store, the server consistently weighed out one-pound samples of lunch meat. When the scale was tested with a known one-pound sample, it was found that the scale actually measured 1.1 pounds. The measurements that had been made with this scale could be described as
 - A. both accurate and precise.
 - B. accurate but not precise.
 - C.** precise but not accurate.
 - D. neither accurate nor precise.
 - E. Almost accurate but not precise.
7. Which of the following questions is a working scientist *least* likely to ask?
 - A. How can this data be used to formulate a scientific law?
 - B. What new experiments can be done to test this hypothesis?
 - C.** What is the meaning of life for humans?
 - D. What is a good question to ask about nature?
 - E. How many times should we run this experiment?

8. To explore what scientists generally agree about you would most likely turn to
A. the newspaper headlines.
B. CNN.
C. *Popular Science*.
D. U.S. National Academy of Sciences publications.
E. PBS.
9. An idea that has been tested widely, is supported by extensive evidence, and is accepted by most scientists in a particular field of study is called a(an)
A. hypothesis
B. scientific law
C. scientific variable
D. theory
E. natural law
10. Frontier science
A. is used in remote places.
B. often deals with well documented data.
C. often deals with untested models and hypotheses.
D. can lead the public to think that science has all the answers.
E. None of these answers.
11. When new information of ideas can disprove or overthrow a well-accepted scientific theory it is called
A. a paradigm shift
B. consensus science
C. frontier science
D. a scientific law
E. a deductive conclusion
12. Technology
A. always applies scientific knowledge to solve a problem.
B. always gives rise to better scientific understanding.
C. is the creation of new products that generally improve the quality of life.
D. is similar to science in that knowledge is passed around freely in order to be verified.
E. None of these answers.
13. The theory that in medicine antibiotics act to kill off bacteria in someone who has an infection would be an example of
A. junk science
B. consensus science
C. frontier science
D. an inductive conclusion
E. a scientific law
14. Environmental science integrates knowledge from the disciplines of
A. chemistry and physics.
B. ecology.
C. demography.
D. economics and politics.
E. All of these answers.
15. Compared to the other natural sciences, environmental science focuses more on
A. reductionistic thinking.
B. comparing experimental groups to control groups.
C. connections and interactions.
D. isolating one variable for study.
E. a and b only.

16. The type of model *least* likely to be used in the scientific process is a
A. mathematical model.
B. theological model.
C. conceptual model.
D. physical model.
E. biological model.
17. A model airplane is an example of a
A. mathematical model.
B. mental model.
C. conceptual model.
D. physical model.
E. biological model.
18. The colored bars showing kilocalories used per person per day in different societies through the course of history form a
A. mathematical model.
B. mental model.
C. conceptual model.
D. graphic model.
E. None of these answers.
19. Weather forecasters rely on complicated
A. mathematical models.
B. mental models.
C. conceptual models.
D. physical models.
E. theological models.
20. Human mental models tend to be unreliable when
A. there are few interacting variables.
B. we attempt to extrapolate from many experiences to a general case.
C. the consequences occur immediately following causal events.
D. consequences of one event lead to other consequences.
E. responses do not vary from one time to the next.
21. Mathematical models are useful when
A. controlled experiments are impossible.
B. responses to causing events are highly variable.
C. controlled experiments are too slow or expensive.
D. there are many interacting variables.
E. All of these answers.
22. Human events which affect the environment are generally characterized by
A. predictability in what happens because the environment is diverse.
B. many experiences upon which to base our generalizations.
C. long delays between events and responses.
D. immediate feedback.
E. None of these answers.
23. The type of model most useful in helping us to perceive and predict events in the environmental arena is a
A. mathematical model.
B. mental model.
C. conceptual model.
D. physical model.
E. None of these answers.

24. Which of the following is a property of a system?
A. functions in a regular and predictable manner
B. highly random in its function
C. cannot be accurately modeled
D. consists solely of inputs and outputs
E. All of these answers.
25. A positive feedback loop is illustrated by all of the following *except*
A. compound interest in a savings account.
B. exponential population growth.
C. a thermostat.
D. the greenhouse effect.
E. None of these answers.
26. Positive feedback loops
A. accelerate change and go on infinitely.
B. accelerate change and are finite.
C. slow down change and go on infinitely.
D. slow down change and are finite.
E. does not affect a change.
27. A negative feedback loop is illustrated by all of the following *except*
A. decelerating loss of heat as a pan of hot water is removed from the stove.
B. exponential population growth.
C. sweating to cool your body down during and after vigorous exercise.
D. a thermostat to maintain a certain temperature in your house.
E. None of these answers.
28. A negative feedback loop keeping a store stable is
A. homeostasis.
B. a synergistic interaction.
C. leverage.
D. chaos.
E. All of these answers.
29. A thermostat keeping your house within a certain acceptable temperature range is an example of
A. homeostasis.
B. synergistic interaction.
C. leverage.
D. chaos.
E. All of these answers.
30. Which one of the following does *not* illustrate a time delay?
A. A smoker develops lung cancer.
B. A fox eats a rabbit.
C. CFCs deplete the ozone layer.
D. Increased carbon dioxide levels enhance the greenhouse effect.
E. None of these answers.
31. Examples of a situation where a long time delay results in environmental degradation include
A. clear-cutting a forest.
B. building new four-lane highways.
C. depletion of the ozone layer.
D. fish kills from oil spills.
E. All of these answers.

32. When time delays allow a problem to build up until there is a fundamental shift in the behavior of a system, it is called
- A. a positive feedback loop
 - B. a negative feedback loop
 - C. a synergistic effect
 - D. a throughput
 - E. a tipping point**
33. A synergistic effect
- A. results in a time delay.
 - B. occurs when two or more factors interact to produce a greater effect than each would have separately.**
 - C. induces a positive feedback loop and results in continued interaction.
 - D. occurs when two or more factors interact to produce a lesser effect than each would have separately.
 - E. induces a negative feedback loop and results in continued interaction.
34. Two or more processes interacting such that the combined effect is greater than the sum of the individual effects is called
- A. homeostasis.
 - B. a synergistic interaction.**
 - C. negative feedback.
 - D. chaos.
 - E. model.
35. When Jeffrey and Lynn drove to a trailhead in Colorado, they were stopped by a fallen birch tree across the road. Jeffrey could not move the tree by himself. Lynn could not move the tree by herself. Together they could move the tree. Their solution illustrates the concept of
- A. homeostasis.
 - B. a synergistic interaction.**
 - C. leverage.
 - D. positive feedback.
 - E. chaos.
36. Which of the following is an example of synergism?
- A. The combined effects of alcohol and a depressant produce a greater effect than would be expected from adding their individual effects.**
 - B. When the exponential growth of the human population exceeds the carrying capacity, a massive dieback will occur.
 - C. The use of alcohol reduces the effectiveness of a blood thinner.
 - D. Secondary smoke may increase chances of lung cancer in a nonsmoker.
 - E. Urbanization.
37. The community knew the effects of Chemical X alone. They set a safe limit for its use. The community knew the effects of Chemical Z alone. They set a safe limit for its use. Unfortunately, both chemicals were released into the environment at their safe levels and there were massive fish kills. The most probable explanation was the occurrence of
- A. homeostasis.
 - B. a synergistic interaction.**
 - C. negative feedback.
 - D. positive feedback.
 - E. chaos.

38. Matter is anything that
A. has mass and occupies space.
B. has the capacity to do work.
C. can be changed in form.
D. can produce change.
E. moves mass.
39. A distinctive building block of matter is called a(an)
A. mixture.
B. compound.
C. isotope.
D. element.
E. atom.
40. All of the following are elements *except*
A. water.
B. oxygen.
C. nitrogen.
D. hydrogen.
E. carbon.
41. Liquid, solid, and gas are
A. physical forms of matter.
B. chemical forms of matter.
C. mixtures.
D. compounds.
E. molecules.
42. N₂ and O₂ are examples of
A. compounds consisting of two different elements.
B. elements consisting of a compound and an ion.
C. molecules consisting of two elements of the same compound.
D. molecules consisting of two atoms of the same element.
E. molecules consisting of two atoms of different elements.
43. Protons, neutrons, and electrons are all
A. forms of energy.
B. equal in mass.
C. subatomic particles.
D. negative ions.
E. charged particles.
44. The volume of an atom is mostly
A. electrons.
B. protons.
C. neutrons.
D. free space.
E. with other atoms.
45. The atomic number is the number of
A. atoms in a molecule.
B. protons in an atom.
C. neutrons in a molecule.
D. electrons in an atom.
E. protons, electrons, and neutrons.

46. The atomic mass is equal to the sum of the
A. neutrons and isotopes.
B. neutrons and electrons.
C. neutrons and protons.
D. protons, neutrons, and electrons.
E. isotopes, protons, and electrons.
47. Isotopes differ from each other by their number of
A. ions.
B. protons.
C. atoms.
D. neutrons.
E. isotopes.
48. Covalent compounds
A. are held together by ionic bonds.
B. consist of networks of oppositely charged ions.
C. share electrons between their constituent atoms.
D. include ordinary table salt.
E. are held together by very weak bonds.
49. The measurement of the concentration of hydrogen ions in a solution is called
A. ionization
B. pH
C. alkalinity
D. acidity
E. synergism
50. An example of an organic compound would be
A. H_2O
B. NaCl
C. H_2SO_4
D. N_2O
E. CO_2
51. A eukaryotic cell contains
A. a membrane-bound nucleus.
B. organelles.
C. genetic material.
D. All of the above.
E. None of the above.
52. Which of the following sources of iron would be of the highest quality?
A. iron deposits on the ocean floor
B. a field of spinach
C. a large, scrap metal junkyard
D. a one-half-mile-deep deposit of iron ore
E. None of these answers.
53. The macromolecules that make up living organisms are
A. proteins
B. lipids
C. carbohydrates
D. nucleic acids
E. All of the above.

54. Genetic material is packaged in units called
A. chromosomes
B. genes
C. DNA
D. nucleotides
E. plasma
55. A parent and a kindergartener spent a half hour picking up all the toys and placing them on the shelves and in the drawers. The next evening, most of the toys were back on the floor. The concept which best describes this observation is
A. conservation of matter.
B. conservation of energy.
C. entropy.
D. kinetic energy.
E. enthalpy.
56. In order to make one plastic soda bottle, approximately 100 liters of crude oil are used (including raw materials for plastic, fuel, etc.), 100 kilograms of steel, 100 liters of water, and various amounts of other materials. Which of the following describes this situation?
A. plastic bottles have a high resource productivity
B. plastic bottles have a low material efficiency
C. plastic bottles represent an efficient use of resources
D. most of the matter used to manufacture plastic bottles ends up in the bottle
E. None of these answers.
57. Which of the following statements is *not* an example of a physical change?
A. Confetti is cut from pieces of paper.
B. Water evaporates from a lake.
C. Ice cubes are formed in the freezer.
D. A plant converts carbon dioxide into carbohydrate.
E. A tree is cut down.
58. All of the following statements can be concluded from the law of conservation of matter *except*
A. We can't throw anything away because there is no away.
B. We'll eventually run out of matter if we keep consuming it at current rates.
C. There will always be pollution of some sort.
D. Everything must go somewhere.
E. We do not consume matter.
59. Physical and chemical reactions
A. always require energy.
B. sometimes give off energy.
C. involve changes in matter, but not energy.
D. involve changes in energy, but not in matter.
E. never require energy.
60. Earth is essentially a closed system for
A. matter.
B. energy.
C. matter and energy.
D. neither matter nor energy.
E. None of these answers.

61. Our capability to measure pollutants in the environment has steadily increased over the decades. It is important for us to understand the meaning of our increased capabilities. We once measured in parts per million (ppm). We measured one drop in 1,000 liters. Now we can measure in parts per trillion (ppt), or one drop in
- A. 1,000,000 liters.
 - B. 10,000,000 liters.
 - C. 100,000,000 liters.
 - D.** 1,000,000,000 liters.
 - E. 10,000,000,000 liters.
62. All of the following are broken down by biological action *except*
- A. sewage.
 - B. litter in the environment.
 - C.** lead and mercury.
 - D. organic garbage.
 - E. litter and sewage.
63. Of the following options to deal with nondegradable pollutants, the *least* effective is to
- A.** remove them from contaminated air, water, or soil.
 - B. reuse them.
 - C. recycle them.
 - D. refrain from introducing them into the environment.
 - E. reuse and recycle.
64. Which of the following involves changes of mass into energy?
- A. chemical changes
 - B. energy changes
 - C. physical changes
 - D.** nuclear changes
 - E. All of these answers.
65. Nuclear changes are governed by
- A. the law of conservation of matter.
 - B. the law of conservation of energy.
 - C.** the law of conservation of matter and energy.
 - D. the law of entropy.
 - E. the law of enthalpy.
66. The amount of time it takes for radioactive decay to change an element into a nonradioactive stable isotope is called
- A. nuclear fission
 - B. nuclear fusion
 - C. critical mass
 - D.** half-lives
 - E. nuclear change
67. Which of the following statements is *true*?
- A. Exposure of a substance to alpha, beta, or gamma radiation makes it radioactive.
 - B. All isotopes are radioactive.
 - C.** Radioactive isotopes give off radiation at a fixed rate.
 - D. Only naturally occurring substances are radioactive.
 - E. Radioactive isotopes give off radiation at a variable rate.

68. Radioisotopes have been used to
A. treat cancer.
B. to detect pollution.
C. to determine the age of fossils.
D. All of these answers.
E. None of these answers.
69. The fuel used in a nuclear reactor is
A. gamma rays.
B. uranium-235.
C. alpha particles.
D. beta particles.
E. delta particles.
70. Multiple nuclear fissions
A. occur when two nuclei hit each other.
B. require isotopes with small mass numbers.
C. occur best with a small mass of isotopes.
D. may result in chain reactions.
E. occur when multiple nuclei hit each other.
71. Which of the following comparisons of nuclear fission and nuclear fusion is correct?
A. Nuclear fusion is harder to initiate than nuclear fission.
B. Nuclear fusion produces less energy than nuclear fission.
C. Nuclear fusion occurs in atomic bombs, whereas nuclear fission occurs in hydrogen bombs.
D. Nuclear fusion occurs in nuclear power plants, whereas nuclear fission occurs in the sun.
E. Nuclear fusion produces the same energy as nuclear fission.
72. Which of the following statements about nuclear fusion is *false*?
A During nuclear fusion, two nuclei of isotopes of light elements are forced together at high temperatures until they fuse and release energy.
B. Fusion is the source of energy in the sun.
C. High-temperature fusion is much harder to initiate but releases more energy per unit of fuel than fission.
D. Controlled nuclear fusion reactors are being tested in California and will probably be ready to come on-line by the year 2000.
E. None of these answers.
73. Energy can be formally defined as
A. the random motion of molecules.
B. the ability to do work and transfer heat.
C. a force that is exerted over some distance.
D. the movement of molecules.
E. the loss of matter.
74. Scientists classify energy as either
A. chemical or physical.
B. kinetic or mechanical.
C. potential or mechanical.
D. potential or kinetic.
E. chemical or kinetic.
75. All of the following are examples of kinetic energy *except*
A. a speeding bullet.
B. a stick of dynamite.
C. a flow of electric current.
D. a falling rock.
E. flowing water.

76. An example of potential energy is
A. electricity flowing through a wire.
B. the chemical energy in a candy bar.
C. a bullet fired at high velocity.
D. a leaf falling from a tree.
E. water flowing.
77. All of the following are examples of ionizing radiation *except*
A. cosmic rays.
B. gamma rays.
C. microwaves.
D. X rays.
E. Y rays.
78. Which of the following is an example of low-quality energy?
A. electricity
B. heat in the ocean
C. nuclei of uranium-235
D. coal
E. food
79. High-quality energy is needed to do all of the following *except*
A. run electric lights.
B. run electric motors.
C. run electric appliances.
D. heat the White House.
E. run automobiles.
80. The relative quality of electricity is
A. very high.
B. high.
C. moderate.
D. low.
E. very low.
81. The relative quality of normal sunlight is
A. very high.
B. high.
C. moderate.
D. low.
E. very low.
82. High-temperature industrial heat is *least* likely to be provided by
A. nuclear fission.
B. concentrated sunlight.
C. dispersed geothermal energy.
D. burning natural gas.
E. oceans.
83. Earth is essentially an open system for
A. matter.
B. energy.
C. matter and energy.
D. neither matter nor energy.
E. None of these answers.

84. Which of the following statements is *false*?
- A. Energy can be converted from one form to another.
 - B.** Energy and matter can generally be converted into each other.
 - C. Energy input always equals energy output.
 - D. The laws of thermodynamics can be applied to living systems.
 - E. Energy conversion results in higher quality energy.
85. The first law of energy tells us that
- A. doing work always creates heat.
 - B. altering matter is the best source of energy.
 - C. energy cannot be recycled.
 - D.** energy is neither created nor destroyed.
 - E. energy cannot be converted.
86. Which of the following statements does *not* apply to the second law of energy?
- A. Energy conversion results in lower-quality energy.
 - B.** Energy can neither be created nor destroyed.
 - C. Energy conversion results in more-dispersed energy.
 - D. Heat is usually given off from energy conversions.
 - E. None of these answers.
87. Energy input is
- A. usually greater than energy output.
 - B. always greater than energy output.
 - C.** always equal to energy output.
 - D. usually less than energy output.
 - E. always less than energy output.
88. The energy "lost" by a system is
- A. converted into an equal amount of matter.
 - B. equal to the energy the system creates.
 - C.** converted to lower-quality energy.
 - D. returned to the system eventually.
 - E. converted to higher-quality energy.
89. Which of the following energy sources has the lowest quality?
- A. high-velocity water flow
 - B. fuelwood
 - C. food
 - D.** dispersed geothermal energy
 - E. nuclear
90. In an energy transformation, some of the energy usually ends up as
- A.** heat energy that flows into the environment.
 - B. mechanical energy that performs useful work.
 - C. chemical energy that performs useful work.
 - D. electrical energy that performs useful work.
 - E. molecular energy that performs useful work.
91. In any heat-to-work conversion, the quality of the energy available after the work is performed will always be ____ the initial energy quality.
- A. equal to
 - B. greater than
 - C. equal to or greater than
 - D.** less than
 - E. slightly greater than

92. The matter and energy laws tell us that we can recycle
 A. both matter and energy.
 B. neither matter nor energy.
C. matter but not energy.
 D. energy but not matter.
 E. None of these answers.
93. Earth's supply of concentrated, usable energy is being steadily
A. depleted.
 B. replenished.
 C. converted to more usable forms.
 D. converted to higher-quality forms.
 E. maintained stable.
94. Which of the following statements is *not* an observation derived from applying the second law of thermodynamics to living systems?
 A. Life is a formation and maintenance of ordered structures.
 B. High-quality energy sources are required to maintain life.
 C. Living things give off heat.
D. Cooking foods turn them into high-quality energy sources.
 E. None of these answers.
95. "You are a raft of order floating on the high seas of entropy." Which scientific law is best described by this analogy?
 A. Law of Conservation of Matter
 B. Law of Conservation of Energy
 C. Law of Conservation of Matter and Energy
D. Second Law of Thermodynamics
 E. First Law of Thermodynamics
96. A high-throughput economy sustains economic growth by
 A. minimizing the rate of energy resource use.
 B. minimizing the rate of energy and matter resource use.
 C. maximizing the rate of energy resource use.
D. maximizing the rate of energy and matter resource use.
 E. maximizing the rate of matter resource use.
97. Which of the following statements is the *most* logical way to cope with the problem of limitations imposed by the three basic physical laws governing matter?
A. Use and waste less energy and matter.
 B. Shift to nonpolluting nuclear fusion power.
 C. Increase the output of low-quality heat.
 D. Increase the input of high-quality energy.
 E. All of these answers.
98. Which of the following statements about a matter-recycling economy is *false*?
 A. The goal of a matter-recycling society is to allow economic growth to continue without depleting matter resources and without producing excessive pollution and environmental degradation.
 B. One limit of a matter-recycling society is dependence on high-quality energy to recycle materials.
 C. A matter-recycling society is limited by the environment's capacity to absorb and disperse waste heat and to dilute and degrade waste matter.
D. A matter-recycling society becomes independent of high-quality matter because materials can continue to be recycled indefinitely.
 E. None of these answers.

99. A low-throughput economy would do all of the following *except*
A. use energy more efficiently.
B. shift to perpetual and renewable energy sources.
C. recycle and reuse most matter that is now discarded.
D. create goods with a short life cycle to increase recycling.
E. None of these answers.
100. Atoms only occur in living organisms.
FALSE
101. According to the Law of Conservation of Matter, a chemical change in the atoms causes some destruction in the atom.
FALSE
102. The amount of energy a person uses each day is approximately the same throughout the world.
FALSE
103. A nuclear change in which two isotopes of light elements are forced together, releasing huge amounts of energy, is called nuclear fission.
FALSE
104. All cells contain a nucleus.
FALSE
105. Chromosomes are contained in genes.
FALSE
106. Organic compounds contain carbon combined with other atoms such as hydrogen, oxygen and nitrogen.
TRUE
107. Energy flow can be used to diagram the ecological interdependence of species.
TRUE
108. In a chemical change, matter may be moved by kinetic energy.
FALSE
109. Scientific hypotheses are laws that explain natural processes.
FALSE
110. Energy cannot be recycled.
TRUE
111. Burning coal demonstrates the first law of thermodynamics.
TRUE
112. An atom of sodium has eleven protons and therefore has eleven _____.
neutrons
113. When ice melts into liquid water a(an) _____ has occurred.
physical change
114. Before an interpretation of an observation can become a theory, it must first be a testable _____.
scientific hypothesis
115. When you release an object from a high altitude, the object's potential energy converts to _____.
kinetic energy

116. A feather and a brick both fall to the earth due to _____.
gravity
117. _____ explains why a barrel of oil can be used only once as fuel.
The second law of thermodynamics