CHAPTER 2--SCIENCE, MATTER, ENERGY, AND SYSTEMS

Student: _____

1. In an experiment, which of the following would not change the chosen variable?

   A. experimental group
   B. controlled experiment
   C. observation
   D. control group
   E. variables

2. In 1963 Bormann and Likens compared the output of two river valleys, one forested and the other clear cut. Which of the following reports their findings?

   A. deforested valley had higher water flow, decrease of nutrient loss
   B. forested valley had higher water flow, decrease of nutrient loss
   C. forested valley had lower water flow, increase of nutrient loss
   D. deforested valley had lower water flow, increase of nutrient loss
   E. deforested valley had higher water flow, increase of nutrient loss

3. Which of the following is the usual order of applying the scientific process to a problem?

   A. hypothesis-question-observation-experimentation-conclusion-analysis
   B. hypothesis-conclusion-question-observation-experimentation-analysis
   C. observation-hypothesis-conclusion-experimentation-analysis-question
   D. observation-question-hypothesis-experimentation-analysis-conclusion
   E. hypothesis-experimentation-observation-analysis-question-conclusion

4. Which of the following is the definition of a scientific hypothesis?

   A. a simulation of a system being studied
   B. a possible explanation for an observation or experimentation
   C. information needed to answer questions
   D. procedures carried out under controlled conditions to gather information
   E. all of these

5. Science has limitations, including all of the following, *except*

   A. science can always prove or disprove anything
   B. scientists are not totally free of bias
   C. testing can involve a huge number of variables
   D. some situations require the use of statistical tools
   E. science is limited to the natural world

6. When an overwhelming body of observations and measurements supports a scientific hypothesis or group of related hypotheses, it becomes a(n)

   A. hypothesis
   B. scientific law
   C. scientific variable
   D. scientific theory
   E. conclusion

7. A well-tested and widely accepted description of what scientists find happening repeatedly in nature in the same way, is called a(n)

   A. theory
   B. scientific law
   C. hypothesis
   D. conclusion
   E. none of these

8. Which of the following is supported by data, hypotheses, models, theories, and laws that are widely accepted by scientists considered experts in the field under study?

   A. frontier science
   B. tentative science
   C. reliable science
   D. unreliable science
   E. guess

9. Matter is anything that

   A. has mass and takes up space
   B. has the capacity to do work
   C. can be changed in form
   D. can produce change
   E. moves mass

10. Which of the following is *not* identified by the author as a building block of matter?

    A. molecules
    B. compounds
    C. ions
    D. atoms
    E. none of these

11. Fundamental types of matter that have unique sets of properties and can not be broken down into simpler substances by chemical means are called

    A. mixtures
    B. compounds
    C. isotopes
    D. elements
    E. atoms

12. All of the following are elements *except*

    A. water
    B. oxygen
    C. nitrogen
    D. hydrogen
    E. carbon

13. The most basic building block of matter is a(n)

    A. atom
    B. element
    C. molecule
    D. compound
    E. ion

14. Protons, neutrons, and electrons are all

    A. forms of energy
    B. equal in mass
    C. subatomic particles
    D. negative ions
    E. charged particles

15. 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

16. The mass number is equal to the sum of the

    A. neutrons and isotopes
    B. neutrons and electrons
    C. neutrons and protons
    D. protons and electrons
    E. ions and isotopes

17. Isotopes are forms of an element that differ from one another by having different

    A. atomic numbers
    B. numbers of electrons
    C. numbers of protons
    D. mass numbers
    E. electrical charges

18. An atom or group of atoms with one or more net positive or negative charges is a(n)

    A. base
    B. isotope
    C. ion
    D. acid
    E. none of these

19. The measurement of the concentration of hydrogen ions compared to the concentration of hydroxide ions in a solution is called

    A. ionization
    B. pH
    C. alkalinity
    D. covalent bonding
    E. isotope

20. An example of an organic compound would be

    A. H_2O
    B. NaCl
    C. H_2SO_4
    D. N_2O
    E. CH_4

21. Which of the following would not be organic molecules?

    A. lipids
    B. nucleic acids
    C. hydrocarbons
    D. proteins
    E. water

22. Which of the following is/are not a macromolecule?

    A. lipids
    B. simple carbohydrates
    C. proteins
    D. nucleic acids
    E. complex carbohydrates

23. The macromolecules that make up living organisms are

    A. proteins
    B. lipids
    C. carbohydrates
    D. nucleic acids
    E. all of these

24. The distinct piece of DNA containing instructions for making proteins is

    A. the chromosome
    B. the nucleotide
    C. the amino acid
    D. the cell membrane
    E. the hydrocarbon

25. The monomer for the protein polymer is the

    A. hydrocarbon
    B. glycerol
    C. amino acid
    D. carbohydrate
    E. nucleotide

26. Which of the following is the fundamental structural and functional unit of life?

    A. atom
    B. macromolecule
    C. DNA
    D. cell
    E. organism

27. 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. iron in water

28. 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 in the forest.

29. Which of the following is *not* one of the nuclear changes matter can undergo?

    A. fission
    B. evaporation
    C. decay
    D. fusion
    E. All of these are nuclear changes.

30. 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. Eventually we will run out of matter if we keep consuming it.
    C. There will always be pollution of some sort.
    D. Everything must go somewhere.
    E. We do not consume matter.

31. 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

32. 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

33. Which of the following does *not* represent kinetic energy?

    A. the wind blowing
    B. water in a stream
    C. steam
    D. a car at the top of a hill
    E. electricity

34. Which of the following is an example of low-quality energy?

    A. electricity
    B. heat in the ocean
    C. nuclear fission
    D. gasoline
    E. food

35. What percentage of the energy used to produce food for living organisms, and to heat the earth, comes from the sun?

    A. 10
    B. 29
    C. 49
    D. 79
    E. 99

36. An example of potential energy is

    A. electricity lighting a lamp
    B. sugar in a sugar bowl
    C. a snowball thrown at a tree
    D. a leaf falling from a tree
    E. water powering a turbine

37. 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 lower quality energy.

38. The first law of thermodynamics 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.

39. Which of the following statements does *not* apply to the second law of energy?

    A. Energy goes from useful to less useful forms.
    B. Energy is neither created nor destroyed.
    C. Energy conversions results in lower-quality energy.
    D. Heat is given off from energy conversions.
    E. We can not recycle or reuse high-quality energy.

40. 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

41. Earth's supply of concentrated, usable energy is being steadily

    A. depleted
    B. recycled
    C. reused
    D. converted to more usable forms
    E. converted to higher-quality forms

42. 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

43. 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

44. Which of the following is *not* a key component of a system?

    A. throughputs
    B. inputs
    C. outputs
    D. All are key components.
    E. None are key components.

45. 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. none of these

46. A positive feedback loop is illustrated by all of the following *except*

    A. melting polar ice
    B. exponential population growth
    C. a thermostat maintaining a certain temperature in your house
    D. the greenhouse effect
    E. none of these

47. Which one of the following does *not* illustrate a time delay?

    A. A smoker develops lung cancer.
    B. CFCs deplete the ozone layer.
    C. Increased carbon dioxide levels enhance the greenhouse effect.
    D. A fox eats a rabbit.
    E. Polar ice melting increases absorption of sunlight.

48. Time delays in feedback systems allow changes in the environment to build slowly until the changes reach a(n)

    A. synergy point
    B. input
    C. throughput
    D. tipping point
    E. bioaccumulation point

49. Which of the following is *not* an example of an environmental threshold having been crossed?

    A. Fishing in some parts of the world is no longer profitable.
    B. Deforested areas are becoming deserts.
    C. Loss of biodiversity.
    D. Sea levels rise.
    E. Water pollution levels in developed countries have decreased.

50. 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. entropy
    E. time delay

51. Which of the following does *not* represent a synergistic interaction?

    A. Smokers who inhale asbestos die of lung cancer.
    B. Combinations of pollutants increase health hazards.
    C. Bartender who doesn't smoke gets lung cancer from secondary smoke.
    D. Running further when running with a partner.
    E. Studying for a test with a group of students.

52. The community knew the effects of chemical X when it was used alone. They knew the same for chemical Z, so they set safe limits for use for both chemicals. When the chemicals were released at safe levels on the same day there was a massive fish kill. The most likely explanation is

    A. homeostasis
    B. a synergistic interaction
    C. negative feedback
    D. positive feedback
    E. entropy

53. Human events that affect the environment are generally characterized by

    A. predictability in what happens because the environment is so large
    B. many experiences that allow for accurate generalizations
    C. long delays between events and responses
    D. obvious and immediate feedback
    E. all of these

54. Which of the following must obey the laws of thermodynamics?

    A. organic life
    B. living systems
    C. economics
    D. humans
    E. all of these

55. Scientists tend to be highly skeptical of new data, hypotheses, and models until they can be tested and verified.

    True False

56. Deductive reasoning goes from the specific to the general, e.g., from the "bottom up."

    True False

57. When someone says that evolution is not important, "after all, it's just a theory," it is probable that they do not understand how scientists use the term "theory."

    True False

58. Tentative or frontier science is always science done by incompetent scientists whose work will never be accepted by their peers.

    True False

59. Scientists can disprove things but they cannot prove anything absolutely, which means there is always some uncertainty in science.

    True False

60. Scientists use the statistical concept of probability to evaluate the results of experimentation.

True False

61. Atoms have a net positive electrical charge.

True False

62. A chemical formula is a shorthand way of writing the symbols for atoms or ions in a compound.

True False

63. Methane, a hydrocarbon, is considered an organic molecule even though it contains only one carbon atom.

True False

64. How useful matter is to humans as a resource is determined by its concentration, availability for use, and its potential.

True False

65. In a nuclear fission reaction atoms are destroyed.

True False

66. A nuclear change in which two isotopes of light elements are forced together, releasing huge amounts of energy, is called nuclear fission.

True False

67. In a chemical reaction, there is a change in the arrangement of atoms, ions, or molecules of the substances involved

True False

68. According to the law of conservation of matter, once trash decomposes in a landfill we have completely gotten rid of the matter which made up the trash.

True False

69. Energy consumption does not mean the disappearance of energy; rather it is the conversion of energy from one form to another with no net loss.

True False

70. Energy cannot be recycled.

True False

71. Burning coal demonstrates the conversion of energy from kinetic to potential.

    True False

72. The scientific principles of sustainability show that everything we do affects someone or something in the environment in some way.

    True False

73. A negative feedback loop causes a system to further change in the same direction.

    True False

74. A very useful tool in studying living systems is the use of computer models or simulations.

    True False

75. Science is based on the assumption that events in the natural world follow _____ patterns that can be understood.

    _____

76. _____ happens when scientists report details of their research and other scientists evaluate it.

    _____

77. Watching a variety of objects fall to earth, we can use _____ reasoning to propose that all objects fall to the earth's surface when dropped.

    _____

78. A(n) _____ occurs when an accepted theory or law of science is changed as a result of new discoveries or ideas.

    _____

79. A molecule is a combination of two or more atoms held together by forces called _____.

    _____

80. Compounds are combinations of two or more different elements held together in _____ proportions.

    _____

81. A(n) _____ has more hydrogen ions than hydroxide ions and has a pH _____ 7.

    _____

82. An organic compound is one that contains one or more _____ atoms combined with atoms of one or more other elements.

_____

83. If a macromolecule was a brick wall it would be called a(n) _____ made up of repeating units called _____.

_____

84. Thousands of genes make up a single _____, a double helix DNA molecule wrapped around proteins.

_____

85. _____ are segments of DNA on chromosomes that contain instructions to make proteins.

_____

86. Matter quality is a measure of how useful a form of matter is to humans as a resource and is based on its _____ and _____ in a given area or volume.

_____

87. According to the _____, when a physical or chemical change occurs, no atoms are created or destroyed.

_____

88. Body fat of a human or other animal is a type of _____ energy.

_____

89. Most of the energy from burning a gallon of gasoline is lost as _____ energy called heat.

_____

90. Scientists estimate that only _____% of the energy used in the U.S. ends up performing useful work.

_____

91. A(n) _____ occurs when an output of matter, energy, or information is fed back into the system as an input and leads to changes in the system.

_____

92. There are many types of electromagnetic radiation, each with a different _____ and energy content.

_____

93. A _____ is a set of components that function and interact in some regular way.

_____

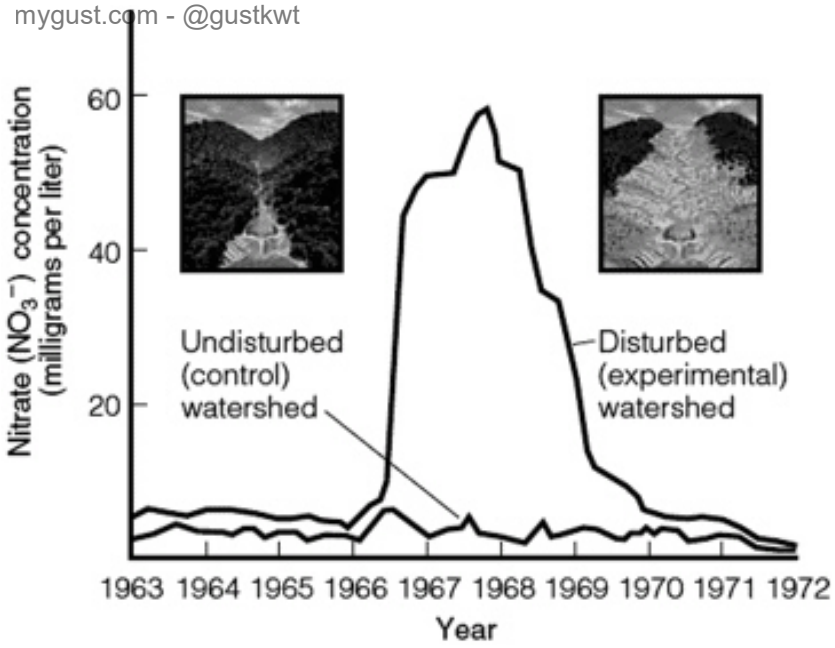
94. Any process that increases or decreases a change to a system is called _____.

_____

95. In recent years, the controversy over whether humans play a major role in global warming was fueled by critics who stated "not enough good science" had been done. Using such concepts as the scientific process, peer review, and reliable science discuss why this may or may not have been an accurate statement.

96. Explain how the human body is intimately connected to the two laws of thermodynamics.

97.



After looking at the figure above, explain the significant difference that occurred between 1966 and 1970 in terms of the two lines representing the control watershed and the experimental watershed.

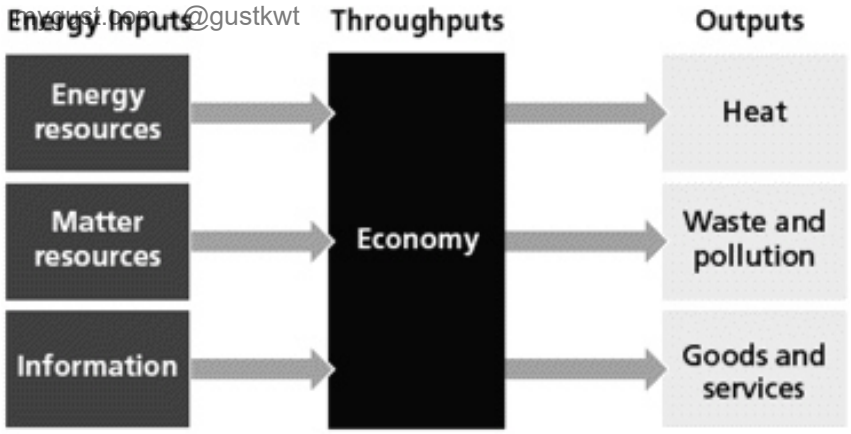
98. Much of the energy produced is lost before it can become useful. Explain how energy efficiency, or energy productivity, and the second law of thermodynamics may be useful in a discussion with another person on how to reduce CO_2 and other greenhouse gas emissions.

99. The population of any organism will increase, if the conditions are correct, until it reaches a point where the population cannot be sustained. This is a type of feedback loop. What type of feedback loop is this and what are the conditions that cause the feedback loop to function?

100. How is the concept of an environmental threshold or tipping point important in regards to global warming?

101. Differentiate between a hypothesis, a guess, and a theory. Explain why it is important for non-scientists to understand how scientists use these terms when discussing something like global warming or evolution. Why might it be incorrect when a non-scientist dismisses a topic like these as being "just a theory"?

102.



The figure above indicates the general flow within an economic system. For many years this concept has been thought of as indicative of individual nations, or subunits of nations. Now it is increasingly indicative of a global economy. What changes are occurring as a result of this change to the global economy?

CHAPTER 2--SCIENCE, MATTER, ENERGY, AND SYSTEMS Key

1. D
2. E
3. D
4. B
5. A
6. D
7. B
8. C
9. A
10. B
11. D
12. A
13. A
14. C
15. B
16. C
17. D
18. C
19. B
20. E
21. E
22. B
23. E
24. C
25. C
26. D
27. D
28. D
29. B

30. B

31. D

32. B

33. D

34. B

35. E

36. B

37. B

38. D

39. B

40. C

41. A

42. C

43. C

44. D

45. A

46. C

47. D

48. D

49. E

50. B

51. C

52. B

53. C

54. E

55. TRUE

56. FALSE

57. TRUE

58. FALSE

59. TRUE

60. TRUE

61. FALSE

62. TRUE

63. TRUE

64. TRUE

65. FALSE

66. FALSE

67. TRUE

68. FALSE

69. TRUE

70. TRUE

71. FALSE

72. TRUE

73. FALSE

74. TRUE

75. cause-and-effect

76. Peer review

77. inductive

78. paradigm shift

79. chemical bonds, bonds

80. fixed

81. acidic solution; less than

82. carbon

83. polymer; monomers

84. chromosome

85. Genes

86. availability; concentration

87. law of conservation of matter

88. potential

89. low-quality

90. 16

91. feedback loop

92. wavelength

93. system

94. feedback *or* feedback loop

95. (page 36) The suggestion that "not enough good science" has two possible emphases: "**not enough** good science" or "not enough **good** science." It is possible to argue that one needs a substantial amount of science before one takes dramatic steps. However, there comes a point at which action must take over from contemplation. As these statements were being made, at least a couple of decades of research had led a substantial number of scientists to conclude humans were substantially responsible for the changes that had been observed. Nothing was to be gained by adding to the volume of work except to delay implementation of steps to counteract the problems.

The second emphasis, that good science had not been done, flies in the face of the scientific process. No scientist would want to be accused of doing "bad" science as that would be very damaging to his or her career. Even more to the point, the process of doing science is self-correcting. After completing research, scientists seek to have their work published in peer-reviewed journals. In those journals peers closely examine and comment on the research and results. When the process is completed, there exists a general agreement on the reliability of the data.

96. (pages 46-47) The first law of thermodynamics says that energy can neither be created nor destroyed, only transformed. This is the basis of the flow of energy from the sun through living systems on earth, including humans. We take in energy in the form of chemicals assembled by other living organisms and transform it, using the energy to do the many things required to live. If any living organism fails to take in and transform energy for their purposes, the second law of thermodynamics takes over. The second law says entropy (randomness or disorder) tends to increase in energy systems. In shortened form, the second law means we will die and decompose. Energy is required to keep a system functioning. When the system is no longer taking in energy, randomness or disorder will increase.

97. (page 40) The line labeled "Disturbed (experimental) watershed" represents the level of loss of nitrates following the removal of vegetation in the experimental watershed. Without vegetation the soil rapidly lost the nitrates to rainfall until they were substantially gone.

98. (pages 46-47) Machines that use fossil fuels are very energy-inefficient, converting a small percentage of the energy in the fuel source to useful activities. An effort to increase the level of efficiency would substantially reduce the amount of fossil fuel that needed to be converted and would reduce the amount of emissions of CO_2 and other greenhouse gases.

99. (pages 48-50) Populations will increase as long as sufficient resources are available. Taking food as an example, the population will increase as long as food is available. At some point the number of organisms will exceed the ability of the system to provide sufficient food. A portion of the population will be weakened and begin to die. If the increase has been very rapid, the population will continue to increase well past where food is insufficient. When enough of the population has died off that food is sufficient, the population will stabilize and may begin to increase once again. This is a negative feedback loop.

100. (page 50) A tipping point is a level at which a critical mass has been reached that causes an event to occur, an event that may be irreversible. If humans cause the climate of the earth to warm beyond a certain level, it may be impossible to correct the situation, and the climate may be irreversibly altered for the worse.

101. (pages 32-34) A hypothesis is an effort to explain phenomenon based on prior experience with the same or similar phenomena. It is often defined as an educated guess. The usual way to define a "guess" is the suggestion of an answer without prior experience. A theory is a structure intended to explain a series of phenomena, and is constructed from hypotheses that have been tested and not proven wrong. As such, a theory is based on substantial amounts of data.

102. (pages 48-50) One change has been the increased volume of resource use, and the increase in the amount of waste heat, waste, and pollution that are generated. As the size of the economy has increased, so too has the volume of input and output. Secondly, the ability to control the system has become much more difficult. Efforts to stem pollution, for example, have become more difficult as the headquarters of a company may be in one country and the factories in another. Thirdly, pollution and resource utilization laws vary from country to country. Making a concerted effort to change is therefore made more difficult. Lastly, it is difficult to suggest to the developing world that they should be made responsible for pollution that has, until recently, been significantly created by the developed world.