Sample Test

Directions**:** Read each item and select the correct response.

1. In an experiment, the scientist states that he believes a change in the color of a liquid is due to a change of pH. This is an example of _____ .

A. observing.

B. inferring.

C. measuring.

D. classifying.

2. When is a hypothesis formed?

A. Before the data is taken.

B. After the data is taken.

C. After the data is analyzed.

D. Concurrent with graphing the data.

3. Who determines the laws regarding the use of safety glasses in the classroom?

A. The state.

B. The school site.

C. The Federal government.

D. The district level.

4. If one inch equals 2.54 cm how many mm in 1.5 feet? (APPROXIMATELY)

A. 18 mm.

B. 1800 mm.

C. 460 mm.

D. 4,600 mm.

5. Which of the following instruments measures wind speed?

A. A barometer.

B. An anemometer.

C. A wind sock.

D. A weather vane.

6. Sonar works by _____ .

A. Timing how long it takes sound to reach a certain speed.

B. Bouncing sound waves between two metal plates.

C. Bouncing sound waves off an underwater object and timing how long it takes for the sound to return.

D. Evaluating the motion and amplitude of sound.

7. The measure of the pull of the earth's gravity on an object is called _____ .

A. mass number.

B. atomic number.

C. mass.

D. weight.

8. Which reaction below is a decomposition reaction?

A. $HCl + NaOH \rightarrow NaCl + H_2O$

B. $C + O_2 \rightarrow CO_2$

C. $2H_2O \rightarrow 2H_2 + O_2$

D. $CuSO_4 + Fe \rightarrow FeSO_4 + Cu$

9. The Law of Conservation of Energy states that _____.

A. There must be the same number of products and reactants in any chemical equation.

B. Objects always fall toward large masses such as planets.

C. Energy is neither created nor destroyed, but may change form.

D. Lights must be turned off when not in use, by state regulation.

10. Which parts of an atom are located inside the nucleus?

A. electrons and neutrons.

B. protons and neutrons.

C. protons only.

D. neutrons only.

11. The elements in the modern Periodic Table are arranged _____ .

A. in numerical order by atomic number.

B. randomly.

C. in alphabetical order by chemical symbol.

D. in numerical order by atomic mass.

12.Carbon bonds with hydrogen by _____ .

A. ionic bonding.

B. non-polar covalent bonding.

C. polar covalent bonding.

D. strong nuclear force.

13. Vinegar is an example of a _____ .

A. strong acid.

B. strong base.

C. weak acid.

D. weak base.

14. Which of the following is not a nucleotide?

A. adenine.

B. alanine.

C. cytosine.

D. guanine.

15. When measuring the volume of water in a graduated cylinder, where does one read the measurement?

A. At the highest point of the liquid.

B. At the bottom of the meniscus curve.

C. At the closest mark to the top of the liquid.

D. At the top of the plastic safety ring.

16. A duck's webbed feet are examples of_____.

A. mimicry.

B. structural adaptation.

C. protective resemblance.

D. protective coloration.

17. What cell organelle contains the cell's stored food?

A. Vacuoles.

B. Golgi Apparatus.

C. Ribosomes.

D. Lysosomes.

18. The first stage of mitosis is called _____ .

A. telophase.

B. anaphase.

C. prophase.

D. mitophase.

19. The Doppler Effect is associated most closely with which property of waves?

A. amplitude.

B. wavelength.

C. frequency.

D. intensity.

20. Viruses are responsible for many human diseases including all of the following *except* _____ ?

A. influenza.

B. A.I.D.S.

C. the common cold.

D. strep throat.

21. A series of experiments on pea plants formed by _____ showed that two invisible markers existed for each trait, and one marker dominated the other.

A. Pasteur.

B. Watson and Crick.

C. Mendel.

D. Mendeleev.

22. Formaldehyde should not be used in school laboratories for the following reason:

A. it smells unpleasant.

B. it is a known carcinogen.

C. it is expensive to obtain.

D. it is explosive.

23. Amino acids are carried to the ribosome in protein synthesis by _____ .

A. transfer RNA (tRNA).

B. messenger RNA (mRNA).

C. ribosomal RNA (rRNA).

D. transformation RNA (trRNA).

24. When designing a scientific experiment, a student considers all the factors that may influence the results. The process goal is to _____.

A. recognize and manipulate independent variables.

B. recognize and record independent variables.

C. recognize and manipulate dependent variables.

D. recognize and record dependent variables.

25. Since ancient times, people have been entranced with bird flight. What is the key to bird flight?

A. Bird wings are a particular shape and composition.

B. Birds flap their wings quickly enough to propel themselves.

C. Birds take advantage of tailwinds.

D. Birds take advantage of crosswinds.

26. Laboratory researchers have classified fungi as distinct from plants because the cell walls of fungi _____ .

A. contain chitin.

B. contain yeast.

C. are more solid.

D. are less solid.

27. In a fission reactor, "heavy water" is used to _____ .

A. terminate fission reactions.

B. slow down neutrons and moderate reactions.

C. rehydrate the chemicals.

D. initiate a chain reaction.

28. The transfer of heat by electromagnetic waves is called _____ .

A. conduction.

B. convection.

C. phase change.

D. radiation.

29. When heat is added to most solids, they expand. Why is this the case?

A. The molecules get bigger.

B. The faster molecular motion leads to greater distance between the molecules.

C. The molecules develop greater repelling electric forces.

D. The molecules form a more rigid structure.

30. The force of gravity on earth causes all bodies in free fall to _____ .

A. fall at the same speed.

B. accelerate at the same rate.

C. reach the same terminal velocity.

D. move in the same direction.

31. Sound waves are produced by _____ .

A. pitch.

B. noise.

C. vibrations.

D. sonar.

32. Resistance is measured in units called _____ .

A. watts.

B. volts.

C. ohms.

D. current.

33. Sound can be transmitted in all of the following *except* _____ .

A. air.

B. water.

C. a diamond.

D. a vacuum.

34. As a train approaches, the whistle sounds _____ .

A. higher, because it has a higher apparent frequency.

B. lower, because it has a lower apparent frequency.

C. higher, because it has a lower apparent frequency.

D. lower, because it has a higher apparent frequency.

35. The speed of light is different in different materials. This is responsible for _____ .

A. interference.

B. refraction.

C. reflection.

D. relativity.

36. A converging lens produces a real image _____.

A. always.

B. never.

C. when the object is within one focal length of the lens.

D. when the object is further than one focal length from the lens.

37. The electromagnetic radiation with the longest wave length is/are _____.

A. radio waves.

B. red light.

C. X-rays.

D. ultraviolet light.

38. Under a 440 power microscope, an object with diameter 0.1 millimeter appears to have a diameter of _____ .

A. 4.4 millimeters.

B. 44 millimeters.

C. 440 millimeters.

D. 4400 millimeters.

39. Separating blood into blood cells and plasma involves the process of _____ .

A. electrophoresis.

B. spectrophotometry.

C. centrifugation.

D. chromatography.

40. Experiments may be done with any of the following animals except _____ .

A. birds.

B. invertebrates.

C. lower order life.

D. frogs.

41. For her first project of the year, a student is designing a science experiment to test the effects of light and water on plant growth. You should recommend that she _____.

A. manipulate the temperature also.

B. manipulate the water pH also.

C. determine the relationship between light and water unrelated to plant growth.

D. omit either water or light as a variable.

42. In a laboratory report, what is the abstract?

A. The abstract is a summary of the report, and is the first section of the report.

B. The abstract is a summary of the report, and is the last section of the report.

C. The abstract is predictions for future experiments, and is the first section of the report.

D. The abstract is predictions for future experiments, and is the last section of the report.

43. What is the scientific method?

A. It is the process of doing an experiment and writing a laboratory report.

B. It is the process of using open inquiry and repeatable results to establish theories.

C. It is the process of reinforcing scientific principles by confirming results.

D. It is the process of recording data and observations.

44. Identify the control in the following experiment: A student had four corn plants and was measuring photosynthetic rate (by measuring growth mass). Half of the plants were exposed to full (constant) sunlight, and the other half were kept in 50% (constant) sunlight.

A. The control is a set of plants grown in full (constant) sunlight.

B. The control is a set of plants grown in 50% (constant) sunlight.

C. The control is a set of plants grown in the dark.

D. The control is a set of plants grown in a mixture of natural levels of sunlight.

45. In an experiment measuring the growth of bacteria at different temperatures, what is the independent variable?

A. Number of bacteria.

B. Growth rate of bacteria.

C. Temperature.

D. Light intensity.

46. A scientific law_____.

A. proves scientific accuracy.

B. may never be broken.

C. may be revised in light of new data.

D. is the result of one excellent experiment.

47. Which is the correct order of methodology?

1. collecting data
2. planning a controlled experiment
3. drawing a conclusion
4. hypothesizing a result
5. re-visiting a hypothesis to answer a question

A. 1,2,3,4,5

B. 4,2,1,3,5

C. 4,5,1,3,2

D. 1,3,4,5,2

48. Which is the most desirable tool to use to heat substances in a middle school laboratory?

A. Alcohol burner.

B. Freestanding gas burner.

C. Bunsen burner.

D. Hot plate.

49. Newton's Laws are taught in science classes because _____.

A. they are the correct analysis of inertia, gravity, and forces.

B. they are a close approximation to correct physics, for usual Earth conditions.

C. they accurately incorporate relativity into studies of forces.

D. Newton was a well-respected scientist in his time.

50. Which of the following is most accurate?

A. Mass is always constant; Weight may vary by location.

B. Mass and Weight are both always constant.

C. Weight is always constant; Mass may vary by location.

D. Mass and Weight may both vary by location.

51. Chemicals should be stored

A. in the principal's office.

B. in a dark room.

C. in an off-site research facility.

D. according to their reactivity with other substances.

52. Which of the following is the worst choice for a school laboratory activity?

A. A genetics experiment tracking the fur color of mice.

B. Dissection of a preserved fetal pig.

C. Measurement of goldfish respiration rate at different temperatures.

D. Pithing a frog to watch the circulatory system.

53. Who should be notified in the case of a serious chemical spill?

A. The custodian.

B. The fire department or their municipal authority.

C. The science department chair.

D. The School Board.

54. A scientist exposes mice to cigarette smoke, and notes that their lungs develop tumors. Mice that were not exposed to the smoke do not develop as many tumors. Which of the following conclusions may be drawn from these results?

I. Cigarette smoke causes lung tumors.

II. Cigarette smoke exposure has a positive correlation with lung tumors in mice.

III. Some mice are predisposed to develop lung tumors.

IV. Mice are often a good model for humans in scientific research.

A. I and II only.

B. II only.

C. I, II, and III only.

D. II and IV only.

55. In which situation would a science teacher be legally liable?

A. The teacher leaves the classroom for a telephone call and a student slips and injures him/herself.

B. A student removes his/her goggles and gets acid in his/her eye.

C. A faulty gas line in the classroom causes a fire.

D. A student cuts him/herself with a dissection scalpel.

56. Which of these is the best example of 'negligence'?

A. A teacher fails to give oral instructions to those with reading disabilities.

B. A teacher fails to exercise ordinary care to ensure safety in the classroom.

C. A teacher displays inability to supervise a large group of students.

D. A teacher reasonably anticipates that an event may occur, and plans accordingly.

57. Which item should always be used when handling glassware?

A. Tongs.

B. Safety goggles.

C. Gloves.

D. Buret stand.

58. Which of the following is *not* a necessary characteristic of living things?

A. Movement.

B. Reduction of local entropy.

C. Ability to cause change in local energy form.

D. Reproduction.

59. What are the most significant and prevalent elements in the biosphere?

A. Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus.

B. Carbon, Hydrogen, Sodium, Iron, Calcium.

C. Carbon, Oxygen, Sulfur, Manganese, Iron.

D. Carbon, Hydrogen, Oxygen, Nickel, Sodium, Nitrogen.

60. All of the following measure energy *except* for _____

A. joules.

B. calories.

C. watts.

D. ergs.

61. Identify the correct sequence of organization of living things from lower to higher order:

A. Cell, Organelle, Organ, Tissue, System, Organism.

B. Cell, Tissue, Organ, Organelle, System, Organism.

C. Organelle, Cell, Tissue, Organ, System, Organism.

D. Organelle, Tissue, Cell, Organ, System, Organism.

62. Which kingdom is comprised of organisms made of one cell with no nuclear membrane?

A. Monera.

B. Protista.

C. Fungi.

D. Algae.

63. Which of the following is found in the least abundance in organic molecules?

A. Phosphorus.

B. Potassium.

C. Carbon.

D. Oxygen.

64. Catalysts assist reactions by _____ .

A. lowering effective activation energy.

B. maintaining precise pH levels.

C. keeping systems at equilibrium.

D. adjusting reaction speed.

65. Accepted procedures for preparing solutions should be made with _____ .

A. alcohol.

B. hydrochloric acid.

C. distilled water.

D. tap water.

66. Enzymes speed up reactions by _____ .

A. utilizing ATP.

B. lowering pH, allowing reaction speed to increase.

C. increasing volume of substrate.

D. lowering energy of activation.

67. When you step out of the shower, the floor feels colder on your feet than the bathmat. Which of the following is the correct explanation for this phenomenon?

A. The floor is colder than the bathmat.

B. Your feet have a chemical reaction with the floor, but not the bathmat.

C. Heat is conducted more easily into the floor.

D. Water is absorbed from your feet into the bathmat.

68. Which of the following is *not* considered ethical behavior for a scientist?

A. Using unpublished data and citing the source.

B. Publishing data before other scientists have had a chance to replicate results.

C. Collaborating with other scientists from different laboratories.

D. Publishing work with an incomplete list of citations.

69. The chemical equation for water formation is: $2H_2 + O_2 \rightarrow 2H_2O$. Which of the following is an *incorrect* interpretation of this equation?

A. Two moles of hydrogen gas and one mole of oxygen gas combine to make two moles of water.

B. Two grams of hydrogen gas and one gram of oxygen gas combine to make two grams of water.

C. Two molecules of hydrogen gas and one molecule of oxygen gas combine to make two molecules of water.

D. Four atoms of hydrogen (combined as a diatomic gas) and two atoms of oxygen (combined as a diatomic gas) combine to make two molecules of water.

70. Energy is measured with the same units as _____.

A. force.

B. momentum.

C. work.

D. power.

71. If the volume of a confined gas is increased, what happens to the pressure of the gas? You may assume that the gas behaves ideally, and that temperature and number of gas molecules remain constant.

A. The pressure increases.

B. The pressure decreases.

C. The pressure stays the same.

D. There is not enough information given to answer this question.

72. A product of anaerobic respiration in animals is _____.

A. carbon dioxide.

B. lactic acid.

C. oxygen.

D. sodium chloride

73. A Newton is fundamentally a measure of _____ .

A. force.

B. momentum.

C. energy.

D. gravity.

74. Which change does *not* affect enzyme rate?

A. Increase the temperature.

B. Add more substrate.

C. Adjust the pH.

D. Use a larger cell.

75. Which of the following types of rock are made from magma?

A. Fossils

B. Sedimentary

C. Metamorphic

D. Igneous

76. Which of the following is *not* an acceptable way for a student to acknowledge sources in a laboratory report?

A. The student tells his/her teacher what sources s/he used to write the report.

B. The student uses footnotes in the text, with sources cited, but not in correct MLA format.

C. The student uses endnotes in the text, with sources cited, in correct MLA format.

D. The student attaches a separate bibliography, noting each use of sources.

77. Animals with a notochord or backbone are in the phylum

A. arthropoda.

B. chordata.

C. mollusca.

D. mammalia.

78. Which of the following is a correct explanation for scientific 'evolution'?

A. Giraffes need to reach higher for leaves to eat, so their necks stretch. The giraffe babies are then born with longer necks. Eventually, there are more long-necked giraffes in the population.

B. Giraffes with longer necks are able to reach more leaves, so they eat more and have more babies than other giraffes. Eventually, there are more long-necked giraffes in the population.

C. Giraffes want to reach higher for leaves to eat, so they release enzymes into their bloodstream, which in turn causes fetal development of longer-necked giraffes. Eventually, there are more long-necked giraffes in the population.

D. Giraffes with long necks are more attractive to other giraffes, so they get the best mating partners and have more babies. Eventually, there are more long-necked giraffes in the population.

79. Which of the following is a correct definition for 'chemical equilibrium'?

A. Chemical equilibrium is when the forward and backward reaction rates are equal. The reaction may continue to proceed forward and backward.

B. Chemical equilibrium is when the forward and backward reaction rates are equal, and equal to zero. The reaction does not continue.

C. Chemical equilibrium is when there are equal quantities of reactants and products.

D. Chemical equilibrium is when acids and bases neutralize each other fully.

80. Which of the following data sets is properly represented by a bar graph?

A. Number of people choosing to buy cars, vs. Color of car bought.

B. Number of people choosing to buy cars, vs. Age of car customer.

C. Number of people choosing to buy cars, vs. Distance from car lot to customer home.

D. Number of people choosing to buy cars, vs. Time since last car purchase.

81. In a science experiment, a student needs to dispense very small measured amounts of liquid into a well-mixed solution. Which of the following is the best choice for his/her equipment to use?

A. Buret with Buret Stand, Stir-plate, Stirring Rod, Beaker.

B. Buret with Buret Stand, Stir-plate, Beaker.

C. Volumetric Flask, Dropper, Graduated Cylinder, Stirring Rod.

D. Beaker, Graduated Cylinder, Stir-plate.

82. A laboratory balance is most appropriately used to measure the mass of which of the following?

A. Seven paper clips.

B. Three oranges.

C. Two hundred cells.

D. One student's elbow.

83. All of the following are measured in units of length, *except* for:

A. Perimeter.

B. Distance.

C. Radius.

D. Area.

84. What is specific gravity?

A. The mass of an object.

B. The ratio of the density of a substance to the density of water.

C. Density.

D. The pull of the earth's gravity on an object.

85. What is the most accurate description of the Water Cycle?

A. Rain comes from clouds, filling the ocean. The water then evaporates and becomes clouds again.

B. Water circulates from rivers into groundwater and back, while water vapor circulates in the atmosphere.

C. Water is conserved except for chemical or nuclear reactions, and any drop of water could circulate through clouds, rain, ground-water, and surface-water.

D. Weather systems cause chemical reactions to break water into its atoms.

86. The scientific name *Canis familiaris* refers to the animal's _____.

A. kingdom and phylum.

B. genus and species.

C. class and species.

D. type and family.

87. Members of the same animal species _____ .

A. look identical.

B. never adapt differently.

C. are able to reproduce with one another.

D. are found in the same location.

88. Which of the following is/are true about scientists?

I. Scientists usually work alone.
II. Scientists usually work with other scientists.
III. Scientists achieve more prestige from new discoveries than from replicating established results.
IV. Scientists keep records of their own work, but do not publish it for outside review.

A. I and IV only.

B. II only.

C. II and III only.

D. I and IV only.

89. What is necessary for ion diffusion to occur spontaneously?

A. Carrier proteins.

B. Energy from an outside source.

C. A concentration gradient.

D. Cell flagellae.

90. All of the following are considered Newton's Laws *except* for:

A. An object in motion will continue in motion unless acted upon by an outside force.

B. For every action force, there is an equal and opposite reaction force.

C. Nature abhors a vacuum.

D. Mass can be considered the ratio of force to acceleration.

91. A cup of hot liquid and a cup of cold liquid are both sitting in a room at comfortable room temperature and humidity. Both cups are thin plastic. Which of the following is a true statement?

A. There will be fog on the outside of the hot liquid cup, and also fog on the outside of the cold liquid cup.

B. There will be fog on the outside of the hot liquid cup, but not on the cold liquid cup.

C. There will be fog on the outside of the cold liquid cup, but not on the hot liquid cup.

D. There will not be fog on the outside of either cup.

92. A ball rolls down a smooth hill. You may ignore air resistance. Which of the following is a true statement?

A. The ball has more energy at the start of its descent than just before it hits the bottom of the hill, because it is higher up at the beginning.

B. The ball has less energy at the start of its descent than just before it hits the bottom of the hill, because it is moving more quickly at the end.

C. The ball has the same energy throughout its descent, because positional energy is converted to energy of motion.

D. The ball has the same energy throughout its descent, because a single object (such as a ball) cannot gain or lose energy.

93. A long silver bar has a temperature of 50 degrees Celsius at one end and 0 degrees Celsius at the other end. The bar will reach thermal equilibrium (barring outside influence) by the process of heat _____.

A. conduction.

B. convection.

C. radiation.

D. phase change.

94. _____are cracks in the plates of the earth's crust, along which the plates move.

A. Faults.

B. Ridges.

C. Earthquakes.

D. Volcanoes.

95. Fossils are usually found in _____ rock.

A. igneous.

B. sedimentary.

C. metamorphic.

D. cumulus.

96. Which of the following is *not* a common type of acid in 'acid rain' or acidified surface water?

A. Nitric acid.

B. Sulfuric acid.

C. Carbonic acid.

D. Hydrofluoric acid.

97. Which of the following is *not* true about phase change in matter?

A. Solid water and liquid ice can coexist at water's freezing point.

B. At 7 degrees Celsius, water is always in liquid phase.

C. Matter changes phase when enough energy is gained or lost.

D. Different phases of matter are characterized by differences in molecular motion.

98. Which of the following is the longest (largest) unit of geological time?

A. Solar Year.

B. Epoch.

C. Period.

D. Era.

99. Extensive use of antibacterial soap has been found to increase the virulence of certain infections in hospitals. Which of the following might be an explanation for this phenomenon?

A. Antibacterial soaps do not kill viruses.

B. Antibacterial soaps do not incorporate the same antibiotics used as medicine.

C. Antibacterial soaps kill a lot of bacteria, and only the hardiest ones survive to reproduce.

D. Antibacterial soaps can be very drying to the skin.

100. Which of the following is a correct explanation for astronaut 'weightlessness'?

A. Astronauts continue to feel the pull of gravity in space, but they are so far from planets that the force is small.

B. Astronauts continue to feel the pull of gravity in space, but spacecraft have such powerful engines that those forces dominate, reducing effective weight.

C. Astronauts do not feel the pull of gravity in space, because space is a vacuum.

D. Astronauts do not feel the pull of gravity in space, because black hole forces dominate the force field, reducing their masses.

101. The theory of 'sea floor spreading' explains _____.

A. the shapes of the continents.

B. how continents collide.

C. how continents move apart.

D. how continents sink to become part of the ocean floor.

102. Which of the following animals are most likely to live in a tropical rain forest?

A. Reindeer.

B. Monkeys.

C. Puffins.

D. Bears.

103. Which of the following is *not* a type of volcano?

A. Shield Volcanoes.

B. Composite Volcanoes.

C. Stratus Volcanoes.

D. Cinder Cone Volcanoes.

104. Which of the following is *not* a property of metalloids?

A. Metalloids are solids at standard temperature and pressure.

B. Metalloids can conduct electricity to a limited extent.

C. Metalloids are found in groups 13 through 17.

D. Metalloids all favor ionic bonding.

105. Which of these is a true statement about loamy soil?

A. Loamy soil is gritty and porous.

B. Loamy soil is smooth and a good barrier to water.

C. Loamy soil is hostile to microorganisms.

D. Loamy soil is velvety and clumpy.

106. Lithification refers to the process by which unconsolidated sediments aretransformed into _____.

A. metamorphic rocks.

B. sedimentary rocks.

C. igneous rocks.

D. lithium oxide.

107. Igneous rocks can be classified according to which of the following?

A. Texture.

B. Composition.

C. Formation process**.**

D. All of the above.

108. Which of the following is the most accurate definition of a non-renewable resource?

A. A nonrenewable resource is never replaced once used.

B. A nonrenewable resource is replaced on a timescale that is very long relative to human life-spans.

C. A nonrenewable resource is a resource that can only be manufactured by humans.

D. A nonrenewable resource is a species that has already become extinct.

109. The theory of 'continental drift' is supported by which of the following?

A. The way the shapes of South America and Europe fit together.

B. The way the shapes of Europe and Asia fit together.

C. The way the shapes of South America and Africa fit together.

D. The way the shapes of North America and Antarctica fit together.

110. When water falls to a cave floor and evaporates, it may deposit calcium carbonate. This process leads to the formation of which of the following?

A. Stalactites.

B. Stalagmites.

C. Fault lines.

D. Sedimentary rocks.

111. A child has type O blood. Her father has type A blood, and her mother has type B blood. What are the genotypes of the father and mother, respectively?

A. AO and BO.

B. AA and AB.

C. OO and BO.

D. AO and BB.

112. Which of the following is the best definition for 'meteorite'?

A. A meteorite is a mineral composed of mica and feldspar.

B. A meteorite is material from outer space, that has struck the earth's surface.

C. A meteorite is an element that has properties of both metals and nonmetals.

D. A meteorite is a very small unit of length measurement.

113. A white flower is crossed with a red flower. Which of the following is a sign of incomplete dominance?

A. Pink flowers.

B. Red flowers.

C. White flowers.

D. No flowers.

114. What is the source for most of the United States' drinking water?

A. Desalinated ocean water.

B. Surface water (lakes, streams, mountain runoff).

C. Rainfall into municipal reservoirs.

D. Groundwater.

115. Which is the correct sequence of insect development?

A. Egg, pupa, larva, adult.

B. Egg, larva, pupa, adult.

C. Egg, adult, larva, pupa.

D. Pupa, egg, larva, adult.

116. A wrasse (fish) cleans the teeth of other fish by eating away plaque. This is an example of _____ between the fish.

A. parasitism.

B. symbiosis (mutualism).

C. competition.

D. predation.

117. What is the main obstacle to using nuclear fusion for obtaining electricity?

A. Nuclear fusion produces much more pollution than nuclear fission.

B. There is no obstacle; most power plants us nuclear fusion today.

C. Nuclear fusion requires very high temperature and activation energy.

D. The fuel for nuclear fusion is extremely expensive.

118. Which of the following is a true statement about radiation exposure and air travel?

A. Air travel exposes humans to radiation, but the level is not significant for most people.

B. Air travel exposes humans to so much radiation that it is recommended as a method of cancer treatment.

C. Air travel does not expose humans to radiation.

D. Air travel may or may not expose humans to radiation, but it has not yet been determined.

119. Which process(es) result(s) in a haploid chromosome number?

A. Mitosis.

B. Meiosis.

C. Both mitosis and meiosis.

D. Neither mitosis nor meiosis.

120. Which of the following is *not* a member of Kingdom Fungi?

A. Mold.

B. Blue-green algae.

C. Mildew.

D. Mushrooms.

121. Which of the following organisms use spores to reproduce?

A. Fish.

B. Flowering plants.

C. Conifers.

D. Ferns.

122. What is the main difference between the 'condensation hypothesis' and the 'tidal hypothesis' for the origin of the solar system?

A. The tidal hypothesis can be tested, but the condensation hypothesis cannot.

B. The tidal hypothesis proposes a near collision of two stars pulling on each other, but the condensation hypothesis proposes condensation of rotating clouds of dust and gas.

C. The tidal hypothesis explains how tides began on planets such as Earth, but the condensation hypothesis explains how water vapor became liquid on Earth.

D. The tidal hypothesis is based on Aristotelian physics, but the condensation hypothesis is based on Newtonian mechanics.

123. Which of the following units is *not* a measure of distance?

A. AU (astronomical unit).

B. Light year.

C. Parsec.

D. Lunar year.

124. The salinity of ocean water is closest to _____ .

A. 0.035 %

B. 0.35 %

C. 3.5 %

D. 35 %

125. Which of the following will not change in a chemical reaction?

A. Number of moles of products.

B. Atomic number of one of the reactants.

C. Mass (in grams) of one of the reactants.

D. Rate of reaction.

Answer Key

1. B	26. A	51. D	76. A	101. C
2. A	27. B	52. D	77. B	102. B
3. A	28. D	53. B	78. B	103. C
4. C	29. B	54. B	79. A	104. D
5. B	30. B	55. A	80. A	105. D
6. C	31. C	56. B	81. B	106. B
7. D	32. C	57. B	82. A	107. D
8. C	33. D	58. A	83. D	108. B
9. C	34. A	59. A	84. B	109. C
10. B	35. B	60. C	85. C	110. B
11. A	36. D	61. C	86. B	111. A
12. C	37. A	62. A	87. C	112. B
13. C	38. B	63. B	88. C	113. A
14. B	39. C	64. A	89. C	114. D
15. B	40. A	65. C	90. C	115. B
16. B	41. D	66. D	91. C	116. B
17. A	42. A	67. C	92. C	117. C
18. C	43. B	68. D	93. A	118. A
19. C	44. A	69. B	94. A	119. B
20. D	45. C	70. C	95. B	120. B
21. C	46. C	71. B	96. D	121. D
22. B	47. B	72. B	97. B	122. B
23. A	48. D	73. A	98. D	123. D
24. A	49. B	74. D	99. C	124. C
25. A	50. A	75. D	100. A	125. B

Sample Questions with Rationale

1. After an experiment, the scientist states that s/he believes a change in color is due to a change in pH. This is an example of

A. observing.

B. inferring.

C. measuring.

D. classifying.

B. Inferring.

To answer this question, note that the scientist has observed a change in color, and has then made a guess as to its reason. This is an example of inferring. The scientist has not measured or classified in this case. Although s/he has observed [the color change], the explanation of this observation is **inferring (B).**

2. When is a hypothesis formed?

A. Before the data is taken.

B. After the data is taken.

C. After the data is analyzed.

D. While the data is being graphed.

A. Before the data is taken.

A hypothesis is an educated guess, made before undertaking an experiment. The hypothesis is then evaluated based on the observed data. Therefore, the hypothesis must be formed before the data is taken, not during or after the experiment. This is consistent only with **answer (A).**

3. Who determines the laws regarding the use of safety glasses in the classroom?

A. The state government.

B. The school site.

C. The federal government.

D. The local district.

A. The state government.

Health and safety regulations are set by the state government, and apply to all school districts. Federal regulations may accompany specific federal grants, and local districts or school sites may enact local guidelines that are stricter than the state standards. All schools, however, must abide by safety precautions as set by state government. This is consistent only with **answer (A).**

4. If one inch equals 2.54 centimeters, how many millimeters are in 1.5 feet? (Approximately)

A. 18

B. 1800

C. 460

D. 4600

C. 460

To solve this problem, note that if one inch is 2.54 centimeters, then 1.5 feet (which is 18 inches), must be (18)(2.54) centimeters, i.e. approximately 46 centimeters. Because there are ten millimeters in a centimeter, this is approximately 460 millimeters:

(1.5 ft) (12 in/ft) (2.54 cm/in) (10 mm/cm) = (1.5) (12) (2.54) (10) mm = 457.2 mm

This is consistent only with **answer (C).**

5. Which of the following instruments measures wind speed?

A. Barometer.

B. Anemometer.

C. Thermometer.

D. Weather Vane.

B. Anemometer.

An anemometer is a device to measure wind speed, while a barometer measures pressure, a thermometer measures temperature, and a weather vane indicates wind direction. This is consistent only with **answer (B).**

If you chose "barometer," here is an old physics joke to console you:

A physics teacher asks a student the following question:
"Suppose you want to find out the height of a building, and the only tool you have is a barometer. How could you find out the height?"
(The teacher hopes that the student will remember that pressure is inversely proportional to height, and will measure the pressure at the top of the building and then use the data to calculate the height of the building.)
"Well," says the student, "I could tie a string to the barometer and lower it from the top of the building, and then measure the amount of string required."
"You could," answers the teacher, "but try to think of a method that uses your physics knowledge from our class."
"All right," replies the student, "I could drop the barometer from the roof and measure the time it takes to fall, and then use free-fall equations to calculate the height from which it fell."
"Yes," says the teacher, "but what about using the barometer per se?"
"Oh," answers the student, "I could find the building superintendent, and offer to exchange the barometer for a set of blueprints, and look up the height!"

6. Sonar works by _____

A. timing how long it takes sound to reach a certain speed.

B. bouncing sound waves between two metal plates.

C. bouncing sound waves off an object and timing how long it takes for the sound to return.

D. evaluating the motion and amplitude of sound.

C. Bouncing sound waves off an object and timing how long it takes for the sound to return.

Sonar is used to measure distances. Sound waves are sent out, and the time is measured for the sound to hit an obstacle and bounce back. By using the known speed of sound, observers (or machines) can calculate the distance to the obstacle. This is consistent only with **answer (C).**

7. The measure of the pull of Earth's gravity on an object is called

A. mass number.

B. atomic number.

C. mass.

D. weight.

D. Weight.

To answer this question, recall that mass number is the total number of protons and neutrons in an atom, atomic number is the number of protons in an atom, and mass is the amount of matter in an object. The only remaining **choice is (D)**, weight, which is correct because weight is the force of gravity on an object.

8. Which reaction below is a decomposition reaction?

A. $HCl + NaOH \rightarrow NaCl + H_2O$

B. $C + O_2 \rightarrow CO_2$

C. $2H_2O \rightarrow 2H_2 + O_2$

D. $CuSO_4 + Fe \rightarrow FeSO_4 + Cu$

C. $2H_2O \rightarrow 2H_2 + O_2$

To answer this question, recall that a decomposition reaction is one in which there are fewer reactants (on the left) than products (on the right). This is consistent only with **answer (C).** Meanwhile, note that answer (A) shows a double-replacement reaction (in which two sets of ions switch bonds), answer (B) shows a synthesis reaction (in which there are fewer products than reactants), and answer (D) shows a single-replacement reaction (in which one substance replaces another in its bond, but the other does not get a new bond).

9. The Law of Conservation of Energy states that

A. there must be the same number of products and reactants in any chemical equation.

B. objects always fall toward large masses such as planets.

C. energy is neither created nor destroyed, but may change form.

D. lights must be turned off when not in use, by state regulation.

C. Energy is neither created nor destroyed, but may change form.

Answer (C) is a summary of the Law of Conservation of Energy (for non-nuclear reactions). In other words, energy can be transformed into various forms such as kinetic, potential, electric, or heat energy, but the total amount of energy remains constant. Answer (A) is untrue, as demonstrated by many synthesis and decomposition reactions. Answers (B) and (D) may be sensible, but they are not relevant in this case. Therefore, the **answer is (C).**

10. Which parts of an atom are located inside the nucleus?

A. Protons and Electrons.

B. Protons and Neutrons.

C. Protons only.

D. Neutrons only.

B. **Protons and Neutrons.**

Protons and neutrons are located in the nucleus, while electrons move around outside the nucleus. This is consistent only with **answer (B)**.

11. The elements in the modern Periodic Table are arranged

A. in numerical order by atomic number.

B. randomly.

C. in alphabetical order by chemical symbol.

D. in numerical order by atomic mass.

A. **In numerical order by atomic number.**

Although the first periodic tables were arranged by atomic mass, the modern table is arranged by atomic number, i.e. the number of protons in each element. (This allows the element list to be complete and unique.) The elements are not arranged either randomly or in alphabetical order. The answer to this question is **therefore (A)**.

12. Carbon bonds with hydrogen by

A. ionic bonding.

B. non-polar covalent bonding.

C. polar covalent bonding.

D. strong nuclear force.

C. **Polar covalent bonding.**

Each carbon atom contains four valence electrons, while each hydrogen atom contains one valence electron. A carbon atom can bond with one or more hydrogen atoms, such that two electrons are shared in each bond. This is covalent bonding, because the electrons are shared. (In ionic bonding, atoms must gain or lose electrons to form ions. The ions are then electrically attracted in oppositely-charged pairs.) Covalent bonds are always polar when between two non-identical atoms, so this bond must be polar. ("Polar" means that the electrons are shared unequally, forming a pair of partial charges, i.e. poles.) In any case, the strong nuclear force is not relevant to this problem. The answer to this question is **therefore (C).**

13. Vinegar is an example of a _____

A. strong acid.

B. strong base.

C. weak acid.

D. weak base.

C. **Weak acid.**

The main ingredient in vinegar is acetic acid, a weak acid. Vinegar is a useful acid in science classes, because it makes a frothy reaction with bases such as baking soda (e.g. in the quintessential volcano model). Vinegar is not a strong acid, such as hydrochloric acid, because it does not dissociate as fully or cause as much corrosion. It is not a base. Therefore, the **answer is (C)**.

14. Which of the following is not a nucleotide?

A. Adenine.

B. Alanine.

.

C. Cytosine.

D. Guanine.

B. **Alanine.**

Alanine is an amino acid. Adenine, cytosine, guanine, thymine, and uracil are nucleotides. The correct **answer is (B).**

15. When measuring the volume of water in a graduated cylinder, where does one read the measurement?

A. At the highest point of the liquid.

B. At the bottom of the meniscus curve.

C. At the closest mark to the top of the liquid.

D. At the top of the plastic safety ring.

B. **At the bottom of the meniscus curve.**

To measure water in glass, you must look at the top surface at eye-level, and ascertain the location of the bottom of the meniscus (the curved surface at the top of the water). The meniscus forms because water molecules adhere to the sides of the glass, which is a slightly stronger force than their cohesion to each other. This leads to a U-shaped top of the liquid column, the bottom of which gives the most accurate volume measurement. (Other liquids have different forces, e.g. mercury in glass, which has a convex meniscus.) This is consistent only with **answer (B).**

16. A duck's webbed feet are examples of

A. mimicry.

B. structural adaptation.

C. protective resemblance.

D. protective coloration.

B. **Structural adaptation.**

Ducks (and other aquatic birds) have webbed feet, which makes them more efficient swimmers. This is most likely due to evolutionary patterns where webbed-footed-birds were more successful at feeding and reproducing, and eventually became the majority of aquatic birds. Because the structure of the duck adapted to its environment over generations, this is termed 'structural adaptation'. Mimicry, protective resemblance, and protective coloration refer to other evolutionary mechanisms for survival. The answer to this question is **therefore (B)**.

17. What cell organelle contains the cell's stored food?

A. Vacuoles.

B. Golgi Apparatus.

C. Ribosomes.

D. Lysosomes.

A. Vacuoles.

In a cell, the sub-parts are called organelles. Of these, the vacuoles hold stored food (and water and pigments). The Golgi Apparatus sorts molecules from other parts of the cell; the ribosomes are sites of protein synthesis; the lysosomes contain digestive enzymes. This is consistent only with **answer (A).**

18. The first stage of mitosis is called _____

A. telophase.

B. anaphase.

C. prophase.

D. mitophase.

C. Prophase.

In mitosis, the division of somatic cells, prophase is the stage where the cell enters mitosis. The four stages of mitosis, in order, are: prophase, metaphase, anaphase, and telophase. ("Mitophase" is not one of the steps.) During prophase, the cell begins the nonstop process of division. Its chromatin condenses, its nucleolus disappears, the nuclear membrane breaks apart, mitotic spindles form, its cytoskeleton breaks down, and centrioles push the spindles apart. Note that interphase, the stage where chromatin is loose, chromosomes are replicated, and cell metabolism is occurring, is technically not a stage of mitosis; it is a precursor to cell division.

19. The Doppler Effect is associated most closely with which property of waves?

A. Amplitude.

B. Wavelength.

C. Frequency.

D. Intensity.

C. Frequency.

The Doppler Effect accounts for an apparent increase in frequency when a wave source moves toward a wave receiver or apparent decrease in frequency when a wave source moves away from a wave receiver. (Note that the receiver could also be moving toward or away from the source.) As the wave fronts are released, motion toward the receiver mimics more frequent wave fronts, while motion away from the receiver mimics less frequent wave fronts. Meanwhile, the amplitude, wavelength, and intensity of the wave are not as relevant to this process (although moving closer to a wave source makes it seem more intense). The **answer to this question is therefore (C)**.

20. Viruses are responsible for many human diseases including all of the following *except*

A. influenza.

B. A.I.D.S.

C. the common cold.

D. strep throat.

D. **Strep throat.**

Influenza, A.I.D.S., and the "common cold" (rhinovirus infection), are all caused by viruses. (This is the reason that doctors should not be pressured to prescribe antibiotics for colds or 'flu—i.e. they will not be effective since the infections are not bacterial.) Strep throat (properly called 'streptococcal throat' and caused by streptococcus bacteria) is not a virus, but a bacterial infection. Thus, the **answer is (D)**.

21. A series of experiments on pea plants formed by _____ showed that two invisible markers existed for each trait, and one marker dominated the other.

A. Pasteur.

B. Watson and Crick.

C. Mendel.

D. Mendeleev.

C. **Mendel.**

Gregor Mendel was a ninteenth-century Austrian botanist, who derived "laws" governing inherited traits. His work led to the understanding of dominant and recessive traits, carried by biological markers. Mendel cross-bred different kinds of pea plants with varying features and observed the resulting new plants. He showed that genetic characteristics are not passed identically from one generation to the next. (Pasteur, Watson, Crick, and Mendeleev were other scientists with different specialties.) This is consistent only with **answer (C)**.

22. Formaldehyde should not be used in school laboratories for the following reason:

A. it smells unpleasant.

B. it is a known carcinogen.

C. it is expensive to obtain.

D. it is an explosive.

B. **It is a known carcinogen.**

Formaldehyde is a known carcinogen, so it is too dangerous for use in schools. In general, teachers should not use carcinogens in school laboratories. Although formaldehyde also smells unpleasant, a smell alone is not a definitive marker of danger. For example, many people find the smell of vinegar to be unpleasant, but vinegar is considered a very safe classroom/laboratory chemical. Furthermore, some odorless materials are toxic. Formaldehyde is neither particularly expensive nor explosive. Thus, the **answer is (B)**.

23. Amino acids are carried to the ribosome in protein synthesis by:

A. transfer RNA (tRNA).

B. messenger RNA (mRNA).

C. ribosomal RNA (rRNA).

D. transformation RNA (trRNA).

A. **Transfer RNA (tRNA).**

The job of tRNA is to carry and position amino acids to/on the ribosomes. mRNA copies DNA code and brings it to the ribosomes; rRNA is in the ribosome itself. There is no such thing as trRNA. Thus, the **answer is (A)**.

24. When designing a scientific experiment, a student considers all the factors that may influence the results. The process goal is to _____

A. recognize and manipulate independent variables.

B. recognize and record independent variables.

C. recognize and manipulate dependent variables.

D. recognize and record dependent variables.

A. Recognize and manipulate independent variables.

When a student designs a scientific experiment, s/he must decide what to measure, and what independent variables will play a role in the experiment. S/he must determine how to manipulate these independent variables to refine his/her procedure and to prepare for meaningful observations. Although s/he will eventually record dependent variables (D), this does not take place during the experimental design phase. Although the student will likely recognize and record the independent variables (B), this is not the process goal, but a helpful step in manipulating the variables. It is unlikely that the student will manipulate dependent variables directly in his/her experiment (C), or the data would be suspect. Thus, the **answer is (A)**.

25. Since ancient times, people have been entranced with bird flight. What is the key to bird flight?

A. Bird wings are a particular shape and composition.

B. Birds flap their wings quickly enough to propel themselves.

C. Birds take advantage of tailwinds.

D. Birds take advantage of crosswinds.

A. Bird wings are a particular shape and composition.

Bird wings are shaped for wide area, and their bones are very light. This creates a large surface-area-to-mass ratio, enabling birds to glide in air. Birds do flap their wings and float on winds, but none of these is the main reason for their flight ability. Thus, the **answer is (A)**.

26. Laboratory researchers have classified fungi as distinct from plants because the cell walls of fungi

A. contain chitin.

B. contain yeast.

C. are more solid.

D. are less solid.

A. **Contain chitin.**

Kingdom Fungi consists of organisms that are eukaryotic, multicellular, absorptive consumers. They have a chitin cell wall, which is the only universally present feature in fungi that is never present in plants. Thus, the **answer is (A)**.

27. In a fission reactor, "heavy water" is used to _____

A. terminate fission reactions.

B. slow down neutrons and moderate reactions.

C. rehydrate the chemicals.

D. initiate a chain reaction.

B. **Slow down neutrons and moderate reactions.**

"Heavy water" is used in a nuclear [fission] reactor to slow down neutrons, controlling and moderating the nuclear reactions. It does not terminate the reaction, and it does not initiate the reaction. Also, although the reactor takes advantage of water's other properties (e.g. high specific heat for cooling), the water does not "rehydrate" the chemicals. Therefore, the **answer is (B)**.

28. The transfer of heat by electromagnetic waves is called _____

A. conduction.

B. convection.

C. phase change.

D. radiation.

D. **Radiation.**

Heat transfer via electromagnetic waves (which can occur even in a vacuum) is called radiation. (Heat can also be transferred by direct contact (conduction), by fluid current (convection), and by matter changing phase, but these are not relevant here.) The answer to this question is **therefore (D)**.

29. When heat is added to most solids, they expand. Why is this the case?

A. The molecules get bigger.

B. The faster molecular motion leads to greater distance between the molecules.

C. The molecules develop greater repelling electric forces.

D. The molecules form a more rigid structure.

B. **The faster molecular motion leads to greater distance between the molecules.**

The atomic theory of matter states that matter is made up of tiny, rapidly moving particles. These particles move more quickly when warmer, because temperature is a measure of average kinetic energy of the particles. Warmer molecules therefore move further away from each other, with enough energy to separate from each other more often and for greater distances. The individual molecules do not get bigger, by conservation of mass, eliminating answer (A). The molecules do not develop greater repelling electric forces, eliminating answer (C). Occasionally, molecules form a more rigid structure when becoming colder and freezing (such as water)—but this gives rise to the exceptions to heat expansion, so it is not relevant here, eliminating answer (D). Therefore, the **answer is (B)**.

30. The force of gravity on earth causes all bodies in free fall to _____

A. fall at the same speed.

B. accelerate at the same rate.

C. reach the same terminal velocity.

D. move in the same direction.

B. **Accelerate at the same rate.**

Gravity causes approximately the same acceleration on all falling bodies close to earth's surface. (It is only "approximately" because there are very small variations in the strength of earth's gravitational field.) More massive bodies continue to accelerate at this rate for longer, before their air resistance is great enough to cause terminal velocity, so answers (A) and (C) are eliminated. Bodies on different parts of the planet move in different directions (always toward the center of mass of earth), so answer (D) is eliminated. Thus, the **answer is (B)**.

31. Sound waves are produced by _____

A. pitch.

B. noise.

C. vibrations.

D. sonar.

C. **Vibrations.**

Sound waves are produced by a vibrating body. The vibrating object moves forward and compresses the air in front of it, then reverses direction so that the pressure on the air is lessened and expansion of the air molecules occurs. The vibrating air molecules move back and forth parallel to the direction of motion of the wave as they pass the energy from adjacent air molecules closer to the source to air molecules farther away from the source. Therefore, the **answer is (C)**.

32. Resistance is measured in units called

A. watts.

B. volts.

C. ohms.

D. current.

C. **Ohms.**

A watt is a unit of energy. Potential difference is measured in a unit called the volt. Current is the number of electrons per second that flow past a point in a circuit. An ohm is the unit for resistance. The correct **answer is (C).**

33. Sound can be transmitted in all of the following *except*

A. air.

B. water.

C. diamond.

D. a vacuum.

D. **A vacuum**.

Sound, a longitudinal wave, is transmitted by vibrations of molecules. Therefore, it can be transmitted through any gas, liquid, or solid. However, it cannot be transmitted through a vacuum, because there are no particles present to vibrate and bump into their adjacent particles to transmit the waves. This is consistent only with **answer (D)**. (It is interesting also to note that sound is actually faster in solids and liquids than in air.)

34. As a train approaches, the whistle sounds

A. higher, because it has a higher apparent frequency.

B. lower, because it has a lower apparent frequency.

C. higher, because it has a lower apparent frequency.

D. lower, because it has a higher apparent frequency.

A. **Higher, because it has a higher apparent frequency.**

By the Doppler effect, when a source of sound is moving toward an observer, the wave fronts are released closer together, i.e. with a greater apparent frequency. Higher frequency sounds are higher in pitch. This is consistent only with **answer (A)**.

35. The speed of light is different in different materials. This is responsible for _____

A. interference.

B. refraction.

C. reflection.

D. relativity.

B. **Refraction.**

Refraction (B) is the bending of light because it hits a material at an angle wherein it has a different speed. (This is analogous to a cart rolling on a smooth road. If it hits a rough patch at an angle, the wheel on the rough patch slows down first, leading to a change in direction.) Interference (A) is when light waves interfere with each other to form brighter or dimmer patterns; reflection (C) is when light bounces off a surface; relativity (D) is a general topic related to light speed and its implications, but not specifically indicated here. Therefore, the **answer is (B)**.

36. A converging lens produces a real image _____

A. always.

B. never.

C. when the object is within one focal length of the lens.

D. when the object is further than one focal length from the lens.

D. **When the object is further than one focal length from the lens.**

A converging lens produces a real image whenever the object is far enough from the lens (outside one focal length) so that the rays of light from the object can hit the lens and be focused into a real image on the other side of the lens. When the object is closer than one focal length from the lens, rays of light do not converge on the other side; they diverge. This means that only a virtual image can be formed, i.e. the theoretical place where those diverging rays would have converged if they had originated behind the object. Thus, the correct **answer is (D)**.

37. The electromagnetic radiation with the longest wave length is _____

A. radio waves.

B. red light.

C. X-rays.

D. ultraviolet light.

A. **Radio waves.**

As one can see on a diagram of the electromagnetic spectrum, radio waves have longer wave lengths (and smaller frequencies) than visible light, which in turn has longer wave lengths than ultraviolet or X-ray radiation. If you did not remember this sequence, you might recall that wave length is inversely proportional to frequency, and that radio waves are considered much less harmful (less energetic, i.e. lower frequency) than ultraviolet or X-ray radiation. The correct answer is **therefore (A)**.

38. Under a 440 power microscope, an object with diameter 0.1 millimeter appears to have diameter _____

A. 4.4 millimeters.

B. 44 millimeters.

C. 440 millimeters.

D. 4400 millimeters.

B. **44 millimeters**.

To answer this question, recall that to calculate a new length, you multiply the original length by the magnification power of the instrument. Therefore, the 0.1 millimeter diameter is multiplied by 440. This equals 44, so the image appears to be 44 millimeters in diameter. You could also reason that since a 440 power microscope is considered a “high power” microscope, you would expect a 0.1 millimeter object to appear a few centimeters long. Therefore, the correct **answer is (B)**.

39. To separate blood into blood cells and plasma involves the process of

A. electrophoresis.

B. spectrophotometry.

C. centrifugation.

D. chromatography.

C. Centrifugation.

Electrophoresis uses electrical charges of molecules to separate them according to their size. Spectrophotometry uses percent light absorbance to measure a color change, thus giving qualitative data a quantitative value. Chromatography uses the principles of capillarity to separate substances. Centrifugation involves spinning substances at a high speed. The more dense part of a solution will settle to the bottom of the test tube, where the lighter material will stay on top. The **answer is (C).**

40. Experiments may be done with any of the following animals except

A. birds.

B. invertebrates.

C .lower order life.

D. frogs.

A. Birds.

No dissections may be performed on living mammalian vertebrates or birds. Lower order life and invertebrates may be used. Biological experiments may be done with all animals except mammalian vertebrates or birds. Therefore the **answer is (A).**

41. For her first project of the year, a student is designing a science experiment to test the effects of light and water on plant growth. You should recommend that she _____

A. manipulate the temperature also.

B. manipulate the water pH also.

C. determine the relationship between light and water unrelated to plant growth.

D. omit either water or light as a variable.

D. Omit either water or light as a variable.

As a science teacher for middle-school-aged kids, it is important to reinforce the idea of 'constant' vs. 'variable' in science experiments. At this level, it is wisest to have only one variable examined in each science experiment. (Later, students can hold different variables constant while investigating others.) Therefore it is counterproductive to add in other variables (answers (A)or (B)). It is also irrelevant to determine the light-water interactions aside from plant growth (C). So the only possible **answer is (D)**.

42. In a laboratory report, what is the abstract?

A. The abstract is a summary of the report, and is the first section of the report.

B. The abstract is a summary of the report, and is the last section of the report.

C. The abstract is predictions for future experiments, and is the first section of the report.

D. The abstract is predictions for future experiments, and is the last section of the report.

A. The abstract is a summary of the report, and is the first section of the report.

In a laboratory report, the abstract is the section that summarizes the entire report (often containing one representative sentence from each section). It appears at the very beginning of the report, even before the introduction, often on its own page (instead of a title page). This format is consistent with articles in scientific journals. Therefore, the **answer is (A).**

43. What is the scientific method?

A. It is the process of doing an experiment and writing a laboratory report.

B. It is the process of using open inquiry and repeatable results to establish theories.

C. It is the process of reinforcing scientific principles by confirming results.

D. It is the process of recording data and observations.

B. It is the process of using open inquiry and repeatable results to establish theories.

Scientific research often includes elements from answers (A), (C), and (D), but the basic underlying principle of the scientific method is that people ask questions and do repeatable experiments to answer those questions and develop informed theories of why and how things happen. Therefore, the best **answer is (B).**

44. Identify the control in the following experiment: A student had four corn plants and was measuring photosynthetic rate (by measuring growth mass). Half of the plants were exposed to full (constant) sunlight, and the other half were kept in 50% (constant) sunlight.

A. The control is a set of plants grown in full (constant) sunlight.

B. The control is a set of plants grown in 50% (constant) sunlight.

C. The control is a set of plants grown in the dark.

D. The control is a set of plants grown in a mixture of natural levels of sunlight.

A. **The control is a set of plants grown in full (constant) sunlight.**

In this experiment, the goal was to measure how two different amounts of sunlight affected plant growth. The control in any experiment is the 'base case,' or the usual situation without a change in variable. Because the control must be studied alongside the variable, answers (C) and (D) are omitted (because they were not in the experiment). The **better answer of (A) and (B) is (A)**, because usually plants are assumed to have the best growth and their usual growing circumstances in full sunlight. This is particularly true for crops like the corn plants in this question.

45. In an experiment measuring the growth of bacteria at different temperatures, what is the independent variable?

A. Number of bacteria.

B. Growth rate of bacteria.

C. Temperature.

D. Light intensity.

C. **Temperature.**

To answer this question, recall that the independent variable in an experiment is the entity that is changed by the scientist, in order to observe the effects (the dependent variable(s)). In this experiment, temperature is changed in order to measure growth of bacteria, so (**C) is the answer**. Note that answer (A) is the dependent variable, and neither (B) nor (D) is directly relevant to the question.

46. A scientific law _____

A. proves scientific accuracy.

B. may never be broken.

C. may be revised in light of new data.

D. is the result of one excellent experiment.

C. May be revised in light of new data.

A scientific law is the same as a scientific theory, except that it has lasted for longer, and has been supported by more extensive data. Therefore, such a law may be revised in light of new data, and may be broken by that new data. Furthermore, a scientific law is always the result of many experiments, and never 'proves' anything but rather is implied or supported by various results. Therefore, the **answer must be (C).**

47. Which is the correct order of methodology?

1. collecting data
2. planning a controlled experiment
3. drawing a conclusion
4. hypothesizing a result
5. re-visiting a hypothesis to answer a question

A. 1,2,3,4,5

B. 4,2,1,3,5

C. 4,5,1,3,2

D. 1,3,4,5,2

B. 4,2,1,3,5

The correct methodology for the scientific method is first to make a meaningful hypothesis (educated guess), then plan and execute a controlled experiment to test that hypothesis. Using the data collected in that experiment, the scientist then draws conclusions and attempts to answer the original question related to the hypothesis. This is consistent only with **answer (B)**.

48. Which is the most desirable tool to use to heat substances in a middle school laboratory?

A. Alcohol burner.

B. Freestanding gas burner.

C. Bunsen burner.

D. Hot plate.

D. **Hot plate.**

Due to safety considerations, the use of open flame should be minimized, so a hot plate is the best choice. Any kind of burner may be used with proper precautions, but it is difficult to maintain a completely safe middle school environment. Therefore, the best **answer is (D)**.

49. Newton's Laws are taught in science classes because _____.

A. they are the correct analysis of inertia, gravity, and forces.

B. they are a close approximation to correct physics, for usual Earth conditions.

C. they accurately incorporate Relativity into studies of forces.

D. Newton was a well-respected scientist in his time.

B. They are a close approximation to correct physics, for usual Earth conditions.

Although Newton's Laws are often taught as fully correct for inertia, gravity, and forces, it is important to realize that Einstein's work (and that of others) has indicated that Newton's Laws are reliable only at speeds much lower than that of light. This is reasonable, though, for most middle- and high-school applications. At speeds close to the speed of light, Relativity considerations must be used. Therefore, the only correct **answer is (B)**.

50. Which of the following is most accurate?

A. Mass is always constant; Weight may vary by location.

B. Mass and Weight are both always constant.

C. Weight is always constant; Mass may vary by location.

D. Mass and Weight may both vary by location.

A. **Mass is always constant; Weight may vary by location**.

When considering situations exclusive of nuclear reactions, mass is constant (mass, the amount of matter in a system, is conserved). Weight, on the other hand, is the force of gravity on an object, which is subject to change due to changes in the gravitational field and/or the location of the object. Thus, the **best answer is (A)**.

51. Chemicals should be stored _____

A. in the principal's office.

B. in a dark room.

C. in an off-site research facility.

D. according to their reactivity with other substances.

D. **According to their reactivity with other substances.**

Chemicals should be stored with other chemicals of similar properties (e.g. acids with other acids), to reduce the potential for either hazardous reactions in the store-room, or mistakes in reagent use. Certainly, chemicals should not be stored in anyone's office, and the light intensity of the room is not very important because light-sensitive chemicals are usually stored in dark containers. In fact, good lighting is desirable in a store-room, so that labels can be read easily. Chemicals may be stored off-site, but that makes their use inconvenient. Therefore, the best **answer is (D)**.

52. Which of the following is the worst choice for a school laboratory activity?

A. A genetics experiment tracking the fur color of mice.

B. Dissection of a preserved fetal pig.

C. Measurement of goldfish respiration rate at different temperatures.

D. Pithing a frog to watch the circulatory system.

D. **Pithing a frog to watch the circulatory system.**

While any use of animals (alive or dead) must be done with care to respect ethics and laws, it is possible to perform choices (A), (B), or (C) with due care. (Note that students will need significant assistance and maturity to perform these experiments.) However, modern practice precludes pithing animals (causing partial brain death while allowing some systems to function), as inhumane. Therefore, the answer to this **question is (D)**.

53. Who should be notified in the case of a serious chemical spill?

A. The custodian.

B. The fire department or other municipal authority.

C. The science department chair.

D. The School Board.

B. **The fire department or other municipal authority**.

Although the custodian may help to clean up laboratory messes, and the science department chair should be involved in discussions of ways to avoid spills, a serious chemical spill may require action by the fire department or other trained emergency personnel. It is best to be safe by notifying them in case of a serious chemical accident. Therefore, the **best answer is (B)**.

54. A scientist exposes mice to cigarette smoke, and notes that their lungs develop tumors. Mice that were not exposed to the smoke do not develop as many tumors. Which of the following conclusions may be drawn from these results?

I. Cigarette smoke causes lung tumors.
II. Cigarette smoke exposure has a positive correlation with lung tumors in mice.
III. Some mice are predisposed to develop lung tumors.
IV. Mice are often a good model for humans in scientific research.

A. I and II only.

B. II only.

C. I , II, and III only.

D. II and IV only.

B. **II only.**

Although cigarette smoke has been found to cause lung tumors (and many other problems), this particular experiment shows only that there is a positive correlation between smoke exposure and tumor development in these mice. It may be true that some mice are more likely to develop tumors than others, which is why a control group of identical mice should have been used for comparison. Mice are often used to model human reactions, but this is as much due to their low financial and emotional cost as it is due to their being a "good model" for humans. Therefore, the **answer must be (B)**.

55. In which situation would a science teacher be legally liable?

A. The teacher leaves the classroom for a telephone call and a student slips and injures him/herself.

B. A student removes his/her goggles and gets acid in his/her eye.

C. A faulty gas line in the classroom causes a fire.

D. A student cuts him/herself with a dissection scalpel.

A. The teacher leaves the classroom for a telephone call and a student slips and injures him/herself.

Teachers are required to exercise a “reasonable duty of care” for their students. Accidents may happen (e.g. (D)), or students may make poor decisions (e.g. (B)), or facilities may break down (e.g. (C)). However, the teacher has the responsibility to be present and to do his/her best to create a safe and effective learning environment. Therefore, the **answer is (A)**.

56. Which of these is the best example of ‘negligence’?

A. A teacher fails to give oral instructions to those with reading disabilities.

B. A teacher fails to exercise ordinary care to ensure safety in the classroom.

C. A teacher displays inability to supervise a large group of students.

D. A teacher reasonably anticipates that an event may occur, and plans accordingly.

B. A teacher fails to exercise ordinary care to ensure safety in the classroom.

‘Negligence’ is the failure to “exercise ordinary care” to ensure an appropriate and safe classroom environment. It is best for a teacher to meet all special requirements for disabled students, and to be good at supervising large groups. However, if a teacher can prove that s/he has done a reasonable job to ensure a safe and effective learning environment, then it is unlikely that she/he would be found negligent. Therefore, **the answer is (B)**.

57. Which item should always be used when handling glassware?

A. Tongs.

B. Safety goggles.

C. Gloves.

D. Buret stand.

B. **Safety goggles.**

Safety goggles are the single most important piece of safety equipment in the laboratory, and should be used any time a scientist is using glassware, heat, or chemicals. Other equipment (e.g. tongs, gloves, or even a buret stand) has its place for various applications. However, the most important is safety goggles. Therefore, the **answer is (B)**.

58. Which of the following is *not* a necessary characteristic of living things?

A. Movement.

B. Reduction of local entropy.

C. Ability to cause local energy form changes.

D. Reproduction.

A. **Movement.**

There are many definitions of “life,” but in all cases, a living organism reduces local entropy, changes chemical energy into other forms, and reproduces. Not all living things move, however, so the correct **answer is (A)**.

59. What are the most significant and prevalent elements in the biosphere?

A. Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus.

B. Carbon, Hydrogen, Sodium, Iron, Calcium.

C. Carbon, Oxygen, Sulfur, Manganese, Iron.

D. Carbon, Hydrogen, Oxygen, Nickel, Sodium, Nitrogen.

A. **Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus.**

Organic matter (and life as we know it) is based on Carbon atoms, bonded to Hydrogen and Oxygen. Nitrogen and Phosphorus are the next most significant elements, followed by Sulfur and then trace nutrients such as Iron, Sodium, Calcium, and others. Therefore, the **answer is (A)**. If you know that the formula for any carbohydrate contains Carbon, Hydrogen, and Oxygen, that will help you narrow the choices to (A) and (D) in any case.

60. All of the following measure energy *except* for _____

A. joules.

B. calories.

C. watts.

D. ergs.

C. **Watts.**

Energy units must be dimensionally equivalent to (force)x(length), which equals (mass)x(length squared)/(time squared). Joules, Calories, and Ergs are all metric measures of energy. Joules are the SI units of energy, while Calories are used to allow water to have a Specific Heat of one unit. Ergs are used in the 'cgs' (centimeter-gram-second) system, for smaller quantities. Watts, however, are units of power, i.e. Joules per Second. Therefore, the **answer is (C)**.

61. Identify the correct sequence of organization of living things from lower to higher order:

A. Cell, Organelle, Organ, Tissue, System, Organism.

B. Cell, Tissue, Organ, Organelle, System, Organism.

C. Organelle, Cell, Tissue, Organ, System, Organism.

D. Organelle, Tissue, Cell, Organ, System, Organism.

C. **Organelle, Cell, Tissue, Organ, System, Organism**.

Organelles are parts of the cell; cells make up tissue, which makes up organs. Organs work together in systems (e.g. the respiratory system), and the organism is the living thing as a whole. Therefore, the **answer must be (C)**.

62. Which kingdom is comprised of organisms made of one cell with no nuclear membrane?

A. Monera.

B. Protista.

C. Fungi.

D. Algae.

A. **Monera.**

To answer this question, first note that algae are not a kingdom of their own. Some algae are in monera, the kingdom that consists of unicellular prokaryotes with no true nucleus. Protista and fungi are both eukaryotic, with true nuclei, and are sometimes multi-cellular. Therefore, the **answer is (A)**.

63. Which of the following is found in the least abundance in organic molecules?

A. Phosphorus.

B. Potassium.

C. Carbon.

D. Oxygen.

B. **Potassium**.

Organic molecules consist mainly of Carbon, Hydrogen, and Oxygen, with significant amounts of Nitrogen, Phosphorus, and often Sulfur. Other elements, such as Potassium, are present in much smaller quantities. Therefore, the **answer is (B)**. If you were not aware of this ranking, you might have been able to eliminate Carbon and Oxygen because of their prevalence, in any case.

64. Catalysts assist reactions by _____

A. lowering effective activation energy.

B. maintaining precise pH levels.

C. keeping systems at equilibrium.

D. adjusting reaction speed.

A. **Lowering effective activation energy**.

Chemical reactions can be enhanced or accelerated by catalysts, which are present both with reactants and with products. They induce the formation of activated complexes, thereby lowering the effective activation energy—so that less energy is necessary for the reaction to begin. Although this often makes reactions faster, answer (D) is not as good a choice as the more generally applicable **answer (A)**, which is correct.

65. Accepted procedures for preparing solutions should be made with

A. alcohol.

B. hydrochloric acid.

C. distilled water.

D. tap water.

C. Distilled water.

Alcohol and hydrochloric acid should never be used to make solutions unless instructed to do so. All solutions should be made with distilled water as tap water contains dissolved particles which may affect the results of an experiment. The correct **answer is (C).**

66. Enzymes speed up reactions by _____

A. utilizing ATP.

B. lowering pH, allowing reaction speed to increase.

C. increasing volume of substrate.

D. lowering energy of activation.

D. **Lowering energy of activation**.

Because enzymes are catalysts, they work the same way—they cause the formation of activated chemical complexes, which require a lower activation energy. Therefore, the **answer is (D).** ATP is an energy source for cells, and pH or volume changes may or may not affect reaction rate, so these answers can be eliminated.

67. When you step out of the shower, the floor feels colder on your feet than the bathmat. Which of the following is the correct explanation for this phenomenon?

A. The floor is colder than the bathmat.

B. Your feet have a chemical reaction with the floor, but not the bathmat.

C. Heat is conducted more easily into the floor.

D. Water is absorbed from your feet into the bathmat.

C. **Heat is conducted more easily into the floor.**

When you step out of the shower and onto a surface, the surface is most likely at room temperature, regardless of its composition (eliminating answer (A)). Your feet feel cold when heat is transferred from them to the surface, which happens more easily on a hard floor than a soft bathmat. This is because of differences in specific heat (the energy required to change temperature, which varies by material). Therefore, the **answer must be (C)**, i.e. heat is conducted more easily into the floor from your feet.

68. Which of the following is *not* considered ethical behavior for a scientist?

A. Using unpublished data and citing the source.

B. Publishing data before other scientists have had a chance to replicate results.

C. Collaborating with other scientists from different laboratories.

D. Publishing work with an incomplete list of citations.

D. **Publishing work with an incomplete list of citations**.

One of the most important ethical principles for scientists is to cite all sources of data and analysis when publishing work. It is reasonable to use unpublished data (A), as long as the source is cited. Most science is published before other scientists replicate it (B), and frequently scientists collaborate with each other, in the same or different laboratories (C). These are all ethical choices. However, publishing work without the appropriate citations, is unethical. Therefore, the **answer is (D).**

69. The chemical equation for water formation is: $2H_2 + O_2 \rightarrow 2H_2O$. Which of the following is an *incorrect* interpretation of this equation?

A. Two moles of hydrogen gas and one mole of oxygen gas combine to make two moles of water.

B. Two grams of hydrogen gas and one gram of oxygen gas combine to make two grams of water.

C. Two molecules of hydrogen gas and one molecule of oxygen gas combine to make two molecules of water.

D. Four atoms of hydrogen (combined as a diatomic gas) and two atoms of oxygen (combined as a diatomic gas) combine to make two molecules of water.

B. **Two grams of hydrogen gas and one gram of oxygen gas combine to make two grams of water.**

In any chemical equation, the coefficients indicate the relative proportions of molecules (or atoms), or of moles of molecules. They do not refer to mass, because chemicals combine in repeatable combinations of molar ratio (i.e. number of moles), but vary in mass per mole of material. Therefore, the answer must be the only choice that does not refer to numbers of particles, i.e. **answer (B)**, which refers to grams, a unit of mass.

70. Energy is measured with the same units as _____

A. force.

B. momentum.

C. work.

D. power.

C. **Work.**

In SI units, energy is measured in Joules, i.e. (mass)(length squared)/(time squared). This is the same unit as is used for work. You can verify this by calculating that since work is force times distance, the units work out to be the same. Force is measured in Newtons in SI; momentum is measured in (mass)(length)/(time); power is measured in Watts (which equal Joules/second). Therefore, the **answer must be (C)**.

71. If the volume of a confined gas is increased, what happens to the pressure of the gas? You may assume that the gas behaves ideally, and that temperature and number of gas molecules remain constant.

A. The pressure increases.

B. The pressure decreases.

C. The pressure stays the same.

D. There is not enough information given to answer this question.

B. **The pressure decreases.**

Because we are told that the gas behaves ideally, you may assume that it follows the Ideal Gas Law, i.e. PV = nRT. This means that an increase in volume must be associated with a decrease in pressure (i.e. higher T means lower P), because we are also given that all the components of the right side of the equation remain constant. Therefore, the **answer must be (B)**.

72. A product of anaerobic respiration in animals is _____

A. carbon dioxide.

B. lactic acid.

C. oxygen.

D. sodium chloride.

B. **Lactic acid**.

In animals, anaerobic respiration (i.e. respiration without the presence of oxygen) generates lactic acid as a byproduct. (Note that some anaerobic bacteria generate carbon dioxide from respiration of methane, and animals generate carbon dioxide in aerobic respiration.) Oxygen is not normally a by-product of respiration, though it is a product of photosynthesis, and sodium chloride is not strictly relevant in this question. Therefore, the **answer must be (B)**. By the way, lactic acid is believed to cause muscle soreness after anaerobic weight-lifting.

73. A Newton is fundamentally a measure of _____.

A. force.

B. momentum.

C. energy.

D. gravity.

A. **Force.**

In SI units, force is measured in Newtons. Momentum and energy each have different units, without equivalent dimensions. A Newton is one (kilogram)(meter)/(second squared), while momentum is measured in (kilgram)(meter)/(second) and energy, in Joules, is (kilogram)(meter squared)/(second squared). Although “gravity” can be interpreted as the force of gravity, i.e. measured in Newtons, fundamentally it is not required. Therefore, the **answer is (A)**.

74. Which change does *not* affect enzyme rate?

A. Increase the temperature.

B. Add more substrate.

C. Adjust the pH.

D. Use a larger cell.

D. **Use a larger cell**.

Temperature, chemical amounts, and pH can all affect enzyme rate. However, the chemical reactions take place on a small enough scale that the overall cell size is not relevant. Therefore, the **answer is (D)**.

75. Which of the following types of rock are made from magma?

A. Fossils.

B. Sedimentary.

C. Metamorphic.

D. Igneous.

D. **Igneous.**

Few fossils are found in metamorphic rock and virtually none found in igneous rocks. Igneous rocks are formed from magma and magma is so hot that any organisms trapped by it are destroyed. Metamorphic rocks are formed by high temperatures and great pressures. When fluid sediments are transformed into solid sedimentary rocks, the process is known as lithification. The **answer is (D).**

76. Which of the following is *not* an acceptable way for a student to acknowledge sources in a laboratory report?

A. The student tells his/her teacher what sources s/he used to write the report.

B. The student uses footnotes in the text, with sources cited, but not in correct MLA format.

C. The student uses endnotes in the text, with sources cited, in correct MLA format.

D. The student attaches a separate bibliography, noting each use of sources.

A. **The student tells his/her teacher what sources s/he used to write the report.**

It may seem obvious, but students are often unaware that scientists need to cite all sources used. For the young adolescent, it is not always necessary to use official MLA format (though this should be taught at some point). Students may properly cite references in many ways, but these references must be in writing, with the original assignment. Therefore, the **answer is (A)**.

77. Animals with a notochord or a backbone are in the phylum

A. arthropoda.

B. chordata.

C. mollusca.

D. mammalia.

B. **Chordata.**

The phylum arthropoda contains spiders and insects and phylum mollusca contain snails and squid. Mammalia is a class in the phylum chordata. The **answer is (B).**

78. Which of the following is a correct explanation for scientific 'evolution'?

A. Giraffes need to reach higher for leaves to eat, so their necks stretch. The giraffe babies are then born with longer necks. Eventually, there are more long-necked giraffes in the population.

B. Giraffes with longer necks are able to reach more leaves, so they eat more and have more babies than other giraffes. Eventually, there are more long-necked giraffes in the population.

C. Giraffes want to reach higher for leaves to eat, so they release enzymes into their bloodstream, which in turn causes fetal development of longer-necked giraffes. Eventually, there are more long-necked giraffes in the population.

D. Giraffes with long necks are more attractive to other giraffes, so they get the best mating partners and have more babies. Eventually, there are more long-necked giraffes in the population.

B. **Giraffes with longer necks are able to reach more leaves, so they eat more and have more babies than other giraffes. Eventually, there are more long-necked giraffes in the population.**

Although evolution is often misunderstood, it occurs via natural selection. Organisms with a life/reproductive advantage will produce more offspring. Over many generations, this changes the proportions of the population. In any case, it is impossible for a stretched neck (A) or a fervent desire (C) to result in a biologically mutated baby. Although there are traits that are naturally selected because of mate attractiveness and fitness (D), this is not the primary situation here, **so answer (B) is the best choice**.

79. Which of the following is a correct definition for 'chemical equilibrium'?

A. Chemical equilibrium is when the forward and backward reaction rates are equal. The reaction may continue to proceed forward and backward.

B. Chemical equilibrium is when the forward and backward reaction rates are equal, and equal to zero. The reaction does not continue.

C. Chemical equilibrium is when there are equal quantities of reactants and products.

D. Chemical equilibrium is when acids and bases neutralize each other fully.

A. Chemical equilibrium is when the forward and backward reaction rates are equal. The reaction may continue to proceed forward and backward.

Chemical equilibrium is defined as when the quantities of reactants and products are at a 'steady state' and are no longer shifting, but the reaction may still proceed forward and backward. The rate of forward reaction must equal the rate of backward reaction. Note that there may or may not be equal amounts of chemicals, and that this is not restricted to a completed reaction or to an acid-base reaction. Therefore, the **answer is (A)**.

80. Which of the following data sets is properly represented by a bar graph?

A. Number of people choosing to buy cars, vs. Color of car bought.

B. Number of people choosing to buy cars, vs. Age of car customer.

C. Number of people choosing to buy cars, vs. Distance from car lot to customer home.

D. Number of people choosing to buy cars, vs. Time since last car purchase.

A. Number of people choosing to buy cars, vs. Color of car bought.

A bar graph should be used only for data sets in which the independent variable is non-continuous (discrete), e.g. gender, color, etc. Any continuous independent variable (age, distance, time, etc.) should yield a scatter-plot when the dependent variable is plotted. Therefore, the **answer must be (A)**.

81. In a science experiment, a student needs to dispense very small measured amounts of liquid into a well-mixed solution. Which of the following is the \best choice for his/her equipment to use?

A. Buret with Buret Stand, Stir-plate, Stirring Rod, Beaker.

B. Buret with Buret Stand, Stir-plate, Beaker.

C. Volumetric Flask, Dropper, Graduated Cylinder, Stirring Rod.

D. Beaker, Graduated Cylinder, Stir-plate.

B. **Buret with Buret Stand, Stir-plate, Beaker**.

The most accurate and convenient way to dispense small measured amounts of liquid in the laboratory is with a buret, on a buret stand. To keep a solution well-mixed, a magnetic stir-plate is the most sensible choice, and the solution will usually be mixed in a beaker. Although other combinations of materials could be used for this experiment, **choice (B)** is thus the simplest and best.

82. A laboratory balance is most appropriately used to measure the mass of which of the following?

A. Seven paper clips.

B. Three oranges.

C. Two hundred cells.

D. One student’s elbow.

A. **Seven paper clips.**

Usually, laboratory/classroom balances can measure masses between approximately 0.01 gram and 1 kilogram. Therefore, answer (B) is too heavy and answer (C) is too light. Answer (D) is silly, but it is a reminder to instruct students not to lean on the balances or put their things near them. **Answer (A)**, which is likely to have a mass of a few grams, is correct in this case.

83. All of the following are measured in units of length, *except* for:

A. Perimeter.

B. Distance.

C. Radius.

D. Area.

D. Area.

Perimeter is the distance around a shape; distance is equivalent to length; radius is the distance from the center (e.g. in a circle) to the edge. Area, however, is the squared-length-units measure of the size of a two-dimensional surface. Therefore, **the answer is (D)**.

84. What is specific gravity?

A. The mass of an object.

B. The ratio of the density of a substance to the density of water.

C. Density.

D. The pull of the earth's gravity on an object.

B. The ratio of the density of a substance to the density of water.

Mass is a measure of the amount of matter in an object. Density is the mass of a substance contained per unit of volume. Weight is the measure of the earth's pull of gravity on an object. The only option here is the ratio of the density of a substance to the density of water, **answer (B).**

85. What is the most accurate description of the Water Cycle?

A. Rain comes from clouds, filling the ocean. The water then evaporates and becomes clouds again.

B. Water circulates from rivers into groundwater and back, while water vapor circulates in the atmosphere.

C. Water is conserved except for chemical or nuclear reactions, and any drop of water could circulate through clouds, rain, ground-water, and surface-water.

D. Weather systems cause chemical reactions to break water into its atoms.

C. **Water is conserved except for chemical or nuclear reactions, and any drop of water could circulate through clouds, rain, ground-water, and surface-water.**

All natural chemical cycles, including the Water Cycle, depend on the principle of Conservation of Mass. (For water, unlike for elements such as Nitrogen, chemical reactions may cause sources or sinks of water molecules.) Any drop of water may circulate through the hydrologic system, ending up in a cloud, as rain, or as surface- or ground-water. Although answers (A) and (B) describe parts of the water cycle, the most comprehensive and correct **answer is (C)**.

86. The scientific name *Canis familiaris* refers to the animal's _____.

A. kingdom and phylum.

B. genus and species.

C. class and species.

D. type and family.

B. **Genus and species**.

To answer this question, you must be aware that genus and species are the most specific way to identify an organism, and that usually the genus is capitalized and the species, immediately following, is not. Furthermore, it helps to recall that 'Canis' is the genus for dogs, or canines. Therefore, the **answer must be (B)**. If you did not remember these details, you might recall that there is no such kingdom as 'Canis,' and that there isn't a category 'type' in official taxonomy. This could eliminate answers (A) and (D).

87. Members of the same animal species _____

A. look identical.

B. never adapt differently.

C. are able to reproduce with one another.

D. are found in the same location.

C. Are able to reproduce with one another.

Although members of the same animal species may look alike (A), adapt alike (B), or be found near one another (D), the only requirement is that they be able to reproduce with one another. This ability to reproduce within the group is considered the hallmark of a species. Therefore, the **answer is (C)**.

88. Which of the following is/are true about scientists?

I. Scientists usually work alone.
II. Scientists usually work with other scientists.
III. Scientists achieve more prestige from new discoveries than from replicating established results.
IV. Scientists keep records of their own work, but do not publish it for outside review.

A. I and IV only.

B. II only.

C. II and III only.

D. III and IV only.

C. II and III only.

In the scientific community, scientists nearly always work in teams, both within their institutions and across several institutions. This eliminates (I) and requires (II), leaving only **answer choices (B) and (C)**. Scientists do achieve greater prestige from new discoveries, so the answer must be (C). Note that scientists must publish their work in peer-reviewed journals, eliminating (IV) in any case.

89. What is necessary for ion diffusion to occur spontaneously?

A. Carrier proteins.

B. Energy from an outside source.

C. A concentration gradient.

D. Cell flagellae.

C. A concentration gradient.

Spontaneous diffusion occurs when random motion leads particles to increase entropy by equalizing concentrations. Particles tend to move into places of lower concentration. Therefore, a concentration gradient is required, and the **answer is (C)**. No proteins (A), outside energy (B), or flagellae (D) are required for this process.

90. All of the following are considered Newton's Laws *except* for:

A. An object in motion will continue in motion unless acted upon by an outside force.

B. For every action force, there is an equal and opposite reaction force.

C. Nature abhors a vacuum.

D. Mass can be considered the ratio of force to acceleration.

C. Nature abhors a vacuum.

Newton's Laws include his law of inertia (an object in motion (or at rest) will stay in motion (or at rest) until acted upon by an outside force) (A), his law that (Force)=(Mass)(Acceleration) (D), and his equal and opposite reaction force law (B). Therefore, the **answer to this question is (C)**, because "Nature abhors a vacuum" is not one of these.

91. A cup of hot liquid and a cup of cold liquid are both sitting in a room at comfortable room temperature and humidity. Both cups are thin plastic. Which of the following is a true statement?

A. There will be fog on the outside of the hot liquid cup, and also fog on the outside of the cold liquid cup.

B. There will be fog on the outside of the hot liquid cup, but not on the cold liquid cup.

C. There will be fog on the outside of the cold liquid cup, but not on the hot liquid cup.

D. There will not be fog on the outside of either cup.

C. There will be fog on the outside of the cold liquid cup, but not on the hot liquid cup.

Fog forms on the outside of a cup when the contents of the cup are colder than the surrounding air, and the cup material is not a perfect insulator. This happens because the air surrounding the cup is cooled to a lower temperature than the ambient room, so it has a lower saturation point for water vapor. Although the humidity had been reasonable in the warmer air, when that air circulates near the colder region and cools, water condenses onto the cup's outside surface. This phenomenon is also visible when someone takes a hot shower, and the mirror gets foggy. The mirror surface is cooler than the ambient air, and provides a surface for water condensation. Furthermore, the same phenomenon is why defrosters on car windows send heat to the windows—the warmer window does not permit as much condensation. Therefore, the correct **answer is (C)**.

92. A ball rolls down a smooth hill. You may ignore air resistance. Which of the following is a true statement?

A. The ball has more energy at the start of its descent than just before it hits the bottom of the hill, because it is higher up at the beginning.

B. The ball has less energy at the start of its descent than just before it hits the bottom of the hill, because it is moving more quickly at the end.

C. The ball has the same energy throughout its descent, because positional energy is converted to energy of motion.

D. The ball has the same energy throughout its descent, because a single object (such as a ball) cannot gain or lose energy.

C. The ball has the same energy throughout its descent, because positional energy is converted to energy of motion.

The principle of Conservation of Energy states that (except in cases of nuclear reaction, when energy may be created or destroyed by conversion to mass), “Energy is neither created nor destroyed, but may be transformed.” Answers (A) and (B) give you a hint in this question—it is true that the ball has more Potential Energy when it is higher, and that it has more Kinetic Energy when it is moving quickly at the bottom of its descent. However, the total sum of all kinds of energy in the ball remains constant, if we neglect ‘losses’ to heat/friction. Note that a single object can and does gain or lose energy when the energy is transferred to or from a different object. Conservation of Energy applies to systems, not to individual objects unless they are isolated. Therefore, the **answer must be (C)**.

93. A long silver bar has a temperature of 50 degrees Celsius at one end and 0 degrees Celsius at the other end. The bar will reach thermal equilibrium (barring outside influence) by the process of heat _____.

A. conduction.

B. convection.

C. radiation.

D. phase change.

A. **conduction**.

Heat conduction is the process of heat transfer via solid contact. The molecules in a warmer region vibrate more rapidly, jostling neighboring molecules and accelerating them. This is the dominant heat transfer process in a solid with no outside influences. Recall, also, that convection is heat transfer by way of fluid currents; radiation is heat transfer via electromagnetic waves; phase change can account for heat transfer in the form of shifts in matter phase. The answer to this question must **therefore be (A)**.

94. _____ are cracks in the plates of the earth's crust, along which the plates move.

A. Faults

B. Ridges

C. Earthquakes

D. Volcanoes

A. Faults.

Faults are cracks in the earth's crust, and when the earth moves, an earthquake results. Faults may lead to mismatched edges of ground, forming ridges, and ground shape may also be determined by volcanoes. The answer to this question must **therefore be (A).**

95. Fossils are usually found in _____ rock.

A. igneous.

B. sedimentary.

C. metamorphic.

D. cumulus.

B. Sedimentary

Fossils are formed by layers of dirt and sand settling around organisms, hardening, and taking an imprint of the organisms. When the organism decays, the hardened imprint is left behind. This is most likely to happen in rocks that form from layers of settling dirt and sand, i.e. sedimentary rock. Note that igneous rock is formed from molten rock from volcanoes (lava), while metamorphic rock can be formed from any rock under very high temperature and pressure changes. 'Cumulus' is a descriptor for clouds, not rocks. The best answer is **therefore (B)**.

96. Which of the following is *not* a common type of acid in 'acid rain' or acidified surface water?

A. Nitric acid.

B. Sulfuric acid.

C. Carbonic acid.

D. Hydrofluoric acid.

D. Hydrofluoric acid.

Acid rain forms predominantly from pollutant oxides in the air (usually nitrogen-based NO_x or sulfur-based SO_x), which become hydrated into their acids (nitric or sulfuric acid). Because of increased levels of carbon dioxide pollution, carbonic acid is also common in acidified surface water environments. Hydrofluoric acid can be found, but it is much less common. In general, carbon, nitrogen, and sulfur are much more prevalent in the environment than fluorine. Therefore, the **answer is (D)**.

97. Which of the following is *not* true about phase change in matter?

A. Solid water and liquid ice can coexist at water's freezing point.

B. At 7 degrees Celsius, water is always in liquid phase.

C. Matter changes phase when enough energy is gained or lost.

D. Different phases of matter are characterized by differences in molecular motion.

B. At 7 degrees Celsius, water is always in liquid phase.

According to the molecular theory of matter, molecular motion determines the 'phase' of the matter, and the energy in the matter determines the speed of molecular motion. Solids have vibrating molecules that are in fixed relative positions; liquids have faster molecular motion than their solid forms, and the molecules may move more freely but must still be in contact with one another; gases have even more energy and more molecular motion. (Other phases, such as plasma, are yet more energetic.) At the 'freezing point' or 'boiling point' of a substance, both relevant phases may be present. For instance, water at zero degrees Celsius may be composed of some liquid and some solid, or all liquid, or all solid. Pressure changes, in addition to temperature changes, can cause phase changes. For example, nitrogen can be liquefied under high pressure, even though its boiling temperature is very low. Therefore, the **correct answer must be (B)**. Water may be a liquid at that temperature, but it may also be a solid, depending on ambient pressure.

98. Which of the following is the longest (largest) unit of geological time?

A. Solar Year.

B. Epoch.

C. Period.

D. Era.

D. **Era**.

Geological time is measured by many units, but the longest unit listed here (and indeed the longest used to describe the biological development of the planet) is the Era. Eras are subdivided into Periods, which are further divided into Epochs. Therefore, the **answer is (D).**

99. Extensive use of antibacterial soap has been found to increase the virulence of certain infections in hospitals. Which of the following might be an explanation for this phenomenon?

A. Antibacterial soaps do not kill viruses.

B. Antibacterial soaps do not incorporate the same antibiotics used as medicine.

C. Antibacterial soaps kill a lot of bacteria, and only the hardiest ones survive to reproduce.

D. Antibacterial soaps can be very drying to the skin.

C. **Antibacterial soaps kill a lot of bacteria, and only the hardiest ones survive to reproduce**.

All of the answer choices in this question are true statements, but the question specifically asks for a cause of increased disease virulence in hospitals. This phenomenon is due to natural selection. The bacteria that can survive contact with antibacterial soap are the strongest ones, and without other bacteria competing for resources, they have more opportunity to flourish. This problem has led to several antibiotic-resistant bacterial diseases in hospitals nation-wide. Therefore, the **answer is (C)**. However, note that answers (A) and (D) may be additional problems with over-reliance on antibacterial products.

100. Which of the following is a correct explanation for astronaut 'weightlessness'?

A. Astronauts continue to feel the pull of gravity in space, but they are so far from planets that the force is small.

B. Astronauts continue to feel the pull of gravity in space, but spacecraft have such powerful engines that those forces dominate, reducing effective weight.

C. Astronauts do not feel the pull of gravity in space, because space is a vacuum.

D. Astronauts do not feel the pull of gravity in space, because black hole forces dominate the force field, reducing their masses.

A. Astronauts continue to feel the pull of gravity in space, but they are so far from planets that the force is small.

Gravity acts over tremendous distances in space (theoretically, infinite distance, though certainly at least as far as any astronaut has traveled). However, gravitational force is inversely proportional to distance squared from a massive body. This means that when an astronaut is in space, s/he is far enough from the center of mass of any planet that the gravitational force is very small, and s/he feels 'weightless'. Space is mostly empty (i.e. vacuum), and there are some black holes, and spacecraft do have powerful engines. However, none of these has the effect attributed to it in the incorrect answer choices (B), (C), or (D). The answer to this question must **therefore be (A).**

101. The theory of 'sea floor spreading' explains _____

A. the shapes of the continents.

B. how continents collide.

C. how continents move apart.

D. how continents sink to become part of the ocean floor.

C. How continents move apart.

In the theory of 'sea floor spreading', the movement of the ocean floor causes continents to spread apart from one another. This occurs because crust plates split apart, and new material is added to the plate edges. This process pulls the continents apart, or may create new separations, and is believed to have caused the formation of the Atlantic Ocean. The **answer is (C)**.

102. Which of the following animals are most likely to live in a tropical rain forest?

A. Reindeer.

B. Monkeys.

C. Puffins.

D. Bears.

B. **Monkeys**.

The tropical rain forest biome is hot and humid, and is very fertile—it is thought to contain almost half of the world's species. Reindeer (A), puffins (C), and bears (D), however, are usually found in much colder climates. There are several species of monkeys that thrive in hot, humid climates, so **answer (B) is correct.**

103. Which of the following is *not* a type of volcano?

A. Shield Volcanoes.

B. Composite Volcanoes.

C. Stratus Volcanoes.

D. Cinder Cone Volcanoes.

C. **Stratus Volcanoes**.

There are three types of volcanoes. Shield volcanoes (A) are associated with non-violent eruptions and repeated lava flow over time. Composite volcanoes (B) are built from both lava flow and layers of ash and cinders. Cinder cone volcanoes (D) are associated with violent eruptions, such that lava is thrown into the air and becomes ash or cinder before falling and accumulating. **'Stratus' (C)** is a type of cloud, not volcano, so it is the correct answer to this question.

104. Which of the following is *not* a property of metalloids?

A. Metalloids are solids at standard temperature and pressure.

B. Metalloids can conduct electricity to a limited extent.

C. Metalloids are found in groups 13 through 17.

D. Metalloids all favor ionic bonding.

D. **Metalloids all favor ionic bonding**.

Metalloids are substances that have characteristics of both metals and nonmetals, including limited conduction of electricity and solid phase at standard temperature and pressure. Metalloids are found in a 'stair-step' pattern from Boron in group 13 through Astatine in group 17. Some metalloids, e.g. Silicon, favor covalent bonding. Others, e.g. Astatine, can bond ionically. Therefore, **the answer is (D).** Recall that metals/nonmetals/metalloids are not strictly defined by Periodic Table group, so their bonding is unlikely to be consistent with one another.

105. Which of these is a true statement about loamy soil?

A. Loamy soil is gritty and porous.

B. Loamy soil is smooth and a good barrier to water.

C. Loamy soil is hostile to microorganisms.

D. Loamy soil is velvety and clumpy.

D. **Loamy soil is velvety and clumpy**.

The three classes of soil by texture are: Sandy (gritty and porous), Clay (smooth, greasy, and most impervious to water), and Loamy (velvety, clumpy, and able to hold water and let water flow through). In addition, loamy soils are often the most fertile soils. Therefore, the **answer must be (D)**.

106. Lithification refers to the process by which unconsolidated sediments are transformed into _____

A. metamorphic rocks.

B. sedimentary rocks.

C. igneous rocks.

D. lithium oxide.

B. **Sedimentary rocks.**

Lithification is the process of sediments coming together to form rocks, i.e. sedimentary rock formation. Metamorphic and igneous rocks are formed via other processes (heat and pressure or volcano, respectively). Lithium oxide shares a word root with 'lithification' but is otherwise unrelated to this question. Therefore, the **answer must be (B)**.

107. Igneous rocks can be classified according to which of the following?

A. Texture.

B. Composition.

C. Formation process.

D. All of the above.

D. **All of the above**.

Igneous rocks, which form from the crystallization of molten lava, are classified according to many of their characteristics, including texture, composition, and how they were formed. Therefore, **the answer is (D).**

108. Which of the following is the most accurate definition of a nonrenewable resource?

A. A nonrenewable resource is never replaced once used.

B. A nonrenewable resource is replaced on a timescale that is very long relative to human life-spans.

C. A nonrenewable resource is a resource that can only be manufactured by humans.

D. A nonrenewable resource is a species that has already become extinct.

B. A nonrenewable resource is replaced on a timescale that is very long relative to human life-spans.

Renewable resources are those that are renewed, or replaced, in time for humans to use more of them. Examples include fast-growing plants, animals, or oxygen gas. (Note that while sunlight is often considered a renewable resource, it is actually a nonrenewable but extremely abundant resource.) Nonrenewable resources are those that renew themselves only on very long timescales, usually geologic timescales. Examples include minerals, metals, or fossil fuels. Therefore, the **correct answer is (B)**.

109. The theory of 'continental drift' is supported by which of the following?

A. The way the shapes of South America and Europe fit together.

B. The way the shapes of Europe and Asia fit together.

C. The way the shapes of South America and Africa fit together.

D. The way the shapes of North America and Antarctica fit together.

C. The way the shapes of South America and Africa fit together.

The theory of 'continental drift' states that many years ago, there was one land mass on the earth ('pangea'). This land mass broke apart via earth crust motion, and the continents drifted apart as separate pieces. This is supported by the shapes of South America and Africa, which seem to fit together like puzzle pieces if you look at a globe. Note that answer choices (A), (B), and (D) give either land masses that do not fit together, or those that are still attached to each other. Therefore, the **answer must be (C)**.

110. When water falls to a cave floor and evaporates, it may deposit calcium carbonate. This process leads to the formation of which of the following?

A. Stalactites.

B. Stalagmites.

C. Fault lines.

D. Sedimentary rocks.

B. **Stalagmites**.

To answer this question, recall the trick to remember the kinds of crystals formed in caves. Stalactites have a 'T' in them, because they form hanging from the ceiling (resembling a 'T'). Stalagmites have an 'M' in them, because they make bumps on the floor (resembling an 'M'). Note that fault lines and sedimentary rocks are irrelevant to this question. Therefore, **the answer must be (B)**.

111. A child has type O blood. Her father has type A blood, and her mother has type B blood. What are the genotypes of the father and mother, respectively?

A. AO and BO.

B. AA and AB.

C. OO and BO.

D. AO and BB.

A. **AO and BO.**

Because O blood is recessive, the child must have inherited two O's—one from each of her parents. Since her father has type A blood, his genotype must be AO; likewise her mother's blood must be BO. Therefore, only **answer (A)** can be correct.

112. Which of the following is the best definition for 'meteorite'?

A. A meteorite is a mineral composed of mica and feldspar.

B. A meteorite is material from outer space, that has struck the earth's surface.

C. A meteorite is an element that has properties of both metals and nonmetals.

D. A meteorite is a very small unit of length measurement.

B. A meteorite is material from outer space, that has struck the earth's surface.

Meteoroids are pieces of matter in space, composed of particles of rock and metal. If a meteoroid travels through the earth's atmosphere, friction causes burning and a "shooting star"—i.e. a meteor. If the meteor strikes the earth's surface, it is known as a meterorite. Note that although the suffix –ite often means a mineral, answer (A) is incorrect. Answer (C) refers to a 'metalloid' rather than a 'meteorite', and answer (D) is simply a misleading pun on 'meter'. Therefore, the **answer is (B)**.

113. A white flower is crossed with a red flower. Which of the following is a sign of incomplete dominance?

A. Pink flowers.

B. Red flowers.

C. White flowers.

D. No flowers.

A. Pink flowers.

Incomplete dominance means that neither the red nor the white gene is strong enough to suppress the other. Therefore both are expressed, leading in this case to the formation of pink flowers. Therefore, the **answer is (A)**.

114. What is the source for most of the United States' drinking water?

A. Desalinated ocean water.

B. Surface water (lakes, streams, mountain runoff).

C. Rainfall into municipal reservoirs.

D. Groundwater.

D. **Groundwater**.

Groundwater currently provides drinking water for 53% of the population of the United States. (Although groundwater is often less polluted than surface water, it can be contaminated and it is very hard to clean once it is polluted. If too much groundwater is used from one area, then the ground may sink or shift, or local salt water may intrude from ocean boundaries.) The other answer choices can be used for drinking water, but they are not the most widely used. Therefore, **the answer is (D**).

115. Which is the correct sequence of insect development?

A. Egg, pupa, larva, adult.

B. Egg, larva, pupa, adult.

C. Egg, adult, larva, pupa.

D. Pupa, egg, larva, adult.

B. **Egg, larva, pupa, adult.**

An insect begins as an egg, hatches into a larva (e.g. caterpillar), forms a pupa (e.g. cocoon), and emerges as an adult (e.g. moth). Therefore, the **answer is (B)**.

116. A wrasse (fish) cleans the teeth of other fish by eating away plaque. This is an example of _____ between the fish.

A. parasitism.

B. symbiosis (mutualism).

C. competition.

D. predation.

B. Symbiosis (mutualism).

When both species benefit from their interaction in their habitat, this is called 'symbiosis', or 'mutualism'. In this example, the wrasse benefits from having a source of food, and the other fish benefit by having healthier teeth. Note that 'parasitism' is when one species benefits at the expense of the other, 'competition' is when two species compete with one another for the same habitat or food, and 'predation' is when one species feeds on another. Therefore, the **answer is (B)**.

117. What is the main obstacle to using nuclear fusion for obtaining electricity?

A. Nuclear fusion produces much more pollution than nuclear fission.

B. There is no obstacle; most power plants us nuclear fusion today.

C. Nuclear fusion requires very high temperature and activation energy.

D. The fuel for nuclear fusion is extremely expensive.

C. Nuclear fusion requires very high temperature and activation energy.

Nuclear fission is the usual process for power generation in nuclear power plants. This is carried out by splitting nuclei to release energy. The sun's energy is generated by nuclear fusion, i.e. combination of smaller nuclei into a larger nucleus. Fusion creates much less radioactive waste, but it requires extremely high temperature and activation energy, so it is not yet feasible for electricity generation. Therefore, the **answer is (C)**.

118. Which of the following is a true statement about radiation exposure and air travel?

A. Air travel exposes humans to radiation, but the level is not significant for most people.

B. Air travel exposes humans to so much radiation that it is recommended as a method of cancer treatment.

C. Air travel does not expose humans to radiation.

D. Air travel may or may not expose humans to radiation, but it has not yet been determined.

A. Air travel exposes humans to radiation, but the level is not significant for most people.

Humans are exposed to background radiation from the ground and in the atmosphere, but these levels are not considered hazardous under most circumstances, and these levels have been studied extensively. Air travel does create more exposure to atmospheric radiation, though this is much less than people usually experience through dental X-rays or other medical treatment. People whose jobs or lifestyles include a great deal of air flight may be at increased risk for certain cancers from excessive radiation exposure. Therefore, the **answer is (A)**.

119. **Which process(es) result(s) in a haploid chromosome number?**

A. Mitosis.

B. Meiosis.

C. Both mitosis and meiosis.

D. Neither mitosis nor meiosis.

B. **Meiosis.**

Meiosis is the division of sex cells. The resulting chromosome number is half the number of parent cells, i.e. a 'haploid chromosome number'. Mitosis, however, is the division of other cells, in which the chromosome number is the same as the parent cell chromosome number. Therefore, the **answer is (B)**.

120. Which of the following is *not* a member of Kingdom Fungi?

A. Mold.

B. Blue-green algae.

C. Mildew.

D. Mushrooms.

B. Blue-green Algae.

Mold (A), mildew (C), and mushrooms (D) are all types of fungus. Blue-green algae, however, is in Kingdom Monera. Therefore, the **answer is (B)**.

121. Which of the following organisms use spores to reproduce?

A. Fish.

B. Flowering plants.

C. Conifers.

D. Ferns.

D. **Ferns.**

Ferns, in Division Pterophyta, reproduce with spores and flagellated sperm. Flowering plants reproduce via seeds, and conifers reproduce via seeds protected in cones (e.g. pinecone). Fish, of course, reproduce sexually. Therefore, the **answer is (D)**.

122. What is the main difference between the 'condensation hypothesis' and the 'tidal hypothesis' for the origin of the solar system?

A. The tidal hypothesis can be tested, but the condensation hypothesis cannot.

B. The tidal hypothesis proposes a near collision of two stars pulling on each other, but the condensation hypothesis proposes condensation of rotating clouds of dust and gas.

C. The tidal hypothesis explains how tides began on planets such as Earth, but the condensation hypothesis explains how water vapor became liquid on Earth.

D. The tidal hypothesis is based on Aristotelian physics, but the condensation hypothesis is based on Newtonian mechanics.

B. The tidal hypothesis proposes a near collision of two stars pulling on each other, but the condensation hypothesis proposes condensation of rotating clouds of dust and gas.

Most scientists believe the 'condensation hypothesis,' i.e. that the solar system began when rotating clouds of dust and gas condensed into the sun and planets. A minority opinion is the 'tidal hypothesis,' i.e. that the sun almost collided with a large star. The large star's gravitational field would have then pulled gases out of the sun; these gases are thought to have begun to orbit the sun and condense into planets. Because both of these hypotheses deal with ancient, unrepeatable events, neither can be tested, eliminating answer (A). Note that both 'tidal' and 'condensation' have additional meanings in physics, but those are not relevant here, eliminating answer (C). Both hypotheses are based on best guesses using modern physics, eliminating answer (D). Therefore, the **answer is (B)**.

123. Which of the following units is *not* a measure of distance?

A. AU (astronomical unit).

B. Light year.

C. Parsec.

D. Lunar year.

D. Lunar year.

Although the terminology is sometimes confusing, it is important to remember that a 'light year' (B) refers to the distance that light can travel in a year. Astronomical Units (AU) (A) also measure distance, and one AU is the distance between the sun and the earth. Parsecs (C) also measure distance, and are used in astronomical measurement- they are very large, and are usually used to measure interstellar distances. A lunar year, or any other kind of year for a planet or moon, is the *time* measure of that body's orbit. Therefore, the answer to this **question is (D)**.

124. The salinity of ocean water is closest to _____ .

A. 0.035 %

B. 0.35 %

C. 3.5 %

D. 35 %

C. 3.5 %

Salinity, or concentration of dissolved salt, can be measured in mass ratio (i.e. mass of salt divided by mass of sea water). For Earth's oceans, the salinity is approximately 3.5 %, or 35 parts per thousand. Note that answers (A) and (D) can be eliminated, because (A) is so dilute as to be hardly saline, while (D) is so concentrated that it would not support ocean life. Therefore, the **answer is (C)**.

125. Which of the following will not change in a chemical reaction?

A. Number of moles of products.

B. Atomic number of one of the reactants.

C. Mass (in grams) of one of the reactants.

D. Rate of reaction.

B. **Atomic number of one of the reactants.**

Atomic number, i.e. the number of protons in a given element, is constant unless involved in a nuclear reaction. Meanwhile, the amounts (measured in moles (A) or in grams(C)) of reactants and products change over the course of a chemical reaction, and the rate of a chemical reaction (D) may change due to internal or external processes. Therefore, the **answer is (B)**.

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