

Essential Facts for Physical Science

Scientific Investigation, Reasoning, and Logic

1. SI (metric) measures, recognized around the world, are a standard way to make measurements.
2. Bar graphs, line graphs, and circle graphs are powerful tools for displaying and interpreting data.
3. To communicate the plan of an experiment accurately, the independent variable, dependent variable, and constants must be explicitly defined.
4. The number of repeated trials needs to be considered in the context of the investigation.
5. Controls are used to establish a standard for comparing the results of manipulating the independent variable.
6. Controls receive no experimental treatment.
7. The analysis of data from a systematic investigation may provide the researcher with a basis to reach a reasonable conclusion.
8. Scientific methodology almost always begins with a question, is based on observation and evidence, and requires logic and reasoning.
9. Not all systematic investigations are experimental.
10. It is important to communicate systematically the design and results of an investigation so that questions, procedures, tools, results, and conclusions can be understood.

Matter

11. Matter is anything that has mass and occupies space.
12. Matter is made up of small particles called atoms.
13. Matter can exist as a solid, liquid, or gas.
14. Matter can be classified as elements, compounds, and mixtures.
15. Matter can be described by its physical properties that include shape, density, solubility, odor, melting point, boiling point, and color.
16. Some physical properties of matter such, as density, boiling point, and solubility are characteristics of a specific substance and do not depend on the size of the sample.
17. Equal volumes of different substances usually have different masses.
18. Matter can be described by its chemical properties that include acidity, basicity, combustibility, and reactivity.
19. A chemical property indicates whether a substance can undergo a chemical change.
20. Atoms of any element are alike but are different from atoms of other elements.
21. The atom is the basic building block of matter and consists of subatomic particles that differ in their location, charge, and relative mass.
22. Atoms and molecules are perpetually in motion.
23. Protons are positively charged particles found in the nucleus of the atom.
24. Neutrons are neutrally charged particles found in the nucleus of the atom.
25. Electrons are electrically charged particles found outside of the nucleus of the atom.
26. The Bohr model is a model used to describe the atom but it does not depict the three dimensional aspect of an atom and it implies that electrons are in static orbits.
27. The electron cloud model better represents our current understanding of the structure of the atom.
28. Compounds may consist of two or more elements that are chemically combined in a fixed ration.
29. Mixtures also consist of two or more substances, but the substances are not chemically combined.
30. Compounds can be classified in several ways including acids, basis, salts, inorganic and organic compounds.
31. Acids make up an important group of compounds that contain hydrogen.
32. Acids release hydrogen ions into solutions. (H⁺)
33. A base is a substance that releases hydroxide ions (OH⁻) into a solution.
34. pH is a measure of the hydrogen ion concentration in a solution.
35. pH ranges from 0-14.
36. pH less than 7 is acidic; solutions with pH greater than 7 are basic; pH of 7 is neutral.
37. When an acid reacts with a base, a salt if formed along with water.
38. No element with an atomic number greater than 92 is found in measurable quantities on earth, and elements combine in many ways to produce compounds that make up all substances of Earth.
39. The periodic table is a tool used to organize information about the elements.
40. The periodic table of elements is an arrangement of elements according to atomic number and properties.

41. The information on the periodic table can be used to predict chemical reactivity.
42. The information within the boxes provides you the atomic symbol, atomic number, atomic mass, state of matter at room temperature and the number of out energy level (valence) electrons.
43. The number of electrons in the outermost energy level determines and element's chemical properties or chemical reactivity.
44. Groups/Families are the vertical columns in the table.
45. Elements are in groups because they have the similar properties because they have the same number of the electrons in their outermost energy level.
46. Periods are the horizontal rows on the table.
47. The periodic table is arranged in increasing order of atomic number.
48. The elements have an increasing nonmetallic character as you read from left to right across the table.
49. Along the stair-step line are the metalloids, which have properties of both metals and nonmetals.
50. Atoms react to form chemically stable substances that are held together by chemical bonds and are represented by chemical formulas.
51. To become chemical stable, atoms lose, gain, or share electrons.
52. Binary compounds are formed when two elements react chemically.
53. When a metallic element reacts with a nonmetallic element, the atoms gain and lose electrons forming ionic bonds.
54. When two nonmetals react, atoms share electrons forming covalent molecular bonds.
55. When matter undergoes physical change, the chemical composition of the substances does not change.
56. When matter undergoes a chemical change, different substances are formed.
57. The Law of Conservation of Matter (Mass) states that regardless of how substances within a closed system are changed, the total mass remains the same.
58. The Law of Conservation of Energy states that energy cannot be created nor destroyed only changed from one form to another.
59. A chemical reaction represents the change that takes place in a chemical reaction.
60. The chemical formulas of the reactants are written on the left; and arrow indicates a change to a new substance; and the chemical formulas of the products are written on the right.
61. Chemical reactions are classified into two broad types: ones in which energy is released (exothermic) and ones in which energy is absorbed (endothermic).
62. Nuclear reactions are another type of chemical reaction in which the energy stored in the nucleus of an atom is released by joining atoms' nuclei together in a process known as Fusion or by splitting atoms' nuclei by Fission.
63. Nuclear reactions produce a large amount of energy but there are potential negative effects of using nuclear energy such as nuclear waster storage and disposal.

Energy

64. Energy is the ability to do work.
65. Energy exists in two states: potential and kinetic energy.
66. Potential energy is energy stored based on position or chemical composition.
67. Kinetic energy is energy of motion. The amount of energy depends on the mass and velocity of the moving object.
68. Forms of energy include light, heat, chemical, electrical, mechanical, and nuclear energy.
69. Sound is form of mechanical energy.
70. Energy can be transformed from one type to another.
71. Energy in the form of heat is one of the by-products of any energy transformation.

Heat

72. Increased temperature means greater average energy of motion (kinetic energy) and most substances expand when heated.
73. The temperature of absolute zero (-273 degrees celcius/0 Kelvin) is the only situation where theoretically there is no atomic/molecular motion.
74. The transfer of heat occurs in three ways: conduction, convection, and by radiation.
75. Heat and temperature are not the same thing. When heat energy is added to or taken away form a system, the temperature does not always change.
76. There is no change in temperature during a phase change (freezing, melting, condensing, boiling, and vaporizing)

Sound

77. Sound is produced by vibrations and is a type of mechanical energy.
78. Sound travels in compression waves and at a speed much slower than light.
79. Sound needs a medium (solid, liquid, or gas) in which to travel.
80. In a compression wave, matter vibrates into the same direction in which the wave travels.
81. All waves exhibit certain characteristics: wavelength, frequency, and amplitude.
82. As wavelength increases, frequency decreases.
83. The speed of sound depends on two things: the medium through which the waves travel, and the temperature of the medium.
84. Reflection and interference patterns are used in ultrasonic technology, including sonar and medical diagnosis.

Light

85. Light travels in straight lines until it strikes an object where it can be reflected, absorbed, or transmitted.
86. As light waves travel through different media, they undergo a change in speed that may result in refraction.
87. Light is a form of radiant energy that moves in transverse waves.
88. Transverse waves move at right angles to the direction the energy travels.
89. There is an inverse proportion between frequency and wavelength.
90. Electromagnetic waves are arranged on the electromagnetic spectrum by wavelength.
91. All types of electromagnetic radiation travel at the speed of light, but differ in wavelength.
92. Radio waves are the lowest energy waves and have the longest wavelength and the lowest frequency.
93. Gamma rays are the highest energy waves and have the shortest wavelength and the highest frequency.
94. Visible light lies in between and makes up only a small portion of the electromagnetic spectrum.

Force and Motion

95. A force is a push or pull.
96. Force is measured in a unit called a Newton.
97. Forces cause objects to move, stop moving, change speed, or change direction.
98. Speed is the change in position of an object per unit of time.
99. Velocity may have a positive or negative value depending on the directions of the change in position, whereas speed always has a positive value and is nondirectional.
100. Newton's three laws describe the motion of all objects.
101. Newton's First Law states that an object in motion will remain at rest or move at a constant speed in a straight line unless it is acted on by an outside force.
102. Newton's Second Law of Motion states that an outside force acting on an object is equated to the mass of the object times its acceleration. ($F=MX A$)
103. Newton's Third Law of Motion states that for every action force, there is an equal and opposite reaction force.
104. Weight is a measure of the force due to gravity acting on a mass.
105. Work is done when an object is moved through a distance in the direction of the applied force.
106. A simple machine is a device that makes work easier.
107. Simple machines have different purposes: to change the effort needed (mechanical advantage), to change the direction or distance to which the force is applied, to change the speed at which the resistance moves, or a combination of these.
108. The work put into a machine is always greater than the work output (due to friction).
109. The ratio of work output to work input is called efficiency.
110. Mathematical formulas are used to calculate speed, force, work, and power.
111. Resistance is a property of matter that affects the flow of electricity and thus some substances are more resistant than others.
112. Friction can cause electrons to be transferred from one object to another.
113. Magnetic fields can produce electrical current in conductors.
114. Electricity can produce a magnetic field and cause iron and steel objects to act like magnets.
115. Electromagnets are temporary magnets that lose their magnetism when the electric current is removed.
116. Both a motor and a generator have magnets or electromagnets and a coil of wire that creates another magnetic field.