

Answers and Explanations

1. **The correct answer is (D).** Photosynthesis is the process used by plants to make food. Sunlight is used as the energy source to convert carbon dioxide and water into glucose.
2. **The correct answer is (B).** The sugar used by plants for energy is created via photosynthesis in the chloroplasts. Mitochondria are the energy generators in animal cells.
3. **The correct answer is (C).** Cellular respiration is the process used by cells to create energy in the form of ATP.
4. **The correct answer is (C).** In prokaryotes, the genetic material is not separated from the remainder of the cell by a membrane, but instead is clustered into the nucleoid region.
5. **The correct answer is (B).** Proteins are made on ribosomes.
6. **The correct answer is (A).** Chromosomes are made up of chromatin, a complex structure of DNA and associated proteins (histones).
7. **The correct answer is (C).** The genetic material is duplicated in the first step of mitosis.
8. **The correct answer is (C).** In mitosis, a cell divides to produce two identical cells with exact copies of the original genetic material. If the parent cell contains M chromosomes, then after mitosis the two daughter cells each contain exactly M chromosomes.
9. **The correct answer is (A).** Cancer cells will continue dividing even when they are in contact with each other, thus exhibiting lack of contact inhibition. Normal cells will stop dividing when they come into contact with each other.
10. **The correct answer is (B).** DNA is transcribed into RNA inside the nucleus. After processing, the RNA is exported into the cytoplasm. Next the mRNA and ribosomes form a complex to translate the genetic code into a polypeptide chain. These polypeptide chains may be further processed in the Golgi apparatus.
11. **The correct answer is (B).** The RNA base triplets code for the same amino acids for all organisms.
12. **The correct answer is (B).** DNA forms a double helix structure. RNA is single-stranded and complementary regions will form hydrogen bonds; however, it does not form a double helix.
13. **The correct answer is (C).** The cross is Aa with aa. There are two possibilities for the offspring, Aa and aa. The plant with the heterozygous trait will donate the A gene 50% of the time, while the plant with the homozygous trait will always donate the a gene.
14. **The correct answer is (A).** The probability that the offspring is homozygous for the recessive traits is $1/4$. The probability that the offspring is homozygous for both recessive traits is found by multiplying the probabilities together. The answer is thus $(1/4) \times (1/4) = (1/16)$.
15. **The correct answer is (D).** This is an example of selective breeding. The frequency of the genes for the phenotype being selected for will be represented in a greater proportion in successive generations.
16. **The correct answer is (C).** This is an example of two genes blending. The red and white genes are each expressed equally with the result that the flowers are pink.
17. **The correct answer is (C).** In order for the child to have the blood type A, the parent with blood type B must have genotype BO.
18. **The correct answer is (C).** Mothers donate one X chromosome to their male offspring. There is a 50% chance she donates the X chromosome that has the gene for the lethal disease.

19. **The correct answer is (A).** Epithelial cells cover the outside of the body and line the internal organs and cavities.
20. **The correct answer is (E).** Nervous tissue consists of cells called neurons and neuroglia located in the brain, spinal cord, and nerves. Nervous tissue produces and conducts nervous impulses.
21. **The correct answer is (D).** Smooth muscle contractions move food along the digestive tract via peristalsis.
22. **The correct answer is (D).** Collagen is a major component of connective tissue.
23. **The correct answer is (A).** All cells contain a complete copy of DNA. Only some of the genes are expressed in the different cell types.
24. **The correct answer is (C).** Radial symmetry describes animals with body equal body parts that radiate out from the center like spokes on a wheel.
25. **The correct answer is (D).** Something with 3 axes of symmetry can be divided into three parts, each of which looks equivalent.
26. **The correct answer is (D).** Caffeine is a stimulant found in coffee.
27. **The correct answer is (B).** Allergies occur when the immune system launches an inflammatory response to environmental antigens.
28. **The correct answer is (A).** In this example, tryptophan acts via a negative feedback loop. When tryptophan is present, the cell does not need to produce more of it. The genes that code for the proteins involved in the production of tryptophan are switched off in the presence of tryptophan.
29. **The correct answer is (E).** Organelles such as mitochondria are components of cells. A collection of similar cells comprises a type of tissue. Tissues make up organs.
30. **The correct answer is (C).** Meiosis is the process responsible for producing ova and sperm cells. Fertilization occurs to form the zygote. The single cell divides and eventually differentiates to form the gastrula stage.
31. **The correct answer is (C).** Blood is filtered through the kidneys and nitrogenous wastes are removed.
32. **The correct answer is (E).** A clone is genetically identical to its parent. It thus shares 100% of its genes with its parent.
33. **The correct answer is (A).** The oxygen in the air inhaled into the lungs is carried by hemoglobin to the tissues. The oxygen is released and the carbon dioxide produced by cellular processes is carried back to the lungs where it is exhaled.
34. **The correct answer is (E).** The immune system produces antibodies to combat foreign invaders such as bacteria and viruses.
35. **The correct answer is (C).** Selective breeding, in which certain traits are specifically selected for, acts to decrease genetic diversity.
36. **The correct answer is (B).** Offspring inherit genes and thus characteristics from their parents. Those offspring with phenotypes best adapted to the environment produce on average a larger number of offspring. In sexual reproduction, offspring are not exact replicas of parents, thus natural evolution can be described as descent with modification.
37. **The correct answer is (C).** Individuals in a population who are best adapted to the environment will tend to produce offspring with a better chance of survival. Their offspring will reproduce on average with a higher success rate. The genes that code for the phenotype that is best suited for the environmental conditions will be represented in a higher percentage in the next generation.
38. **The correct answer is (B).** Race horses are bred for selected characteristics. The breeding is highly regulated and non-random: it is selective.
39. **The correct answer is (A).** The genetic code is universal for all living organisms. The closer the base pair sequence is for a particular gene, the closer two organisms are in the evolutionary tree.

40. **The correct answer is (C).** Genetic diversity is decreased when populations are reduced drastically in size.
41. **The correct answer is (E).** The order of appearance is as follows: marine invertebrates (570 million years ago), land plants (438 million years ago), reptiles (320 million years ago), mammals (208 million years ago).
42. **The correct answer is (B).** The common scientific name uses the genus and species classifications as a shorthand version of the full name.
43. **The correct answer is (D).** The classification scheme is as follows: Kingdom, Subkingdom, Phylum, Subphylum, Class, Subclass, Order, Family, Genus, Species.
44. **The correct answer is (B).** Bacteria inheriting characteristics that allow them to survive and more effectively reproduce is an example of natural selection.
45. **The correct answer is (D).** Rabbits who had an immune system capable of combating the viral invader were able to survive and reproduce. Many of these genes were passed to the offspring. Over many generations the genes that allowed for resistance to this virus were selected for.
46. **The correct answer is (B).** The virus and rabbit populations both undergo an evolutionary process.
47. **The correct answer is (E).** Many fruit-eating birds coevolve with the plants whose fruits they eat. The birds get nourishment, and in the process the plants get their digestion-resistant seeds dispersed along with the birds' droppings.
48. **The correct answer is (E).** Primary producers are the first step in the food chain. These are plants that utilize sunlight to produce sugar via photosynthesis.
49. **The correct answer is (E).** Communities with high levels of diversity are more stable and complex. The increased diversity typically allows these communities to better cope with changes in environmental factors.
50. **The correct answer is (D).** Abiotic factors are non-living factors. Vegetation is living.
51. **The correct answer is (D).** Producers are at the base of the energy pyramid. These producers consist of predominantly green plants that harness the energy from the sun to fuel the process of photosynthesis, which converts carbon dioxide and water into sugar.
52. **The correct answer is (D).** Genetic diversity is related to the number of genes in the gene pool. When only a few types are planted, their genes are overly represented in the gene pool and genetic diversity is decreased.
53. **The correct answer is (C).** Ecosystems are composed of an environment and the community of plants and animals that live there.
54. **The correct answer is (D).** Tropical rainforests contain the highest level of biodiversity, with 50% of all species.
55. **The correct answer is (D).** All of the listed contribute to the extinction of species.
56. **The correct answer is (B).** The brown tree snake is hunting its prey species into extinction and is a super predator.
57. **The correct answer is (A).** Mutualism is a symbiotic interaction between two organisms in which both organisms benefit.
58. **The correct answer is (B).** There is a great deal of energy lost of energy at each level of the energy pyramid: only about 10% of the energy of a producer is transferred to the consumer that eats it.
59. **The correct answer is (E).** A decomposer is an organism that breaks down dead organisms and animal waste products.
60. **The correct answer is (C).** $\text{Velocity} = \text{Initial velocity} \times \text{time}$ when there is no acceleration. This is the equation for a straight line with zero y-intercept.

61. **The correct answer is (C).** The equation for an ideal gas is $PV = nRT$. At constant volume $P = (nR/V)T$. The graph that shows the relationship $y = Cx$ is shown in c.
62. **The correct answer is (A).** The potential energy of a spring is given by the equation $V = 1/2 kx^2$. This is the equation for a parabola represented in graph a.
63. **The correct answer is (D).** There are no attractive forces between particles in an ideal gas. When energy is added, the kinetic energy of the particles increases.
64. **The correct answer is (B).** The equation states energy = mass*the speed of light squared.
65. **The correct answer is (B).** Reactions that occur spontaneously are exothermic. The free energy is negative.
66. **The correct answer is (C).** Enzymes act to lower the activation barrier of chemical reactions.
67. **The correct answer is (C).** Assuming there are no frictional forces, the energy of the system is constant. At the top of the highest point, all of the energy is potential energy.
68. **The correct answer is (D).** The centripetal acceleration is directed along lines from the center of the object to the center of the circle it traces out as it moves.
69. **The correct answer is (B).** Glass is a super cooled liquid, or amorphous solid.
70. **The correct answer is (B).** The addition of salt lowers the freezing/melting point of ice/water. The ice can melt at temperatures at which it was previously frozen.
71. **The correct answer is (D).** Entropy (S) is a measure of how much disorder is in a system.
72. **The correct answer is (B).** When launching a rocket into space, it is necessary to overcome the gravitational pull of the Earth. The minimum velocity necessary for this is called the escape velocity.
73. **The correct answer is (D).** Mechanical energy is conserved. There are no dissipative forces.
74. **The correct answer is (C).** Nuclei are made up of protons and neutrons. There is one isotope of hydrogen that contains a single proton and no neutrons.
75. **The correct answer is (B).** The number of protons in a nucleus determines what element an atom is. An isotope contains the same number of protons and different numbers of neutrons.
76. **The correct answer is (E).** Ionization energy increases across rows in the periodic table.
77. **The correct answer is (A).** An alpha particle is a helium nucleus ${}^4_2\text{He}$, thus both the atomic mass and number decrease.
78. **The correct answer is (B).** Metals are the best conductors of electricity. The only metal in the list is copper.
79. **The correct answer is (C).** An alpha particle is emitted.
80. **The correct answer is (D).** When an element undergoes beta decay, it emits an electron and a neutron is converted to a proton in the nucleus. The atomic weight remains the same but the atomic mass increases by one.
81. **The correct answer is (C).** Gamma rays are high-frequency electromagnetic waves.
82. **The correct answer is (B).** Electronegativity is the measure of how much an atom attracts electrons.
83. **The correct answer is (D).** Sodium chloride is a salt and has an ionic bond.
84. **The correct answer is (A).** Each carbon chlorine bond is polar. The molecule overall is tetrahedral and is thus not polar.
85. **The correct answer is (D).** HCl is an acid and NaOH is a base. When the two are combined, a neutralization reaction takes place.

86. **The correct answer is (C).** The C-C bond is a pure covalent bond. The remaining bonds increase in polarity with the trend in electronegativity, thus C-H then C-Cl and C-F.
87. **The correct answer is (C).** Butane is the only compound to have structural isomers in this list.
88. **The correct answer is (C).** Chlorine has an oxidation state of +7 in HClO_4 .
89. **The correct answer is (B).** Sodium metal produces the most exothermic reaction with water.
90. **The correct answer is (B).** The triple bond in N_2 has the most energy.
91. **The correct answer is (A).** The atom that loses electrons is oxidized and the atom that gains electrons is reduced. The Zn is oxidized and the Cu is reduced.
92. **The correct answer is (D).** Each oxygen has an oxidation state of -2, the chromium must have an oxidation state of +6 for the total charge of the system to add to -2.
93. **The correct answer is (C).** The double helix is maintained by hydrogen bonds between the base pairs A-T, and G-C.
94. **The correct answer is (D).** The alkali metals react vigorously with water. The reaction increases in intensity as one goes down the periodic table.
95. **The correct answer is (D).** The four gaseous planets are Jupiter, Saturn, Uranus and Neptune.
96. **The correct answer is (B).** Pluto has the most elliptical orbit about the sun.
97. **The correct answer is (E).** A day is defined by how long it takes for one revolution of a planet about its axis.
98. **The correct answer is (A).** Mercury and Venus do not have any moons.
99. **The correct answer is (C).** Hydrogen and helium undergo nuclear fusion reactions in stars to form the other elements.
100. **The correct answer is (B).** A comet is a frozen mass of gas and dust with a definite orbit through the solar system.
101. **The correct answer is (A).** A black hole is named as such because light cannot escape its gravitational pull.
102. **The correct answer is (B).** Nuclear fusion occurs in the sun's core. The reaction converts 4 hydrogen nuclei into a helium nucleus.
103. **The correct answer is (B).** Nuclear fusion occurs in the sun's core. The reaction converts 4 hydrogen nuclei into a helium nucleus.
104. **The correct answer is (C).** The relationship is an inverse relationship. The formula is $f \cdot w = c$. Therefore, f is proportional to $1/w$.
105. **The correct answer is (A).** Sound travels at different speeds in different media. The speed of sound is faster in steel than air.
106. **The correct answer is (B).** Magnetic monopoles do not exist.
107. **The correct answer is (B).** The sky appears blue as a result of Rayleigh scattering. Light is scattered by particles smaller than the wavelength of light. Blue photons are scattered more across the sky so one sees blue light from all directions.
108. **The correct answer is (B).** The plants in the tropical rain forest produce oxygen as a by-product of photosynthesis, and are the main producers of all the earth's oxygen.
109. **The correct answer is (C).** The troposphere extends from the surface of the earth to 5-9 miles high. This is where weather occurs.
110. **The correct answer is (B).** The two major components of the atmosphere are nitrogen (78%) and oxygen (21%).

- 111. The correct answer is (B).** Heated objects emit long-wavelength, infrared radiation. Carbon dioxide is able to absorb radiation of this wavelength. An increase in carbon dioxide in the atmosphere will result in more infrared radiation being trapped in the atmosphere with the result of an increase in temperature.
- 112. The correct answer is (D).** Erosion the process by which the surface of the earth is worn away by water or wind.
- 113. The correct answer is (C).** All the earth's continents were connected into one large continent called Pangea surrounded by one large ocean called Panthalassa. Approximately 180 million years ago, Pangea split apart into two continents called Laurasia and Gondwanaland.
- 114. The correct answer is (E).** The earth spins about its axis. The centripetal forces are greatest where the diameter is greatest, which causes the center to bulge and the poles to flatten.
- 115. The correct answer is (B).** The first life forms were photosynthetic plants. In the process of photosynthesis water and carbon dioxide are consumed and glucose and molecular oxygen are created.
- 116. The correct answer is (D).** The bonds in ozone are able to absorb radiation with frequencies in the ultraviolet region of the electromagnetic spectrum. It would not be possible for life to exist on Earth if the majority of UV radiation were able to penetrate to the earth's surface.
- 117. The correct answer is (D).** The outermost layer of the earth's surface is the crust. It floats on top of the mantle.
- 118. The correct answer is (C).** When two tectonic plates move away from each other, a gap is created. This gap is filled with lava, which forms the new oceanic crust.
- 119. The correct answer is (B).** The nutrients in commercial fertilizers are in the form of ionic salts that are very water-soluble compared to the bio-organic compounds in compost.
- 120. The correct answer is (B).** Igneous rock is formed when molten magma cools.