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Exam

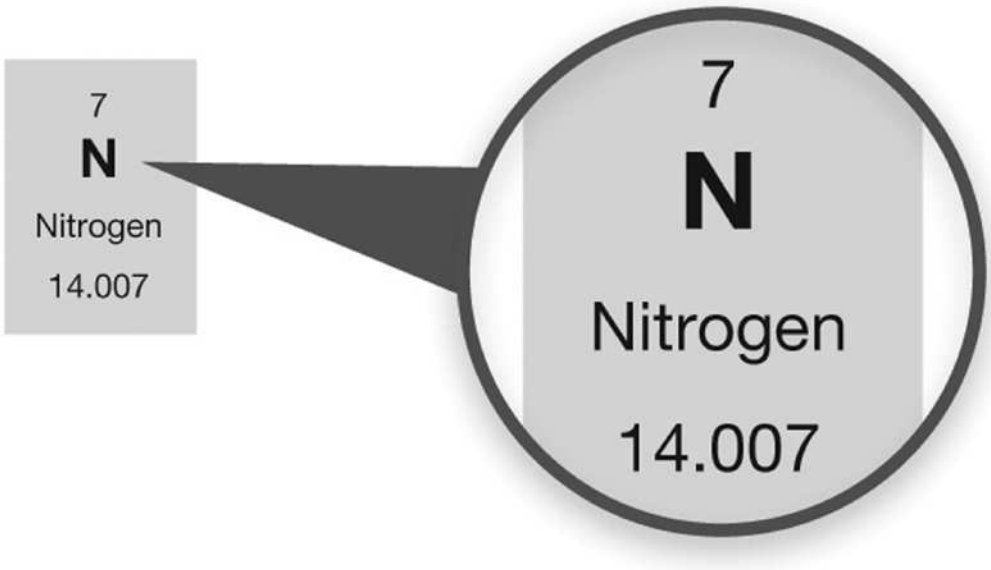
Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) An atom is best described as 1) _____
A) defined by its atomic mass.
B) always containing an equal number of protons and neutrons.
C) defined by its number of electrons.
D) having a nucleus containing protons and electrons.
E) the smallest unit of an element.

2) Which particle is described incorrectly? 2) _____
A) Electron: Negatively charged and negligible mass
B) Proton: Found in shells orbiting the nucleus
C) Neutron: Found in the nucleus and 1 atomic mass unit
D) Proton: Positively charged and 1 atomic mass unit
E) Electron: Found in shells orbiting the nucleus

3) What information can you determine about the element nitrogen from the periodic table entry show 3) _____



A) The atomic number for nitrogen is 14.007 and there are 14 neutrons in the nucleus of a nitrogen atom.
B) The atomic number for nitrogen is 14.007.
C) There are 14 neutrons in the nucleus of a nitrogen atom.
D) The atomic number for nitrogen is 7.
E) The atomic number for nitrogen is 7 and there are 14 neutrons in the nucleus of a nitrogen atom.

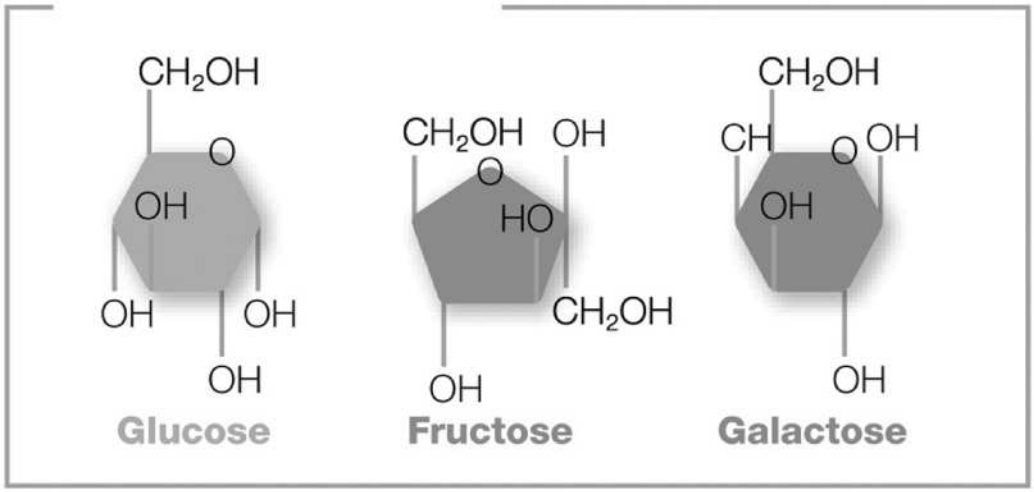
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4) An anion is formed when 4) _____
A) an atom has an equal number of positively-charged protons and negatively-charged electrons.
B) an atom gains one or more negatively-charged electrons.
C) an atom loses one or more positively-charged protons.
D) an atom loses one or more negatively-charged electrons.
E) an atom gains one or more positively-charged protons.

5) Isotopes are atoms of the same element that differ in 5) _____
A) the number of protons found in the nucleus.
B) the number of protons and neutrons found in the nucleus.
C) the number of neutrons found in the nucleus.
D) the number of protons and electrons found in the atom.
E) the number of electrons orbiting the nucleus.

6) A feature of many of the isotopes that are used in the field of medicine is that the isotopes are radioactive. What does this mean? 6) _____
A) Cationic forms of the atom are used.
B) The same number of atoms are arranged into different molecular structures.
C) The nucleus of the isotope is unstable and breaks down over time.
D) Anionic forms of the atoms are used.
E) The atoms with the greatest atomic mass are used.

7) The pictured molecules both contain six carbon atoms, twelve hydrogen atoms, and six oxygen atoms ($C_6H_{12}O_6$). However, these atoms are arranged differently in each molecule. What are these molecules called? 7) _____



A) anions
B) functional groups
C) isomers
D) R groups
E) isotopes

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8) Which of the following is an organic compound? 8) _____

A) ethanol (C_2H_6O)

B) ethanol (C_2H_6O) and methane (CH_4)

C) carbon dioxide (CO_2)

D) carbon dioxide (CO_2), ethanol (C_2H_6O), and methane (CH_4)

E) methane (CH_4)

9) Which functional group is incorrectly matched with its structure? 9) _____

A) alcohol: R–OH

B) phosphate: R–PO_4^{2-}

C) ether: R–CH_3

D) carboxyl: R–COOH

E) amino: R–NH_2

10) Which of the following is incorrectly matched? 10) _____

A) Base: Release hydroxide ions (OH^-) in an aqueous solution

B) Acid: Release hydrogen ions (H^+) in an aqueous solution

C) Salt: Formed by the combination of hydrogen ions (H^+) and hydroxide ions (OH^-)

D) pH: Measure of the acidity or basicity of a solution

E) Water: Is the solvent in aqueous solutions

11) Pure water is defined by 11) _____

A) a neutral pH of 7.

B) a neutral pH of 7, and equal number of H^+ and OH^- ions, and its ability to serve as a pH buffer in solutions.

C) its ability to serve as a pH buffer in solutions.

D) a neutral pH of 7 and an equal number of H^+ and OH^- ions.

E) an equal number of H^+ and OH^- ions.

12) Compared to a solution with a pH value of 4, a solution with a pH value of 2 has _____ H^+ ions. 12) _____

A) twice as many

B) the same number of

C) one hundred times as many

D) one hundred times fewer

E) half as many

13) A compound which stabilizes pH by absorbing or releasing H+ ions is called a(n) 13) _____

A) salt. B) solute. C) base. D) acid. E) buffer.

14) Which statement is true about valence electrons? 14) _____

A) Interactions between valence electrons in reacting atoms determine what kind of chemical bond is formed.

B) Valence electrons participate in chemical reactions.

C) Valence electrons participate in chemical reactions, and interactions between valence electrons in reacting atoms determine what kind of chemical bond is formed.

D) Valence electrons are found in the innermost shell.

E) Valence electrons are found in the innermost shell and participate in chemical reactions.

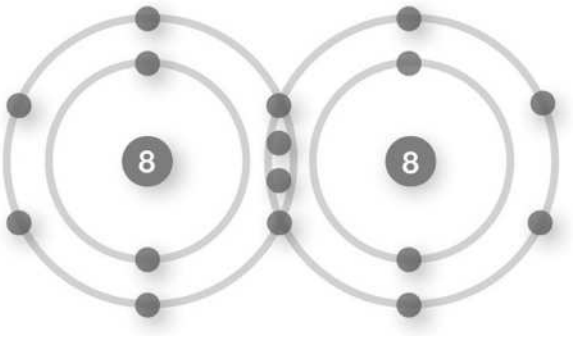
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15) Ionic bonds 15) _____

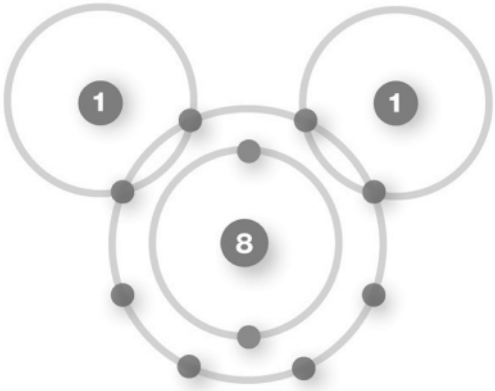
A) form when electrons are transferred from atom to another and only exist as ions in solution.
B) only exist as ions in solution.
C) are electrostatic forces of attraction between oppositely charged ions.
D) form when electrons are transferred from atom to another.
E) are electrostatic forces of attraction between oppositely charged ions and form when electrons are transferred from atom to another.

16) Which of the following shows an ionic bond? 16) _____

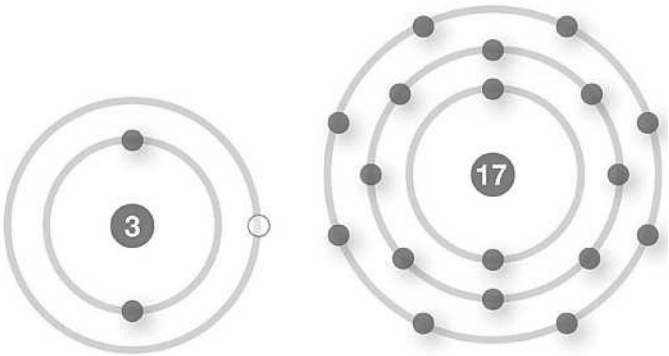
A)



B)

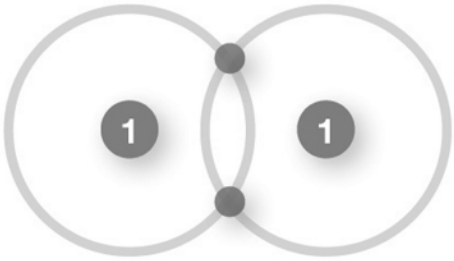


C)

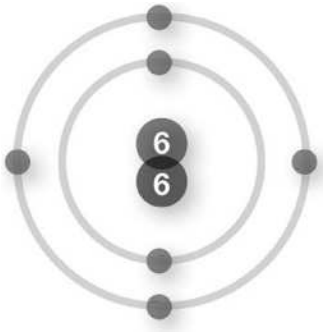


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D)



E)



17) Electrolytes 17) _____

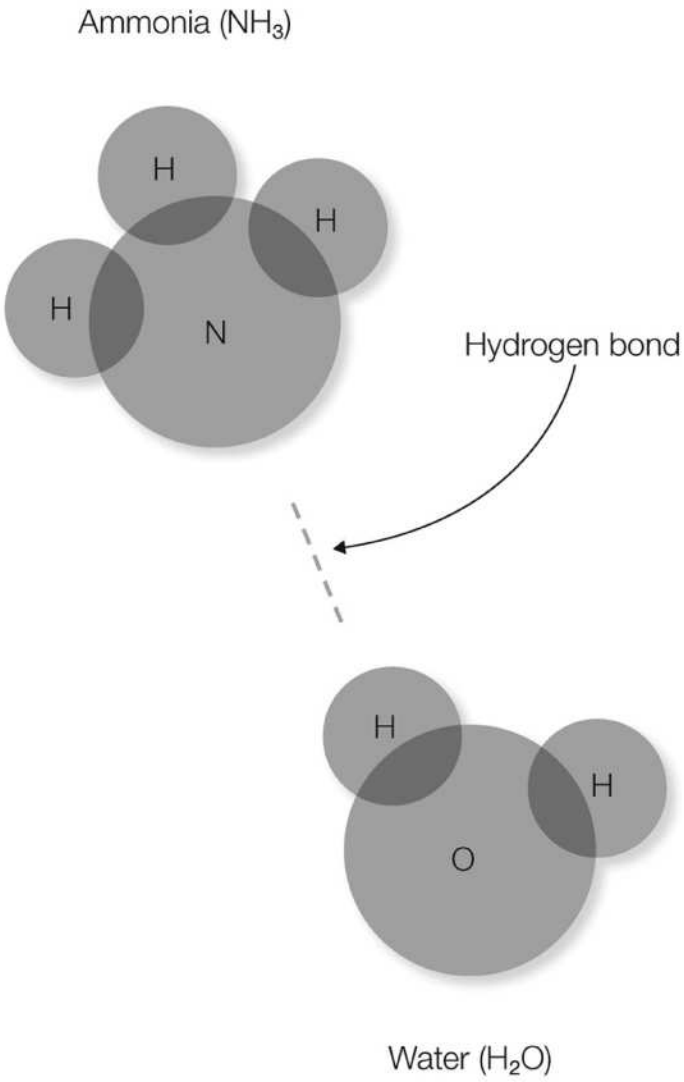
A) include acids, bases, and salts, are ionic compounds dissolved in solution and are involved in regulating the nervous system, heartbeat, blood volume and water balance in the body.
B) are involved in regulating the nervous system, heartbeat, blood volume and water balance in the body.
C) are ionic compounds dissolved in solution.
D) are ionic compounds dissolved in solution and are involved in regulating the nervous system, heartbeat, blood volume and water balance in the body.
E) include acids, bases, and salts.

18) In a polar covalent bond, 18) _____

A) electrons are shared equally between two atoms.
B) electrons are shared unequally between more than two atoms.
C) electrons are shared unequally between two atoms.
D) an acid and a base neutralize each other to form a salt.
E) electrons are transferred from one atom to another.

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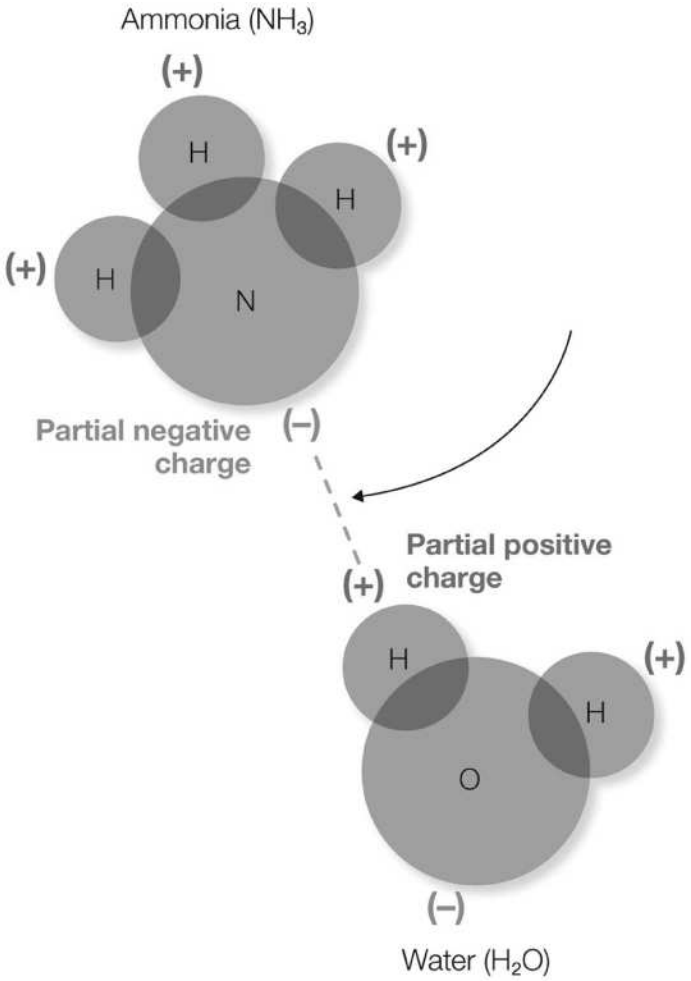
19) In the figure shown, which atom(s) will have a partial negative charge? 19) _____



A) nitrogen and oxygen
B) nitrogen
C) oxygen
D) hydrogen and oxygen
E) hydrogen

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20) In the figure shown, what does the dotted line represent? 20) _____



A) an interaction between a hydrophilic and a hydrophobic molecule
B) sharing of electrons between the ammonia and water molecules
C) transfer of the electron from the hydrogen atom to the nitrogen atom
D) an electrostatic interaction between the partially-positive hydrogen and the partially-negative nitrogen
E) a Van der Waals interaction

21) Hydrogen bonds 21) _____

A) are involved in stabilizing the structure of proteins and nucleic acids and form whenever hydrogen is involved in any covalent or ionic bond.
B) are responsible for the unique properties of water and are involved in stabilizing the structure of proteins and nucleic acids.
C) are involved in stabilizing the structure of proteins and nucleic acids.
D) are responsible for the unique properties of water.
E) form whenever hydrogen is involved in any covalent or ionic bond.

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22) Van der Waals interactions 22) _____
A) are stronger than either hydrogen bonds or ionic bonds.
B) are responsible for the repulsion between hydrophilic and hydrophobic compounds.
C) exhibit a force of repulsion that serves to destabilize molecules.
D) occur when temporary dipoles within molecules form that are not the result of hydrogen bond to O, N, or F atoms.
E) are another name for hydrogen bonds.

23) Which term is incorrectly matched to its description? 23) _____
A) Hydrophilic: Substances which readily dissolve in water AND hydrophobic: substances which are not readily dissolved in water are both incorrectly matched.
B) Amphipathic: Has properties that are neither hydrophilic nor hydrophobic
C) Hydrophilic: Substances which readily dissolve in water
D) Amphipathic: Has properties that are neither hydrophilic nor hydrophobic; hydrophilic: substances which readily dissolve in water; AND hydrophobic: substances which are not readily dissolved in water are all incorrectly matched
E) Hydrophobic: Substances which are not readily dissolved in water

24) A micelle is formed of 24) _____
A) amphipathic molecules where the hydrophilic portion faces toward the center.
B) both hydrophilic and hydrophobic molecules.
C) hydrophobic molecules only.
D) amphipathic molecules where the hydrophobic portion faces toward the center.
E) hydrophilic molecules only.

25) Plasma membranes, the key boundary layer of cells, are composed of amphipathic molecules called phospholipids. Why would neither purely hydrophilic nor purely hydrophobic molecules be a suitable molecule for plasma membranes? 25) _____
A) Hydrophilic molecules would dissolve in the aqueous environment in which cells live, disrupting the structural integrity of the cell, and hydrophobic molecules would be unable to interact with the aqueous environment in which cells live.
B) Hydrophobic molecules would be unable to interact with the aqueous environment in which cells live.
C) Both hydrophilic and hydrophobic molecules would dissolve in the aqueous environment in which cells live, disrupting the structural integrity of the cell.
D) Hydrophobic molecules would dissolve in the aqueous environment in which cells live, disrupting the structural integrity of the cell, while hydrophilic molecules could not interact.
E) Hydrophilic molecules would dissolve in the aqueous environment in which cells live, disrupting the structural integrity of the cell.

26) Consider the reaction AB → A + B. What is the product of this reaction? 26) _____
A) A
B) B
C) AB
D) A and B
E) A, B, and AB

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27) Which reaction has X and Y as reactants? 27) _____

A) $XY \rightarrow X + Y$

B) $XY + AB \rightarrow XB + AY$

C) $XY + W \rightarrow WY + X$

D) $X + YZ \rightarrow Y + XZ$

E) $X + Y \rightarrow XY$

28) Which statement does **not** describe a catalyst? 28) _____

A) A catalyst may be an inorganic substance.
B) A catalyst is not used up in the reaction.
C) A catalyst may be an organic substance.
D) A catalyst will increase the rate of a reaction.
E) A catalyst will decrease the rate of a reaction.

29) Which reaction is incorrectly matched with its name? 29) _____

A) Single exchange: $AB + C \rightarrow AC + B$

B) Decomposition: $AB \rightarrow A + B$

C) Hydrolysis: $A + B \rightarrow AB + H_2O$

D) Synthesis: $A + B \rightarrow AB$

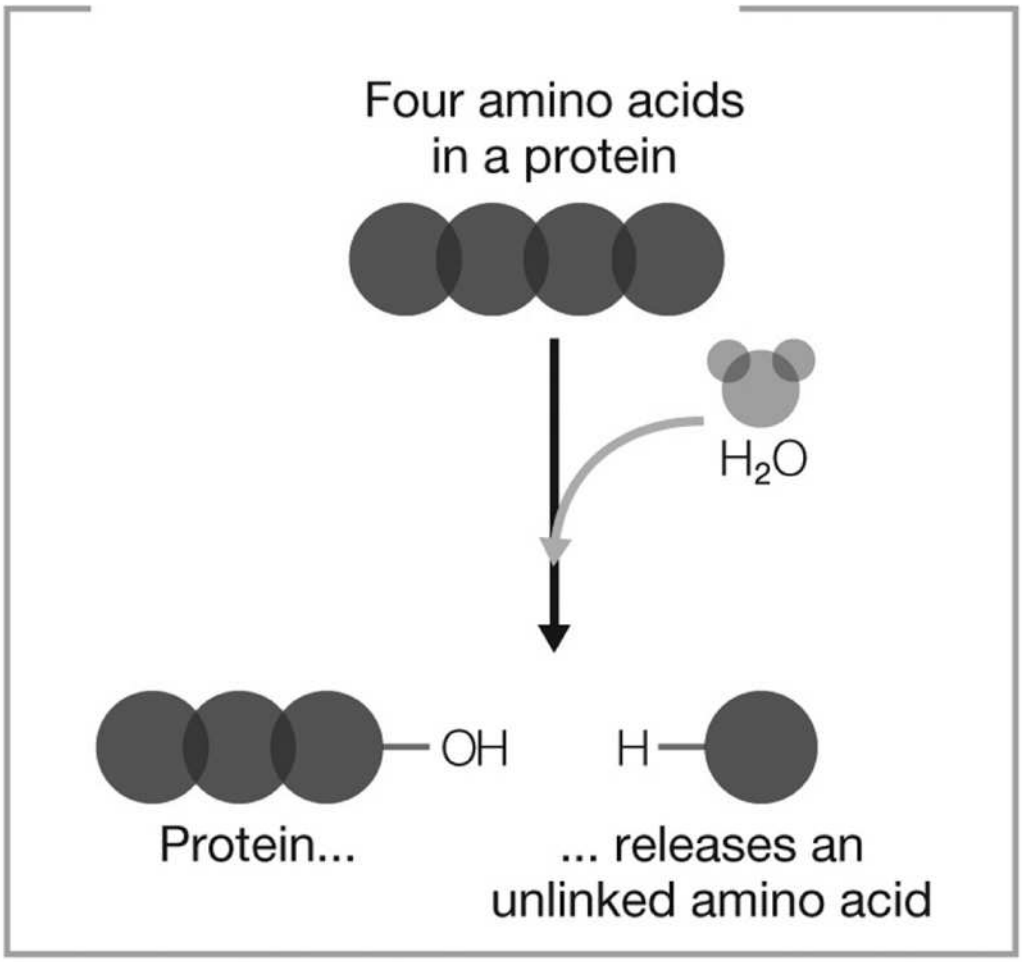
E) Double exchange: $AB + CD \rightarrow AD + CB$

30) In a dehydration synthesis reaction, macromolecules are built when _____ is removed to form a covalent bond. 30) _____

A) carbon dioxide
B) an electron
C) oxygen
D) water
E) an amino acid

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31) What type of reaction does the figure show? 31) _____



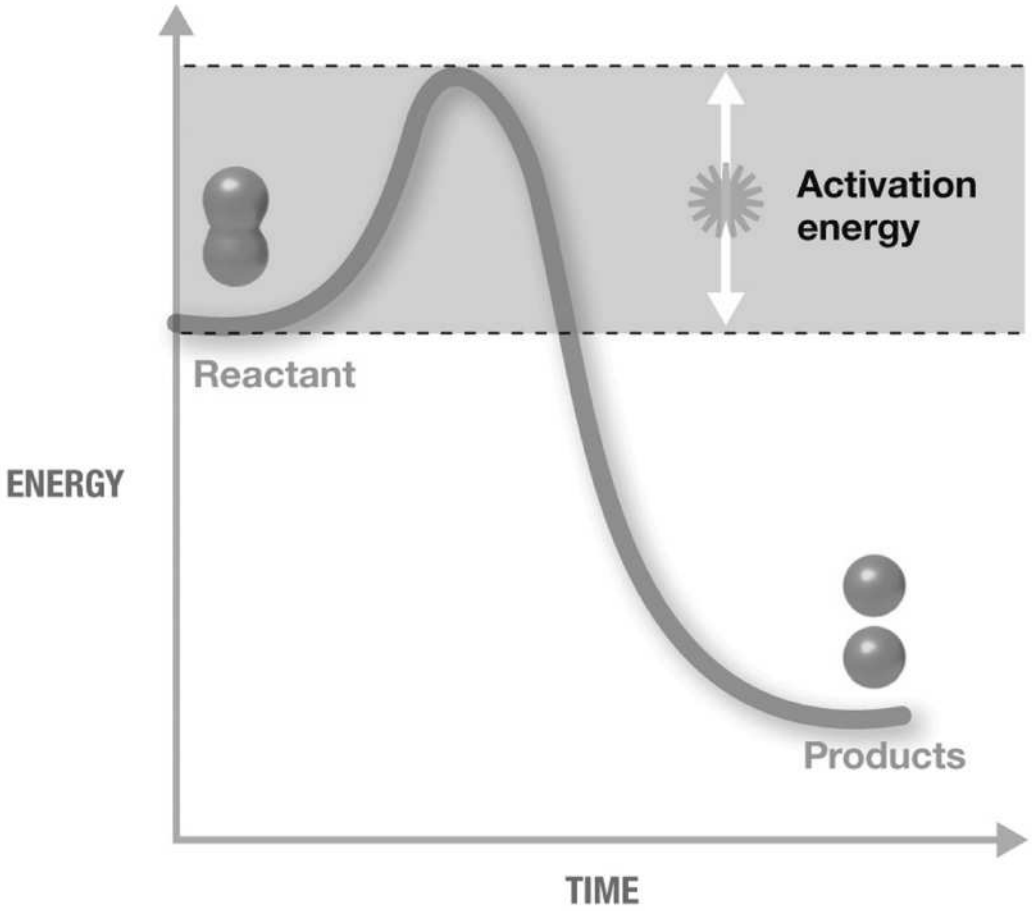
A) decomposition
B) dehydration synthesis and hydrolysis
C) hydrolysis
D) decomposition and hydrolysis
E) dehydration synthesis

32) Activation energy 32) _____

A) is the minimum amount of energy needed to get a reaction started and is due to the necessity of collisions between reactants which have enough energy and with the reactants properly oriented.
B) is the minimum amount of energy needed to get a reaction started.
C) is due to the necessity of collisions between reactants which have enough energy and with the reactants properly oriented.
D) can be lowered by catalysts such as enzymes in biochemical reactions.
E) is the minimum amount of energy needed to get a reaction started and is due to the necessity of collisions between reactants which have enough energy and with the reactants properly oriented and can be lowered by catalysts such as enzymes in biochemical reactions.

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33) The figure shown is an exergonic reaction because 33) _____



A) it is a decomposition reaction and the products have a lower final energy than the reactants.
B) it is a decomposition reaction.
C) activation energy was required and the products have a lower final energy than the reactants.
D) the products have a lower final energy than the reactants.
E) activation energy was required.

34) Which of the following does **not** describe equilibrium? 34) _____

A) when there is an equal amount of products and reactants and a reaction has stopped
B) A forward and reverse reaction occur at the same rate.
C) The total amount of products and reactants is no longer changing.
D) A reaction has stopped.
E) when there is an equal amount of products and reactants

35) Which of the following is **not** one of the four main groups of biomolecules? 35) _____

A) lipids
B) proteins
C) nucleic acids
D) electrolytes
E) carbohydrates

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36) Which of the biomolecules is incorrectly matched with its building block? 36) _____
A) Nucleic acid: Nucleotide
B) Carbohydrate: Polysaccharide
C) Lipid: Fatty acid
D) Protein: Amino acid
E) Lipid: Glycerol

37) The type of bond which links the amino group of one amino acid to the carboxyl group of another amino acid is called a(n) 37) _____
A) peptide bond.
B) phosphodiester bond.
C) glycerol bond.
D) glycosidic bond.
E) amino bond.

38) Which statement is true about carbohydrates? 38) _____
A) They are usually hydrophobic.
B) They are a component of the cell wall of different types of organisms.
C) They maybe saturated or unsaturated.
D) They consist of simple sugars which contain carbon, hydrogen, and oxygen in a 2: 1: 2 ratio.
E) They have primary, secondary, tertiary, and quaternary structure.

39) Which type of lipid is incorrectly matched to its description? 39) _____
A) Mono–, di–, or triglyceride: One, two, or three fatty acids linked to a glycerol molecule
B) Wax: Refers to any lipid which is solid at room temperature
C) Glycolipid: A lipid linked to a carbohydrate
D) Steroid: Made of four fused hydrocarbon rings
E) Phospholipid: An amphipathic lipid found in the plasma membrane of cells

40) Deoxyribonucleotides and ribonucleotides differ in all of the following **except** 40) _____
A) the nitrogenous base thymine is only found in deoxyribonucleotides while the nitrogenous base uracil is only found in ribonucleotides.
B) the sugar is different in the two types of nucleotides.
C) phosphodiester bonds can only form between deoxyribonucleotides, not ribonucleotides.
D) deoxyribonucleotides are found in DNA while ribonucleotides are found in RNA.
E) ribonucleotides can serve as energy molecules while deoxyribonucleotides do not.

41) Plasma membranes must be in a fluid (liquid) state in order to function properly. Fluidity is temperature–dependent. Bacteria can regulate the specific lipid composition of their plasma membranes. Which of the following statements is true? 41) _____
A) The proportion of saturated lipids in the plasma membrane will increase with both cooler and warmer growth temperatures.
B) The proportion of unsaturated lipids in the plasma membrane will increase with cooler growth temperatures.
C) The proportion of saturated lipids in the plasma membrane will increase with cooler growth temperatures while the proportion of unsaturated lipids will increase with warmer growth temperatures.
D) The proportion of unsaturated lipids in the plasma membrane will increase with warmer growth temperatures.
E) The proportion of saturated lipids in the plasma membrane will increase with cooler growth temperatures.

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42) The primary structure of a protein 42) _____
A) is the linear sequence of amino acids which are held together by peptide bonds and is dictated by genetic sequence and is unique to that protein and lays the foundation for all higher order structure of that protein.
B) is the linear sequence of amino acids which are held together by peptide bonds.
C) is the linear sequence of amino acids which are held together by peptide bonds and is dictated by genetic sequence.
D) is dictated by a genetic sequence.
E) is unique to that protein and lays the foundation for all higher order structure of that protein.

43) Which level of protein structure can involve hydrogen bonds? 43) _____
A) primary
B) secondary
C) tertiary
D) primary and secondary
E) secondary and tertiary

44) In the human genetic disease sickle cell anemia, a single change in the genetic sequence of the hemoglobin–beta gene results in the amino acid valine being substituted for the amino acid glutamic acid in the beta chain of the hemoglobin protein. Which level(s) of the protein structure will be affected? 44) _____
A) primary structure
B) secondary structure
C) tertiary structure
D) quaternary structure
E) primary, secondary, tertiary, and quaternary structures

45) Chaperone proteins 45) _____
A) escort proteins to the location in a cell where they are needed.
B) ensure that a protein is folded correctly.
C) ensure that DNA molecules form double–stranded helices.
D) cleave a phosphate from ATP to release energy.
E) ensure that amino acids are placed in the correct order when forming a protein.

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

46) A cation forms when an atom loses one or more negatively–charged electrons. 46) _____

47) Water (H_2O) and carbon dioxide (CO_2) are both molecules and compounds. 47) _____

48) A molecule of glucose contains six carbon atoms, twelve hydrogen atoms, and six oxygen atoms. The proper way to write the molecular formula for glucose is $^{6}C^{12}H^{6}O$. 48) _____

49) Acids increase the H^+ concentration in a solution and so lower pH. 49) _____

50) Blood pH is stabilized by carbonic acid (H_2CO_3) which releases H^+ ions to lower pH and bicarbonate (HCO_3^-) which absorbs H^+ ions to raise pH. 50) _____

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51) During vigorous exercise, both carbon dioxide and lactic acid enter the blood in increased amounts. Both compounds have the effect of lowering the blood pH. In order to maintain blood pH within the normal range of 7.35–7.45, we would expect the carbonic acid (H_2CO_3) portion of the blood buffer system to pick up the extra H^+ ions. 51) _____

52) In a polar covalent bond involving hydrogen and oxygen, the hydrogen takes on a partial negative charge while the oxygen takes on a partial positive charge. 52) _____

53) Endergonic reactions make products with a lower final energy than the reactants and use more energy than is released. 53) _____

54) A reversible reaction is one in which the forward and reversible reactions are both possible such as: AB → A + B and A + B → AB. 54) _____

55) A phosphodiester bond links a fatty acid to a glycerol molecule to form a fat or an oil. 55) _____

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

56) Describe the relationship between acids, bases, salts, and water, and explain how the pH scale is used to measure acidity and basicity.

57) Compare and contrast ionic bonds, covalent bonds, polar covalent bonds, and hydrogen bonds. Explain how valence electrons are involved in the formation of each.

58) Vitamin deficiencies (not getting enough of a certain vitamin) pose obvious health problems, but an excess of certain vitamins in the system can also be harmful. Explain why you would be far less likely to experience an excess of water–soluble vitamins compared to fat–soluble vitamins in the context of the characteristics of polar and nonpolar substances.

59) List the four types of biomolecules. For each type, name the monomer building block, the type of chemical bond which joins the building block, and give two functions, naming a specific example where appropriate.

60) List and describe the four levels of protein structure. Explain how the levels of structure are dependent on each other and describe what types of molecular interactions are involved.

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1) E
2) B
3) D
4) B
5) C
6) C
7) C
8) B
9) C
10) C
11) D
12) C
13) E
14) C
15) E
16) C
17) A
18) C
19) A
20) D
21) B
22) D
23) B
24) D
25) A
26) D
27) E
28) E
29) C
30) D
31) D
32) E
33) D
34) A
35) D
36) B
37) A
38) B
39) B
40) C
41) B
42) A
43) E
44) E
45) B
46) TRUE
47) TRUE
48) FALSE
49) TRUE
50) TRUE

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51) FALSE
52) FALSE
53) FALSE
54) TRUE
55) FALSE
56) Acids are substances that increase the concentration of hydrogen ions (H^+) when dissolved in water. Bases are substances that increase the concentration of hydroxide ions (OH^-) when dissolved in water. When an acid and a base are mixed, the result is a salt and water. For example: hydrogen chloride + sodium hydroxide → sodium chloride and water or HCl + NaOH→ NaCl + H_2O. The pH scale measures the amount of H^+ ions in an aqueous solution. Neutral pH is defined as 7.0 where the amount of H^+ ions and OH^- ions are equal; this is the pH of pure water. Acids lower pH values; values below 7 are considered acidic and lower numbers are more acidic than higher numbers. Bases raise pH value; values above 7 are considered basic and higher numbers are more basic than lower numbers. The pH scale is a logarithmic scale, so each whole number step pH represents a tenfold change in acidity or basicity.
57) Chemical bonds form between two atoms to form molecules. Chemical bonds form by the action of the valence electron found in the outer shell of each atom. Atoms combine in a way to achieve full valence shells which is the most stable configuration for atoms.
Ionic bonds are electrostatic forces of attraction between a cation and an anion. These bonds form when one or more val electrons are transferred from one atom to another. The receiving atom becomes the negatively–charged anion while the donating atom becomes the positively–charged cation. Covalent bonds are electrostatic forces of attraction between atoms that share one or more pairs of valence electrons. The two atoms may share the paired electrons equally or symmetrically in which case the covalent bond is referred to as nonpolar. Conversely, the shared valence electron pair may spend more time orbiting one of the atoms in the pair than the other. This causes the first atom to acquire a partial negative charge while the other acquires a partial positive charge. In this case, the covalent bond is said to be polar.
Hydrogen bonds are not really bonds but are noncovalent electrostatic interactions between atoms in two different molecules or within the same, large molecules. Hydrogen bonds form because of the partial negative or positive charges that occur on polar molecules. In particular, when hydrogen is bonded to either oxygen or nitrogen, the hydrogen becomes partially–positively charged, while the oxygen or nitrogen is becomes partially–negatively charged. The attraction of the oppositely charged atoms forms the hydrogen bond.
58) Water–soluble vitamins are polar molecules which dissolve in water (hydrophilic). They are easily excreted from the body in the urine, and therefore are unlikely to build up to toxic levels. Fat–soluble vitamins are non–polar. They do not dissolve in water (hydrophobic) and so are not easily excreted in urine. Instead they are stored in fat, where it is possible for them to build up to unsafe levels if an excess amount is ingested over a period of time.

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59) The four types of biomolecules are carbohydrates, lipids, nucleic acids, and proteins.
(1) Carbohydrates include monomer building blocks called monosaccharides, or simple sugars which usually have 3, 5, carbons along with hydrogen and oxygen in a 1: 2: 1 ratio. A monosaccharide may join with another monosaccharide th glycosidic bond to form a disaccharide; multiple monosaccharides chained together through glycosidic bonds are called polysaccharides. Carbohydrates are the chief energy sources in biological systems, serve as structural biomolecules, and mediate cellular adhesion, communication, and environmental sensing. Glucose is a favorite energy source for cells while cellulose, peptidoglycan, and chitin are all constituents of cell walls. (2) Lipids are a group of mostly hydrophobic molecules including fats, oils, waxes, and steroids. Lipids such as fats and oils are composed of fatty acid chains attached to a glycerol molecule through an ester bond. The fatty acids may be saturated (no double bonds, i.e. the maximum possible amount of hydrogen is bonded to each carbon atom) or unsaturated (one or more double bonds, i.e. less than the maximum number of hydrogen atoms bonded to each carbon atom). Fats and oils serve as energy sources for cells, as cell structure components, and mediate cell signaling. Waxes are fatty acids bonded to a long–chain alcohol; they serve a variety of protective functions. Steroids are composed of four fused hydrocarbon rings; they are involved in cell signaling pathways. (3) Nucleic acids come in two varieties: DNA and RNA. Both are composed of polymers of nucleotide monomers. Nucleotides are held together in chains through a phosphodiester bond. Each nucleotide is composed of a pentose sugar (deoxyribose or ribose), 1 –3 phosphate groups, and one of five nitrogenous bases. DNA serves as the genetic blueprint for all cells and some viruses; RNA can serve as the genetic blueprint for viruses and directs the production of proteins in all cells and viruses. (4) Proteins are polymers of amino acids joined in a chain by peptide bonds. The sequence of amino acids used in a given protein is unique to that protein and determines the structural and functional characteristics of that protein. Proteins typically fold into specific three–dimensional structures which are determined by the amino acids found in the protein. Proteins may serve as structural scaffolds in cells, as enzymes facilitating chemical reactions, cellular transporters, and are involved in cell recognition and communication.

60) The four levels of protein structure include primary, secondary, tertiary, and quaternary structure. (1) Primary structure is the linear sequence of amino acids in the protein, which are linked together by a type of covalent bond known as a peptide bond. A protein's primary structure is unique to that type of protein, and the overall structure and function of the protein results from the properties of each amino acid in the protein. All higher levels of protein structure are dependent on specific interactions between particular amino acids, so the primary structure of a protein determines its secondary, tertiary, and (if applicable) its quaternary structure. (2) Secondary structure consists of regular, consistent coils or folds in the protein chain which are held together by hydrogen bonds between amino acids. Types of secondary structure include alpha–helices and beta–pleated sheets. (3) Tertiary structure is the folding of the protein chain upon itself to form a characteristic three–dimensional structure. These structures are formed by both covalent and noncovalent interactions between specific amino acids. Not all proteins display quaternary structure. (4) Quaternary structure occurs when two or more separate polypeptide chains combine to form a functional protein. Both noncovalent and covalent interactions are involved in quaternary structure.

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