

Practice Questions

Small Molecules:

- The ability of atoms to combine with other atoms is determined by
 - the atom's atomic weight.
 - the number and distribution of electrons.
 - the atom's ability to form isomers.
 - the atom's nucleus.
 - the pH

- The optimum pH for growing strawberries is 6.5, whereas the optimum pH for growing blueberries is 4.5. Therefore, the number of hydrogen ions needed to grow blueberries is _____ the number needed for strawberries.
 - 2 times
 - 10 times
 - 100 times
 - 1000 times
 - 1000000 times

- Which of the following statements is false? A weak acid in a watery solution
 - dissociates partially
 - dissociates into a base and a H^+ ion
 - can act as a buffer
 - can only act as a buffer if you also add a weak base
 - none of the above

- Equal volumes of watery solutions with the same pH
 - contain the same number of protons
 - contain the same number of OH^- ions
 - contain the same number of water molecules
 - contain solutes of the same weight
 - A and B

5. An element has a weight of 131.3. The reason the number includes 0.3 is that

- a. the atomic weight includes the weight of electrons.
- b. atomic weight is the average of the mass numbers of all its isotopes.
- c. the neutrons do not have a single unit weight.
- d. the atomic weight does not include the weight of protons.
- e. the number of electrons may vary.

6. Which of the following molecules is insoluble in water?

- a. NaCl
- b. $\text{H}_3\text{C}-\text{CH}_3$
- c. $\text{H}_3\text{C}-\text{COOH}$
- d. $\text{H}_3\text{C}-\text{CH}_2-\text{OH}$
- e. none of the above

7. Which of the following is the correct order for the relative strengths of chemical bonds/interactions in decreasing order?

- a. hydrogen, covalent, hydrophobic
- b. covalent, hydrogen, hydrophobic
- c. hydrophobic, covalent, hydrogen
- d. hydrogen, hydrophobic, covalent
- e. covalent, hydrophobic, hydrogen

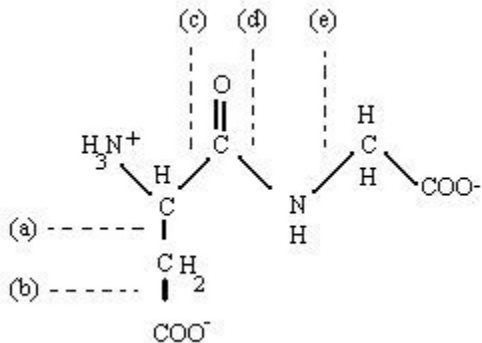
Macromolecules:

1. The polymers cellulose and starch differ in
 - a. the types of monosaccharide subunits composing them
 - b. the presence or absence of side groups such as $-\text{NH}_2$ or $-\text{H}_2\text{PO}_4$
 - c. the manner in which the subunits are linked together
 - d. the type of cell in which they are synthesized
 - e. all of the above

2. Hydrogen bonds are important in maintaining the structure of
 - a. the double helix of DNA
 - b. an alpha helix of a protein
 - c. a beta pleated sheet structure of a protein
 - d. cellulose
 - e. all of the above

3. The molecular formula for glucose is $\text{C}_6\text{H}_{12}\text{O}_6$. What would be the molecular formula for maltose, which consists of two glucose molecules linked together?
 - a. $\text{C}_{12}\text{H}_{24}\text{O}_{12}$
 - b. $\text{C}_6\text{H}_{12}\text{O}_6$
 - c. $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
 - d. $\text{C}_{12}\text{H}_{26}\text{O}_{13}$
 - e. $\text{C}_{12}\text{H}_{20}\text{O}_{10}$

4. The following formula represents a dipeptide formed by joining together two amino acids. If this molecule is hydrolyzed, indicate which bond (a, b, c, d, e) is broken



- a. (a)
- b. (b)
- c. (c)
- d. (d)
- e. (e)

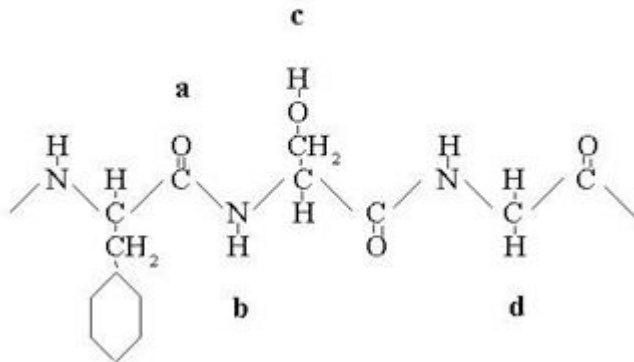
9. Which of the following is not a difference between DNA and RNA?
- DNA has thymine and RNA has uracil.
 - DNA usually has two polynucleotide strands and RNA usually has one strand.
 - DNA has deoxyribose sugar and RNA has ribose sugar.
 - DNA is a polymer and RNA is a monomer.
 - In DNA, A pairs with T and in RNA, A pairs with U.

10. According to the base-pairing rules for nucleic acids, purines always pair with

- deoxyribose sugars
- uracil
- pyrimidines
- adenine
- guanine

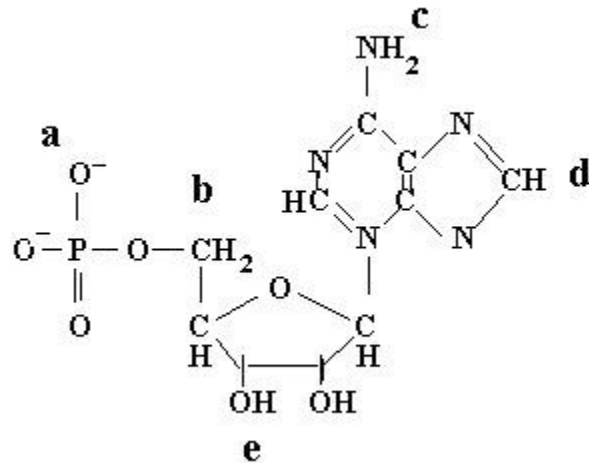
11. Common chemical features of all membrane lipids include

- a phosphate group
- a glycerol backbone
- sugar constituents
- a hydrophobic domain
- all of the above



12. The structure shown above represents part of a polypeptide chain. Which of the labelled groups might be involved in bonds that stabilize protein secondary structure?

- a and b
- b and c
- b and d
- a, b and c
- a, b and d



13.

The above molecule is a nucleotide. If this molecule is incorporated into RNA, indicate at which position on this nucleotide (a, b, c, d, or e) you might expect to find a covalent bond to the phosphate of another nucleotide in the sequence.

- a. a
- b. b
- c. c
- d. d
- e. e

14. Lipids form the barriers surrounding various compartments within an organism. Which property of lipids makes them a good barrier?

- a. Many biologically important molecules are not soluble in lipids.
- b. Lipids are polymers.
- c. Lipids store energy.
- d. Triglycerides are lipids.
- e. Lipids release large amounts of energy when broken down.

15. A molecule with the formula C₁₆H₃₂O₂ is a

- a. hydrocarbon.
- b. carbohydrate.
- c. lipid.
- d. protein.
- e. nucleic acid.

16. The formation of biological polymers involves

- a. production of one molecule of water for each subunit added
- b. incorporation of one molecule of water for each subunit added
- c. hydrolysis
- d. formation of a hydrogen bond between adjacent subunits
- e. none of the above

Membranes :

1. The compounds in biological membranes that form a barrier to the movement of materials across the membrane are

- a. integral membrane proteins.
- b. carbohydrates.
- c. lipids.
- d. nucleic acids.
- e. peripheral membrane proteins.

2. A patient is brought to the hospital severely dehydrated. An IV of normal saline is started immediately. Why doesn't the doctor order an IV of distilled water instead?

- a. An IV of distilled water would cause water to leave the cells, causing them to collapse.
- b. The patient needs the nutrients available in normal saline.
- c. An IV of distilled water would cause blood cells to swell and eventually burst.
- d. Normal saline is more economical than pure water.
- e. The distilled water may be contaminated by bacteria.

3. Transmembrane proteins of the plasma membrane may:

- a. contain aqueous channels
- b. have covalently attached carbohydrate side chains
- c. act as signal receptors
- d. bind cytoskeletal proteins
- e. all of the above

4. For cells in which carbon dioxide crosses the cell membrane by simple diffusion, what determines the rate at which carbon dioxide enters the cell?

- a. The concentration of carbon dioxide on each side of the membrane
- b. The amount of ATP produced by the cell
- c. The number of carrier proteins in the membrane
- d. The amount of energy available
- e. The concentration of hydrogen ions on each side of the membrane

5. Which of the following is false? A membrane

- a. allows lateral diffusion of phospholipids
- b. contains fatty acid chains
- c. contains cholesterol
- d. includes polypeptide chains, usually in alpha-helical form
- e. is impermeable to oxygen

6. The plasma membranes of winter wheat are able to remain fluid when it is extremely cold by

- a. increasing the number of cholesterol molecules present.
- b. closing protein channels.
- c. decreasing the number of hydrophobic proteins present.
- d. replacing saturated fatty acids with unsaturated fatty acids.
- e. using fatty acids with longer tails.

7. You place cells in a solution of glucose and measure the rate at which glucose enters the cells. As you increase the concentration of the glucose solution, the rate increases. However, when the glucose concentration of the solution is increased above 10 M, the rate no longer increases. Which of the following is the most likely mechanism for glucose transport into the cell?

- a. Facilitated diffusion via a channel protein
- b. Facilitated diffusion via a carrier protein
- c. Simple diffusion
- d. Endocytosis
- e. none of the above

8. The LDL receptor is an integral protein that crosses the plasma membrane, with portions of the protein extending both outside and into the interior of the cell. The amino acid side chains in the region of the protein that crosses the membrane are most likely to be

- a. charged.
- b. hydrophilic.
- c. hydrophobic.
- d. carbohydrates.
- e. lipids.

Cells:

1. If various organelles of the cell are represented by letters, as:
a: Golgi apparatus, b: Vesicles, c: Endoplasmic reticulum, d: Ribosomes, e: Nucleus, which of the following represents the path followed by a secreted protein, starting from its assembly from amino acids.
 - a. edcab
 - b. dcbab
 - c. dbabc
 - d. decba
 - e. dcbcb
2. The Golgi apparatus
 - a. is found only in animals.
 - b. is found in prokaryotes.
 - c. is the appendage that moves a cell around in its environment.
 - d. packages and modifies proteins.
 - e. is a site of rapid ATP production.
3. Which of the following structures of a cell is typically present in the largest number per cell?
 - a. vacuole
 - b. chromosome
 - c. ribosome
 - d. Golgi apparatus
 - e. cilia
4. What is the function of the folds of the inner mitochondrial membrane?
 - a. They increase the volume of the inner mitochondrial matrix.
 - b. They create new membrane-bounded compartments within the mitochondrion.
 - c. They increase the surface area to accommodate respiratory enzymes.
 - d. They anchor more of the mitochondrial DNA.
 - e. The folds have no known purpose.
5. A newly synthesized polypeptide chain that is attached together with a ribosome and the mRNA to the endoplasmic reticulum (ER) is likely to
 - a. be inserted into the membrane of the ER or move across the membrane into the ER lumen
 - b. have a signal sequence in the first 20-30 amino acids
 - c. become a glycoprotein with carbohydrate side chains
 - d. pass through the Golgi apparatus
 - e. all of the above

6. Which of the following organelles is common to plant and animal cells?
- a. chloroplasts
 - b. cellulose cell wall
 - c. vacuole
 - d. mitochondria
 - e. none of the above
7. Which of the following cellular organelles does NOT take part in the transfer of membrane vesicles from one organelle to another?
- a. lysosome
 - b. cell membrane
 - c. mitochondrion
 - d. endoplasmic reticulum
 - e. Golgi apparatus
8. Cilia contain
- a. microtubules
 - b. actin filaments
 - c. intermediate filaments
 - d. ribosomes
 - e. plasmodesmata
9. Lysosomes are important to eukaryotic cells because they contain
- a. photosynthetic pigments.
 - b. starch molecules for energy storage.
 - c. their own DNA molecules.
 - d. the cell's waste materials.
 - e. digestive enzymes.
10. If not prevented, solutes could move from the gut to the blood by diffusing through the spaces between the epithelial cells. Which of the following prevents materials from crossing an epithelial layer of cells in this way?
- a. coated pits on the surfaces of cells
 - b. adherens junctions between the cells
 - c. gap junctions between the cells
 - d. the extracellular matrix around the cells
 - e. tight junctions between the cells

Energy_Enzymes_Glycolysis_Respiration:

1. During the citric acid cycle, oxidation of organic acids is coupled to
 - a. phosphorylation.
 - b. the reduction of electron carriers.
 - c. the oxidation of water.
 - d. the oxidation of electron carriers.
 - e. the hydrolysis of ATP.

2. The complete aerobic respiration of glucose produces
 - a. glycerol
 - b. urea
 - c. oxygen
 - d. carbon dioxide
 - e. none of the above

3. For bacteria to continue growing rapidly when they are shifted from an environment containing oxygen to an anaerobic environment, they must
 - a. increase the rate of the citric acid cycle.
 - b. produce more ATP per mole of glucose during glycolysis.
 - c. produce ATP during the oxidation of NADH.
 - d. increase the rate of transport of electrons down the respiratory chain.
 - e. increase the rate of the glycolytic reactions.

4. If the change in heat of a chemical reaction is negative (i.e., heat is dispersed to the environment) and the change in entropy is positive, what can you conclude about the reaction?
 - a. It requires energy.
 - b. It is endergonic.
 - c. It is spontaneous.
 - d. It will not reach equilibrium.
 - e. It decreases the disorder in the system.

5. The hydrolysis of sucrose to glucose and fructose is a spontaneous reaction. However, if you dissolve sucrose in water and keep the solution overnight at room temperature, there is no detectable conversion to glucose and fructose. Why?
 - a. The change in free energy of the reaction is positive.
 - b. The activation energy of the reaction is high.
 - c. The change in free energy of the reaction is negative.
 - d. The reaction is endergonic.
 - e. The free energy of the products is higher than the free energy of the reactants.

6. Which of the following statements is false?

End product inhibition

- a. can only occur if an enzyme shows allosteric behaviour.
- b. refers to the inhibition of an enzyme reaction by the immediate product of that reaction.
- c. occurs in many biochemical pathways including respiration.
- d. is readily reversible.
- e. increases the stability and efficiency of metabolism.

7. Which of the following is produced during the citric acid cycle?

- a. FAD
- b. pyruvate
- c. reduced electron carriers
- d. lactic acid
- e. water

8. Pyruvate is an end product of:

- a. the Calvin cycle
- b. glycolysis
- c. the citric acid cycle
- d. the respiratory chain
- e. fermentation

9. During photosynthesis, plants use light energy to synthesize glucose from carbon dioxide. However, plants do not use up energy during photosynthesis; they merely convert it from light energy to chemical energy. This is an illustration of

- a. increasing entropy
- b. chemical equilibrium
- c. the first law of thermodynamics
- d. the second law of thermodynamics
- e. a spontaneous reaction

10. Which of the following would be inhibited if the inner membrane of the mitochondrion becomes leaky to H^+ ?

- a. The citric acid cycle.
- b. Electron transfer in the respiratory chain.
- c. ATP synthesis by oxidative phosphorylation.
- d. all of the above
- e. b and c

11. Isocitrate dehydrogenase is an enzyme of the citric acid cycle. Where in the cell is this enzyme located?

- a. In the thylakoids.
- b. In the cytoplasm.
- c. In the chloroplast.
- d. In the mitochondrial matrix.
- e. In the plasma membrane.

12. Oxidation of NADH occurs:

- a. in the respiratory electron transfer chain.
- b. in the conversion of pyruvate to lactic acid or lactate.
- c. in the conversion of pyruvate to alcohol and carbon dioxide.
- d. all of the above
- e. neither a, b, or c

13. According to the chemiosmotic theory, the energy for the synthesis of ATP during the flow of electrons down the electron transport chain is provided directly by

- a. the hydrolysis of GTP.
- b. the reduction of NAD^+ .
- c. the transport of protons.
- d. the reduction of FAD.
- e. the hydrolysis of ATP.

14. A type of inhibitor that binds within the active site of an enzyme is termed

- a. allosteric
- b. noncompetitive
- c. competitive
- d. cofactor
- e. None of the above

15. A "connector" molecule between the citric acid cycle and the respiratory electron transfer chain is:

- a. pyruvate
- b. NADH
- c. acetyl CoA
- d. ATP
- e. isocitric acid

16. The supply of NAD^+ that is required for the breakdown of glucose can be regenerated by the oxidation of NADH during

- a. glycolysis
- b. fermentation
- c. electron transfer in the respiratory chain
- d. a and b, but not c
- e. b and c, but not a

Photosynthesis:

1. In photosynthesis, the first product of CO₂ fixation, 3-phosphoglycerate, is reduced to the 3-carbon sugar, glyceraldehyde 3-phosphate. Why does this reaction stop if cells are placed in the dark?

- a. It requires CO₂
- b. It requires O₂
- c. It requires ATP and NADPH
- d. Chlorophyll is not synthesized in the dark
- e. The enzyme is directly activated by light

2. Which of the following statement(s) about photorespiration is (are) true?

- a. Photorespiration is a metabolically expensive pathway.
- b. Photorespiration is avoided when carbon dioxide is abundant.
- c. Photorespiration requires ATP.
- d. All of the above.
- e. A and B.

3. Which of the following is false?

- a. Of the pigments contributing to light energy capture in photosynthesis, only chlorophyll a is involved in an oxidation-reduction reaction.
- b. Accessory pigments such as carotene transfer electrons to chlorophylls.
- c. Different pigments can absorb photons of different energies.
- d. Chlorophyll a can absorb photons of different energies.
- e. A photon of blue light has more energy than a photon of red light.

4. Since plant material leaves relatively little ash when burned, it appears that most of the material of a plant consists of organic compounds derived from photosynthesis. The dry weight of a tree (i.e., the weight after oven drying to remove water from the tissues) was estimated to increase by about 100 kg over a 5-year period of growth. Which of the following statements about this phenomenon is most correct?

- a. The soil in which the tree was growing lost about 100 kg in dry weight during that time.
- b. Most of the gained dry weight came from the water applied to the plant during that time.
- c. Most of the gained weight came from the oxygen molecules assimilated from the atmosphere.
- d. Most of the gained weight came from the CO₂ assimilated during that time.
- e. none of the above

5. The fact that there are two possible energy levels in an excited molecule of chlorophyll causes, or explains:

- a. photosystems I and II
- b. the Calvin cycle
- c. the two peaks in the absorption spectrum of chlorophyll
- d. synthesis of ATP and NADPH
- e. CO² fixation

6. Why are the absorption spectrum of chlorophyll a and the action spectrum of photosynthesis not identical?

- a. Accessory pigments contribute energy to drive photosynthesis.
- b. Chlorophyll a absorbs both red and blue light.
- c. Chlorophyll a reflects green light.
- d. Different wavelengths of light have different energies.
- e. Chlorophyll a can be activated by absorbing a photon of light.

7. In noncyclic photophosphorylation, electrons from which source replenish chlorophyll molecules that have given up electrons?

- a. carbon dioxide
- b. water
- c. NADPH + H⁺
- d. gaseous oxygen
- e. none of the above

8. Photosynthesis and respiration have which of the following in common?

- a. In eukaryotes, both processes reside in specialized organelles.
- b. ATP synthesis in both processes relies on the chemiosmotic mechanism.
- c. Both use electron transport.
- d. Both produce sugars.
- e. A, B, and C.