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Name:_____ Class:_____ Date:_____

Chapter 1 - The Facts of Life: Chemistry is the Logic of Biological Phenomena

1. All are distinctive properties of living systems EXCEPT:
   a. Living organisms are relatively simple.
   b. Biological structures play a role in the organism's existence.
   c. The living state is characterized by the flow of energy through the organism.
   d. Living organisms are highly organized.
   e. Living organisms are actively engaged in energy transformation.

ANSWER: a

2. Even though the building blocks have fairly simple structures, macromolecules are exquisitely organized in their intricate three-dimensional architecture known as:
   a. configuration.
   b. conformation.
   c. sequence.
   d. Lewis structure.
   e. structural maturation.

ANSWER: b

3. All of the following activities require the presence of ATP or NADPH EXCEPT:
   a. osmoregulation.
   b. biosynthesis.
   c. movement of muscles.
   d. light emission.
   e. none, they are all energy-requiring activities.

ANSWER: e

4. Which are the four most common elements in the human body?
   a. hydrogen, calcium, oxygen and sodium
   b. hydrogen, oxygen, iron and carbon
   c. hydrogen, oxygen, carbon and nitrogen
   d. oxygen, carbon, iron and nitrogen
   e. oxygen, silicon, calcium and nitrogen

ANSWER: c

5. What makes carbon such an abundant element in biomolecules?
   a. It can form up to five bonds by sharing its electrons.
   b. It forms only single bonds.
   c. It provides low bond energy.
   d. It forms stable covalent bonds by electron pair sharing.
   e. It does not usually bond to other carbons, allowing a more diverse combination of elements.

ANSWER: d

6. The major precursors for the formation of biomolecules include all EXCEPT:
   a. nitrate and dinitrogen.
   b. water.

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c. carbon dioxide.
d. ammonium ion.
e. none, all are major precursors.

ANSWER: e

7. From the major precursors, the complex biomolecules are made in which sequence?
a. metabolites, building blocks, macromolecules, supramolecular complexes
b. macromolecules, building blocks, metabolites, supramolecular complexes
c. building blocks, macromolecules, supramolecular complexes, metabolites
d. metabolites, macromolecules, building blocks, supramolecular complexes
e. metabolites, building blocks, supramolecular complexes, macromolecules

ANSWER: a

8. The structural integrity of supramolecular complexes (assemblies) of multiple components are bonded to each other by all of the following forces EXCEPT:
a. covalent bonds
b. van der Waals forces
c. hydrogen bonds
d. hydrophobic interactions
e. ionic interactions

ANSWER: a

9. Organelles have what three attributes?
a. Only in prokaryotic cells, membrane bound, have a dedicated set of tasks.
b. Only in eukaryotic cells, membrane bound, have a dedicated set of tasks.
c. Only in eukaryotic cells, seldom membrane bound, have a dedicated set of tasks.
d. Only in prokaryotic cells, membrane bound, multi-functional.
e. In both prokaryotic cells and eukaryotic cells, membrane bound, have a dedicated set of tasks.

ANSWER: b

10. Membrane structures are maintained primarily by:
a. hydrophobic interactions.
b. covalent bonds.
c. hydrogen bonds.
d. non-spontaneous assembly.
e. ionic interactions.

ANSWER: a

11. All of the following are properties of membranes EXCEPT:
a. supramolecular assemblies.
b. define boundaries of cellular components.
c. spontaneous assemblies resulting from hydrophobic interactions.
d. identical protein and lipid composition in the major organelles.
e. none, all are true.

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ANSWER: d

12. Which of the following properly ranks the non-covalent interactions in order of increasing strength?
    a. ionic, hydrogen bond, van der Waals
    b. van der Waals, hydrogen bond, ionic
    c. van der Waals, ionic, hydrogen bond
    d. hydrogen bond, van der Waals, ionic
    e. cannot be determined since ionic interactions and hydrogen bonds often vary in strength

ANSWER: e

13. Weak forces that create constantly forming and breaking interactions at physiological temperatures, but cumulatively impart stability to biological structures generated by their collective activity include all EXCEPT:
    a. hydrogen bonds
    b. van der Waals forces
    c. covalent bonds
    d. ionic interactions
    e. hydrophobic interactions

ANSWER: c

14. Which of the following is a true statement about non-covalent bonds?
    a. They are all the result of electron sharing.
    b. Hydrogen bonds, ionic bond and hydrophobic interactions all carry a degree of specificity while van der Waals interactions are induced.
    c. All noncovalent bonds are formed between oppositely charged polar functions.
    d. Van der Waals interactions are not affected by structural complementarity, while hydrogen bonds, ionic bonds and hydrophobic interaction are affected by structural complementarity.
    e. Hydrogen, van der Waals, and hydrophobic interactions do not form linear bonds.

ANSWER: b

15. Electrostatic forces
    a. include ionic interactions between negatively charged carboxyl groups and positively charged amino groups.
    b. average about 2 kJ/mol in aqueous solutions.
    c. typically are directional like hydrogen bonds.
    d. require a precise fit like van der Waals interactions.
    e. include ionic, induced dipole and permanent dipole interactions.

ANSWER: a

16. All are true about hydrophobic interactions EXCEPT:
    a. Hydrophobic interactions result from the strong tendency of water to exclude nonpolar groups or molecules.
    b. Hydrophobic interactions result because water molecules prefer the stronger interactions that they share with one another, compared to their interactions with nonpolar molecules.
    c. Hydrophobic interactions result from hydrogen bonds between water and the hydrophobic molecules.
    d. The preferential interactions between water molecules "exclude" hydrophobic substances from aqueous solution and drive the tendency of nonpolar molecules to cluster together.

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e. Hydrophobic interactions result in nonpolar regions of biological molecules being buried in the molecule's interior to exclude them from the aqueous milieu.

ANSWER: c

17. Which of the following molecular recognition mechanisms is based upon structural complementarity?
a. interaction of a protein with a metabolite.
b. the association of a strand of DNA with its complementary strand.
c. the ability for a sperm cell to bind to an egg.
d. the binding of a hormone to its receptor.
e. all of the above

ANSWER: e

18. All of the statements about structural complementarity are true EXCEPT:
a. Weak chemical forces mediate it.
b. It produces strong irreversible interactions.
c. It is the interaction of a biological macromolecule and its ligand.
d. It is the basis of many biological functions.
e. It is the means of recognition in bimolecular interactions.

ANSWER: b

19. Which of the following statements regarding molecular recognition is correct?
a. Covalent bonds are a common interaction used in molecular recognition.
b. Molecular recognition takes place only between protein molecules.
c. For molecular recognition to occur, complementarity of the molecules is required.
d. Hydrogen bonds are not effective mediators of molecular recognition due to their low strength.
e. None of the above are correct.

ANSWER: c

20. Biological molecules are functionally active only within a narrow range of environmental conditions with denaturation occurring in all EXCEPT:
a. dramatic increase in temperature.
b. change in ionic strength.
c. refrigeration.
d. addition of strong acid or base.
e. none, all will denature biological macromolecules.

ANSWER: c

21. All of the following functions of an enzyme are true EXCEPT:
a. Enzymes help to catalyze virtually every metabolic reaction.
b. Enzymes mediate the rates of cellular reaction in proportion to cellular requirements.
c. Enzymes are sensitive to temperature, pH, and concentration changes.
d. An increased activity of an enzyme increases the amount of energy produced.
e. Enzymes are used as a catalyst to increase reaction rates many orders of magnitude.

ANSWER: d

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22. All are true for prokaryotic cells EXCEPT:
    a. Some have flagella.
    b. They have a simple plasma or cell membrane.
    c. They posses a distinct nuclear area, but no nucleus.
    d. They have ribosomes, but no mitochondria.
    e. All are true.

ANSWER: e

23. Composed of peptidoglycan, a rigid framework of polysaccharide cross-linked by short peptide chains, describes what structural feature of a prokaryotic cell?
    a. cytosol
    b. ribosome
    c. nuclear area
    d. cell membrane
    e. cell wall

ANSWER: e

24. All are internal membrane specialized structures of animal cells EXCEPT:
    a. lysosome.
    b. nucleus.
    c. endoplasmic reticulum.
    d. mitochondria.
    e. chloroplast.

ANSWER: e

25. Arrays of filaments in eukaryotic cells that give the cell its shape and its capacity to move are called the:
    a. plasma membrane.
    b. smooth endoplasmic reticulum.
    c. cytoskeleton.
    d. lysosome.
    e. Golgi body.

ANSWER: c

26. Supramolecular complexes of nucleic acid encapsulated in a protein coat, and in some instances, surrounded by a membrane envelope are called:
    a. viruses.
    b. plasmids.
    c. nucleosomes.
    d. ribosomes.
    e. all are true.

ANSWER: a

27. Viruses are acellular, but they act as cellular parasites in order to:

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a. reproduce.
b. protect themselves.
c. grow in size.
d. gain genetic information.
e. all are true.

ANSWER: a

28. Rough ER are "studded" with:
a. lysosomes.
b. ribosomes.
c. peroxisomes.
d. nucleosomes.
e. all are true.

ANSWER: b

29. When viral genetic elements are integrated into the host chromosome and become quiescent, it is referred to as:
a. cytolytic.
b. lysogeny.
c. hemolytic.
d. propagational.
e. autonomy.

ANSWER: b

30. Which organelle is responsible for the bulk of energy production in the form of ATP?
a. chloroplast
b. mitochondria
c. golgi apparatus
d. lysosome
e. endoplasmic reticulum

ANSWER: b

31. Which of the following molecules is not generally incorporated into macromolecules?
a. amino acids
b. monosaccharides
c. nucleotides
d. fatty acids
e. all of the above are incorporated into macromolecules

ANSWER: d

32. Discuss the distinctive properties of living organisms.

ANSWER: First, living systems are highly organized. For example, large animals are composed of many different types of cells that in turn have subcellular structures called organelles—complex assemblies of very large polymeric molecules called macromolecules. Second, every biological structure in a living system—from parts of organisms, such as limbs and organs, down to the chemical agents of metabolism, such as enzymes

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and metabolic intermediates—has a particular function. Third, living systems perform energy transformations by means of special energized biomolecules such as ATP and NADPH. Fourth, living systems are capable of self-replication—the ability to reproduce virtually identical copies of themselves.

33. Briefly explain the different organelles.

ANSWER: Organelles, found only in eukaryotic cells, are cellular inclusions that are usually membrane bounded and are dedicated to important cellular tasks. Organelles include the nucleus, mitochondria, chloroplasts, endoplasmic reticulum, Golgi apparatus, and vacuoles, as well as other relatively small cellular inclusions, such as peroxisomes, lysosomes, and chromoplasts. The nucleus is the repository of genetic information as contained within the linear sequences of nucleotides in the DNA of chromosomes. Mitochondria are organelles surrounded by two membranes that differ markedly in their protein and lipid composition. They carry out the energy-releasing aerobic metabolism of carbohydrates and fatty acids, capturing the energy in metabolically useful forms such as ATP. Chloroplasts endow cells with the ability to carry out photosynthesis. The endoplasmic reticulum is a labyrinthine organelle where both membrane proteins and lipids are synthesized. The Golgi is an asymmetrical system of flattened membrane-bounded vesicles often stacked into a complex. The vacuole is usually the most obvious compartment in plant cells. It is a very large vesicle enclosed by a single membrane called the tonoplast.

34. Discuss the properties of a hydrogen bond.

ANSWER: Hydrogen bonds form between a hydrogen atom covalently bonded to an electronegative atom (such as oxygen or nitrogen) and a second electronegative atom that serves as the hydrogen bond acceptor. Hydrogen bonds, at a strength of 12 to 30 kJ/mol, are stronger than van der Waals forces and have an additional property: H bonds are cylindrically symmetrical and tend to be highly directional, forming straight bonds between donor, hydrogen, and acceptor atoms. Hydrogen bonds are also more specific than van der Waals interactions because they require the presence of complementary hydrogen donor and acceptor groups.

35. Briefly explain the structural organization of bacteria.

ANSWER: Bacteria, which are prokaryotes, are very small, on the order of several microns in length, and are usually surrounded by a rigid cell wall that protects the cell and gives it its shape. Prokaryotic cells have only a single membrane, the plasma membrane or cell membrane. They contain no nucleus but possess a distinct nuclear area called the nucleoid where a single circular chromosome is localized. Reactions of cellular respiration are localized on internal membranous structures derived from and continuous with the cell membrane. In cyanobacteria, flat, sheetlike membranous structures called lamellae—formed from cell membrane infoldings—are the sites of photosynthetic activity. Some bacteria have flagella, single, long filaments used for motility.

36. Describe the structure of viruses.

ANSWER: Viruses are supramolecular complexes of nucleic acid, either DNA or RNA, encapsulated in a protein coat and, in some instances, surrounded by a membrane envelope. Viruses are acellular, but they act as cellular parasites in order to reproduce. The bits of nucleic acid in viruses are, in reality, mobile elements of genetic information. The protein coat serves to protect the nucleic acid and allows it to gain entry to the cells that are its specific hosts. Mature virus particles in host cells arise by encapsulating the nucleic acid within a protein coat called the capsid.

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