SUMMER PACKET FOR HONORS BIOLOGY
NAME: _____

Note on Collaboration: Authentic collaboration where students discuss the skills, contents, and processes required to complete the following questions is not only permitted but encouraged and very much in keeping with the practice of science as implemented in academia and industry.

Students are cautioned however that there is a *significant* difference in both ethical behavior, adherence to the Honor Code, and benefit derived from work done between authentic collaboration and either simply seeking the answers from or providing the answers to a peer.

Chemistry for Biology – Basic Concepts

Multiple Choice: Read Carefully, Select the BEST Response.

1. Classify the following statement, "Bald Eagle eggs in northern Maine will have thinner shells than those from birds in southern Alaska due to increased levels of pesticides in the water".

    a. Theory
    b. Fact
    c. Law
    d. Hypothesis

2. Classify the following statement, "Ancient human like species existed 2 million years ago".

    a. Theory
    b. Fact
    c. Law
    d. Hypothesis

3. Classify the following statement, "The inverse-square law for gravity and Newton's Laws of motion explain why orbits are in the shape of ellipses".

    a. Theory
    b. Fact
    c. Law
    d. Hypothesis

4. Which one of the following is not a hypothesis?

    a. The foraging patterns of *S. carpocapsae*, as measured by directional response, are affected by electrical fields.
    b. If I give a plant an unlimited amount of sunlight, then the plant will grow to its largest possible size.
    c. Marsh grass growth is limited by available nitrogen
    d. Prairie fires replenish the nutrients in the soil.

5. Using the correct rules for significant figures solve: 450 meters / 114 seconds =

   a. 3.9 m.s
   b. 3.95 m.s
   c. 3.9 m/s
   d. 3.95 m/s

6. Using the correct rules for significant figures solve: 298.01 kilograms + 34.112 kilograms =

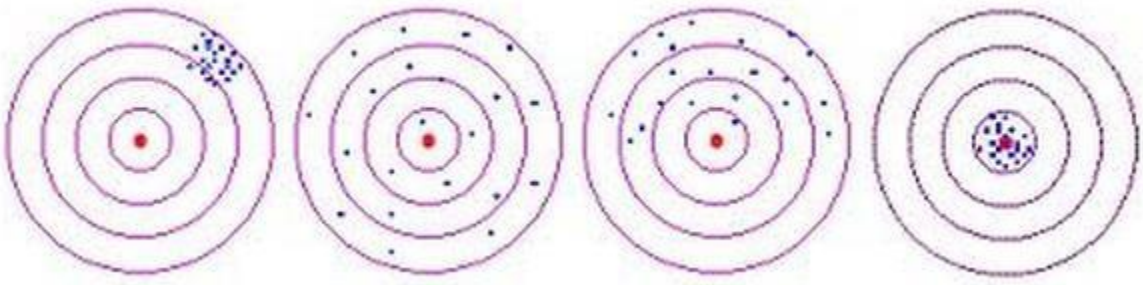
   a. 332.122 kg
   b. 332.122 kg^2
   c. 332.12 kg
   d. 332.12 kg^2

7. Using the correct rules for significant figures solve: 84 m/s x 31.221 s =

   a. 2,600 m
   b. 2,600 m/s^2
   c. 2,700 m
   d. 2,700 m/s^2

Use the following diagram to answer questions 8-11

A B C D



8. Which target represents good precision and good accuracy?

    a. TARGET A
    b. TARGET B
    c. TARGET C
    d. TARGET D

9. Which target represents poor precision and good accuracy?

    a. TARGET A
    b. TARGET B
    c. TARGET C
    d. TARGET D

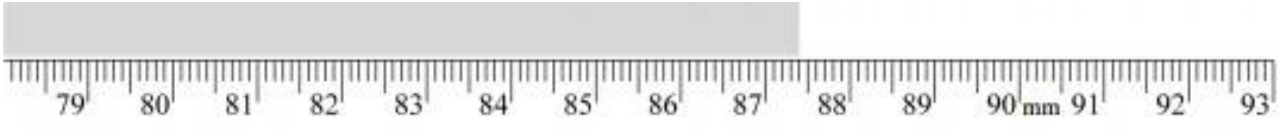
10. Which target represents poor precision and poor accuracy?

    a. TARGET A
    b. TARGET B
    c. TARGET C
    d. TARGET D

11. Which target represents good precision and poor accuracy?

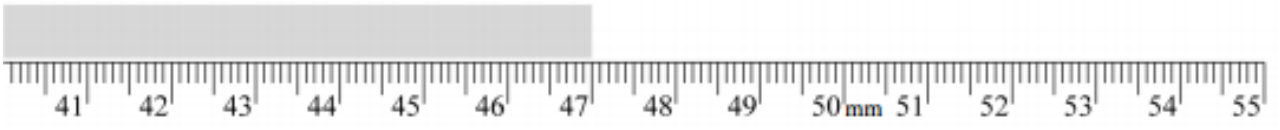
    a. TARGET A
    b. TARGET B
    c. TARGET C
    d. TARGET D

12. What would be an acceptable value to report for the measurement shown below?



    a. 87 mm
    b. 87.4 mm
    c. 87.40 mm
    d. 87.400 mm

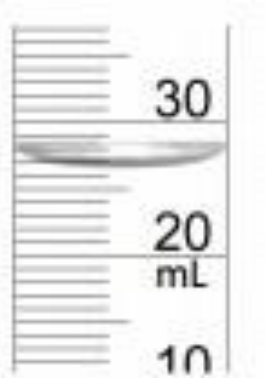
13. What would be an acceptable value to report for the measurement shown below?



a. 47 mm
b. 47.0 mm
c. 47.00 mm
d. 47.000 mm

14. What would be an acceptable value to report for the measurement shown to the right?

a. 26 mL
b. 26.7 mL
c. 33 mL
d. 33.3 mL



15. Express 0.000840 in scientific notation

a. 8.40×10^{-3}
b. 8.40×10^{4}
c. 8.40×10^{-4}
d. 8.4×10^{4}

16. Density is found by dividing _____.

a. Mass by volume
b. Volume by mass
c. Mass by area
d. Area by mass

17. Using the correct rules for significant figures solve: 349 cm + 1.10 cm + 100.0 cm =

a. 450. cm
b. 450. cm^3
c. 450.1 cm
d. 450.1 cm^3

18. What is the mass of 20.0 mL solution if its density is 1.84 g/mL?

a. 10.8 g
b. 21.8 g
c. 36.8 g
d. 10.9 g

Use the table to help you answer the question(s).

Commonly Used Metric Prefixes		
Prefix	**Meaning**	**Factor**
mega (M)	1 million times larger than the unit it precedes	10^{6}
kilo (k)	1000 times larger than the unit it precedes	10^{3}
deci (d)	10 times smaller than the unit it precedes	10^{-1}
centi (c)	100 times smaller than the unit it precedes	10^{-2}
milli (m)	1000 times smaller than the unit it precedes	10^{-3}
micro (μ)	1 million times smaller than the unit it precedes	10^{-6}
nano (n)	1000 million times smaller than the unit it precedes	10^{-9}
pico (p)	1 trillion times smaller than the unit it precedes	10^{-12}

19. 44 cm is how many km?

    a. 0.00044 km
    b. 0.044 km
    c. 44000 km
    d. 4400000 km

20. 0.90 mA is how many nA?

    a. 0.000009 nA
    b. 0.009 nA
    c. 900000 nA
    d. 90000 nA

21. What is the quantity 0.0075 meters expressed in centimeters?
    a. 0.075 cm
    b. 0.75 cm
    c. 7.5 cm
    d. 70.5 cm

22. Which of the following metric prefixes is the smallest:
    a. micro-
    b. centi-
    c. nano-
    d. milli-

23. The prefix micro- means:
    a. 10^{6}
    b. 10^{-6}
    c. 10^{3}
    d. 10^{-3}

24. Which of the following equalities is correct?
    a. 100 cg = 10 g
    b. 1000 mm = 100 m
    c. 1 cm^3 = 1 mL
    d. 10 kg = 1 g

25. A cubic meter is about the same as the volume occupied by a ____.
    a. kilogram of water
    b. cup of milk
    c. washing machine
    d. basketball arena

26. What quantity is represented by the metric system prefix deci-?
    a. 1000
    b. 100
    c. 0.1
    d. 0.01

27. What is the metric system prefix for the quantity 0.000 001?
    a. centi-
    b. deci-
    c. kilo-
    d. micro

28. An example of an extensive property of matter is

a. temperature.
b. pressure.
c. mass.
d. hardness.

29. Which of the following is a physical property?

a. explosive
b. combustible
c. melting point
d. ability to rust

30. Which of the following is a physical property of water?

a. It reacts with calcium metal to produce a basic solution.
b. It can be decomposed by electrolysis.
c. It is composed of hydrogen and oxygen.
d. It melts below room temperature.

31. Which of the following is considered a physical property of a substance?

a. reaction with an acid
b. products of decomposition
c. malleability
d. ability to oxidize

32. The chemical formula of a compound indicates

a. the source of the elements in the compound.
b. how elements are joined in the compound.
c. the alchemy symbols for the elements in the compound.
d. the relative proportions of the elements in the compound.

33. What do chemical symbols and formulas represent, respectively?

a. elements and compounds
b. atoms and mixtures
c. compounds and mixtures
d. elements and ions

34. What must occur for a change to be a chemical reaction?

a. There must be a change in chemical properties.
b. There must be a change in physical properties.
c. The change must involve a change in mass.
d. The change must involve a change in volume.

35. Which of the following is a chemical change?

a. grating cheese
b. melting cheese
c. fermenting of cheese
d. mixing two cheeses in a bowl

36. Which of the following changes to a metal is a chemical change?

a. bending
b. melting
c. rusting
d. polishing

37. Which of the following involves a chemical change?

a. mixing
b. melting
c. grinding
d. decomposing

38. _____ is an example of an element.

a. Water
b. Carbon
c. Glucose
d. Salt

39. The four most common elements found in living things are

a. nitrogen, oxygen, phosphorus, and carbon.
b. carbon, oxygen, nitrogen, and hydrogen.
c. carbon, oxygen, potassium, and calcium.
d. Oxygen, calcium, hydrogen, and carbon.

40. Which of the following elements, essential to life and found in all organic compounds, is a trace element?

a. phosphorus
b. carbon
c. iodine
d. calcium

41. An atom with a positive charge has____.

a. more protons than electrons
b. more electrons than protons
c. more neutrons than protons
d. more protons than electrons

42. All atoms of an element have the same number of _____.

a. protons plus neutrons
b. protons
c. electrons
d. neutrons

43. An atom's _____ are found in its nucleus.

a. neutrons and protons
b. protons only
c. neutrons and electrons
d. electrons, protons, and neutrons.

44. Beryllium's atomic mass is 9 and its atomic number is 4. How many neutrons are found in a beryllium atom?

a. 9
b. 13
c. 4
d. 5

45. The way Earth moves about the sun is most like _____.

a. a neutron and electron moving around a proton
b. an electron moving around the nucleus of an atom
c. a proton moving about an electron
d. a neutron moving about a proton

46. Isotopes of an element have the same number of_____ and different numbers of_____.

a. protons... neutrons
b. protons... electrons
c. neutrons... protons
d. electrons…protons

47. How do radioactive isotopes differ from isotopes?

a. Radioactive isotopes have more neutrons than do isotopes.
b. Radioactive isotopes are stable; isotopes are unstable.
c. Radioactive isotopes have fewer neutrons than do isotopes.
d. Radioactive isotopes are unstable; isotopes are stable.

48. The second electron shell of an atom can hold a maximum of _____ electrons.

a. 1
b. 2
c. 6
d. 8

49. Nitrogen has an atomic number of 7; therefore, it has _____ electrons in its outermost electron shell.

a. 10
b. 18
c. 5
d. 2

50. An atom with a charge is a(n) _____.

a. isotope
b. molecule
c. ion
d. compound

51. Which of the following occurs in an ionic bond?

a. Oppositely charged ions attract.
b. Two atoms share two electrons.
c. Two atoms share more than two electrons.
d. Like-charged ions attract.

52. What is the representative unit in a molecular compound?

a. a molecule
b. an ion
c. a formula unit
d. shared electrons

53. What information does a molecular formula provide?

a. the number and kind of atoms that are bonded by the transfer of electrons
b. the simplest whole-number ratio of atoms that are bonded by the transfer of electrons
c. information about a molecule's structure
d. the number and kind of atoms present in a molecule

54. Why do atoms share electrons in covalent bonds?

a. to become ions and attract each other
b. to attain a noble-gas electron configuration
c. to become more polar
d. to increase their atomic numbers

55. According to VSEPR theory, molecules adjust their shapes to keep which of the following as far apart as possible?

a. pairs of valence electrons
b. inner shell electrons
c. mobile electrons
d. the electrons closest to the nuclei

56. The hydrogens and oxygen of a water molecule are held together by _____ bonds.

a. electron
b. hydrogen
c. covalent
d. osmotic

57. The bond between oppositely charged ions is a(n) _____ bond.

a. ionic
b. polar
c. hydrogen
d. covalent

58. In the following reaction, what type of bond is holding the two atoms together?
$K + Cl \rightarrow K^+ + Cl^- \rightarrow KCl$

a. hydrophilic
b. ionic
c. hydrophobic
d. covalent

59. What name is given to bonds that involve the sharing of electrons?

a. covalent
b. hydrogen
c. ionic
d. polar

60. Sulfur has an atomic number of 16. How many covalent bonds can sulfur form?

a. 1
b. 2
c. 4
d. 0

61. What causes water molecules to have a bent shape, according to VSEPR theory?

a. repulsive forces between unshared pairs of electrons
b. interaction between the fixed orbitals of the unshared pairs of oxygen
c. ionic attraction and repulsion
d. the unusual location of the free electrons

62. Why is water considered a polar molecule?

a. The oxygen is found between the two hydrogens.
b. The oxygen atom attracts the hydrogen atoms.
c. The oxygen end of the molecule has a slight negative charge, and the hydrogen end has a slight positive charge.
d. Both hydrogens are at one end of the molecule, and oxygen is at the other end.

63. What causes dipole interactions?

a. sharing of electron pairs
b. attraction between polar molecules
c. bonding of a covalently bonded hydrogen to an unshared electron pair
d. attraction between ions

64. Which of the following molecules is non-polar?

a. SO_2
b. SCl_2
c. SO_3
d. H_2S

65. Which of the following molecules is polar?

a. CCl_4
b. CHF_3
c. $Cl_2C{=}CCl_2$
d. CF_4

66. Which of the following formulas represents an ionic compound?

a. CS_2
b. BaI_2
c. N_2O
d. PCl_3

67. The name for $Sn(SO_4)_2$ is

a. Tin (II) sulfate
b. Tin (II) sulfide
c. Tin (IV) sulfate
d. Tin disulfate

68. In the reaction:
$2H_2O_2 \rightarrow 2H_2O + O_2$
the oxygen gas is the_____.

a. Reactant
b. Product
c. Catalyst
d. All the above

69. Chemical reactions

a. occur only in living organisms.
b. create and destroy atoms.
c. only occur outside living organisms.
d. produce new substances.

70. A catalyst is

a. the product of a combustion reaction.
b. not used up in a reaction.
c. one of the reactants in single-replacement reactions.
d. a solid product of a reaction.

71. What are the coefficients that will balance the skeleton equation below?
$AlCl_3 + NaOH \rightarrow Al(OH)_3 + NaCl$

a. 1, 3, 1, 3
b. 3, 1, 3, 1
c. 1, 1, 1, 3
d. 1, 3, 3, 1

72. What are the coefficients that will balance the skeleton equation below?
$N_2 + H_2 \rightarrow NH_3$

a. 1, 1, 2
b. 1, 3, 3
c. 3, 1, 2
d. 1, 3, 2

73. When the equation $Fe + Cl_2 \rightarrow FeCl_3$ is balanced, what is the coefficient for Cl_2?

a. 1
b. 2
c. 3
d. 4

74. Which of the following is an inorganic compound?

a. rust
b. carbohydrates
c. lipids
d. nucleic acids

75. The products of a combustion reaction include

a. water, carbon dioxide, and carbon monoxide.
b. hydrogen, water, and carbon dioxide.
c. hydrogen and carbon monoxide.
d. hydrogen and water.

76. In a double-replacement reaction, the

a. products are always molecular.
b. reactants are two ionic compounds.
c. reactants are two elements.
d. products are a new element and a new compound.

77. In the reaction $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$, what is the ratio of moles of oxygen used to moles of CO produced?

a. 1:1
b. 2:1
c. 1:2
d. 2:2

78. How many oxygen atoms are in the products of the following reaction? $C_6H_{12}O_6 + 6H_2O + 6O_2 \rightarrow 6CO_2 + 12H_2O$

a. 18
b. 6
c. 12
d. 24

79. What are the reactant(s) in the following chemical reaction?
$C_6H_{12}O_6 + 6H_2O + 6O_2 \rightarrow 6CO_2 + 12H_2O$

a. CO_2 and H_2O
b. $C_6H_{12}O_6$, H_2O, and O_2
c. O_2 only
d. $C_6H_{12}O_6$, H_2O, O_2, CO_2, and H_2O

If you took Honors Chemistry, the following questions should look familiar. If you took CP Chemistry, the following information can be found at the following reference sites. You are not required to look up this material, but may be helpful when learning about the uses of these chemicals and mixtures in biology.

Solutes, solvents, solutions: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/15.4/primary/lesson/solute-and-solvent-chem

Acids: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/21.1/primary/lesson/properties-of-acids-chem

Bases: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/7.13/primary/lesson/names-and-formulas-of-bases-chem

pH: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/21.9/primary/lesson/the-ph-scale-chem

51. Sugar dissolves when stirred into water. The sugar is the _____, the water is the_____, and the sweetened water is the_____.

    a. solution... solvent... solute
    b. solute... solvent... solution
    c. solvent... solute... solution
    d. solution... solute... solvent

52. Which of the following is an acid?

    a. NaOH
    b. NaCl
    c. HCl
    d. CH_4

53. A base_____.

    a. removes H_2O molecules from a solution
    b. decreases the pH of a solution
    c. removes OH^- ions from a solution
    d. removes H^+ ions from a solution

54. The lower the pH of a solution, the_____.

    a. greater the number of oxygen atoms
    b. more acidic the solution
    c. less toxic the solution
    d. higher the OH^- concentration

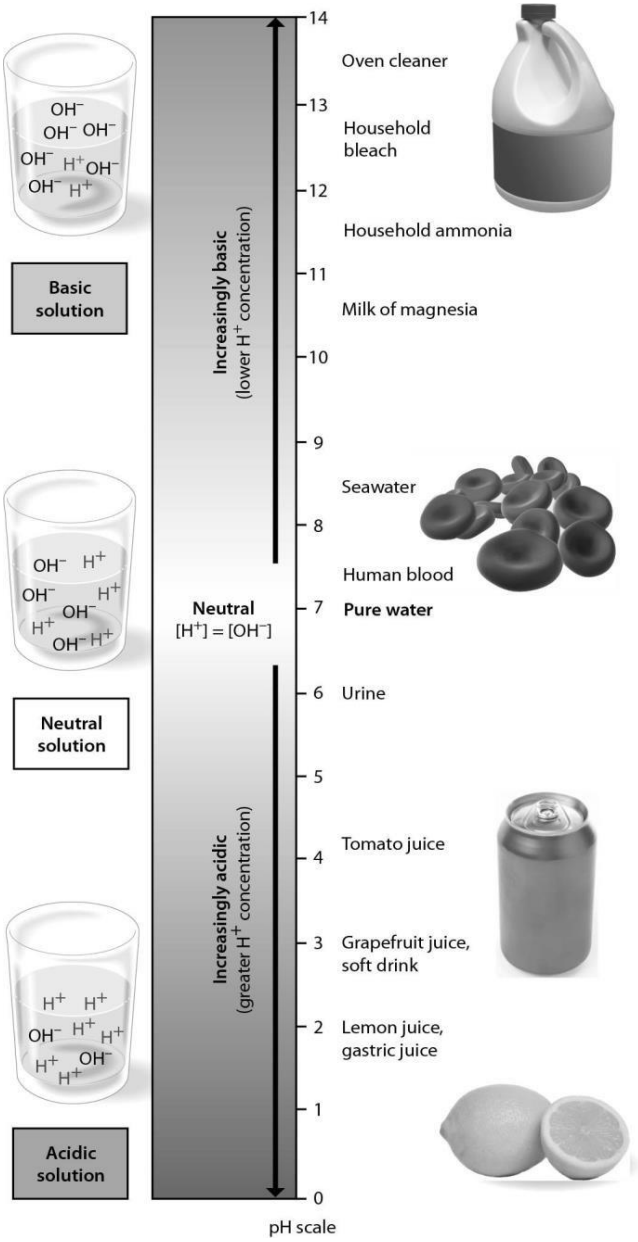
55. Relative to a pH of 6, a pH of 4 has ____.

a. 200 times higher H^+ concentration
b. 100 times higher H^+ concentration
c. 20 times higher H^+ concentration
d. 100 times lower H^+ concentration

56. What name is given to substances that resist changes in pH?

a. buffers
b. sugars
c. salts
d. bases

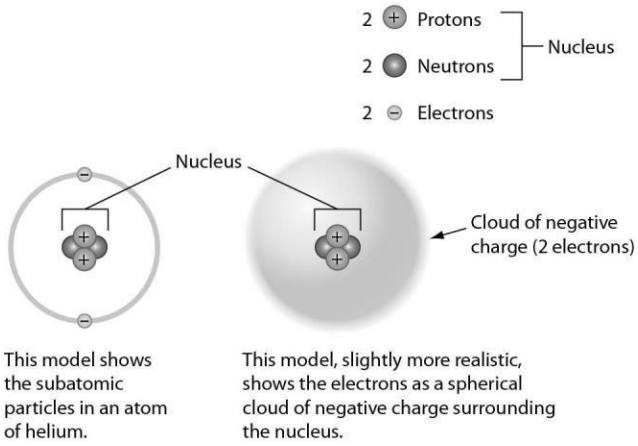
57. Examine the pH scale below. How does household bleach compare to household ammonia?



a. Household bleach is more acidic than household ammonia.
b. Household bleach has 10 times higher H^+ concentration than household ammonia.
c. Household bleach has 100 times higher H^+ concentration than household ammonia.
d. Household ammonia has 10 times higher H^+ concentration.

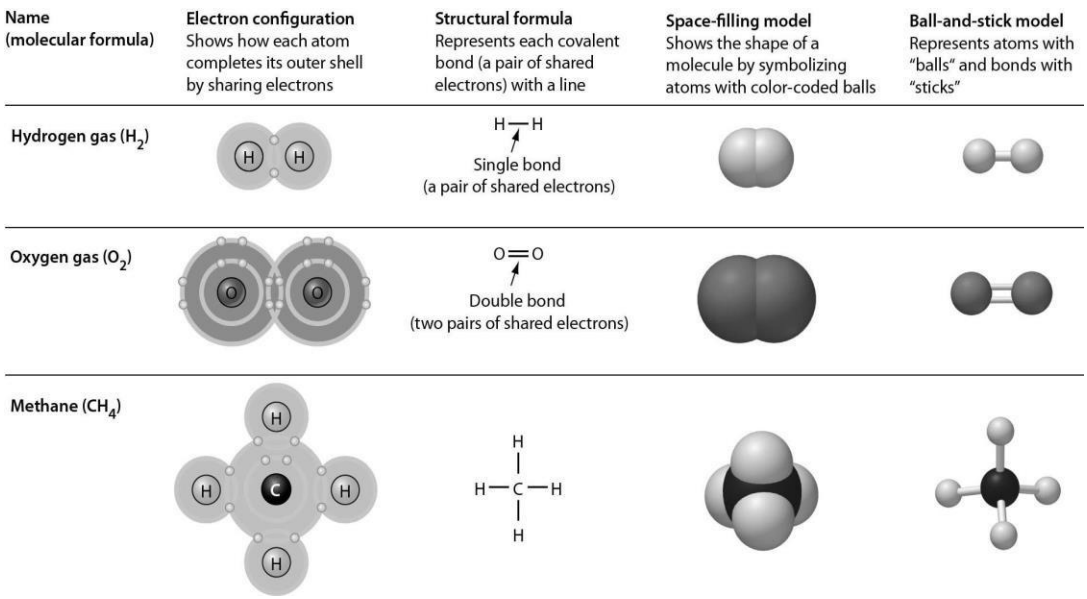
Art Questions

58. Examine the drawing of an atom below. The art is technically incorrect in that____.



a. neutrons are not located in the nucleus
b. the electrons should be much farther away from the nucleus
c. electrons do not orbit the nucleus
d. electrons do not have a negative charge

59. Examine the following figure. Which of the representations of molecules does *not* reveal double bonds?



a. electron configuration
b. structural formula
c. space-filling model
d. all of the representations of molecules reveal double bonds.

The remainder of this study packet covers topics that should be considered *enrichment* in preparation for your upcoming Honors Biology course. As such you will *not* be held accountable for completing this material by your Honors Biology teacher in regards to the assessments you *will* be receiving based on your completion of the earlier questions in this packet.

However, any independent research you elect to do towards understanding the following concepts will be extremely beneficial as you encounter these topics in your upcoming Honors Biology course.

Topic 1: Chemistry of Water
Core Concept/Application: Without water, life wouldn't exist. How does the structure of water affect how water interacts with itself and other molecules? Why is water so crucial to living things? Understanding hydrogen bonds and polarity will lead you to an answer to these questions.
Recommended reading:
Structure of water: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/15.1/primary/lesson/structure-of-water-chem/
Properties of water: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/15.3/primary/lesson/physical-properties-of-water-chem

Topic 2: Acids and Bases:
Core Concepts/Application: Acid/Base chemistry plays a huge role in how living things function. Understanding the differences between acids and bases, what neutral is, and how pH affects living things will help you understand how certain systems function.
Recommened reading:
Solutes, solvents, solutions: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/15.4/primary/lesson/solute-and-solvent-chem
Acids: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/21.1/primary/lesson/properties-of-acids-chem
Bases: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/7.13/primary/lesson/names-and-formulas-of-bases-chem
pH: https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/21.9/primary/lesson/the-ph-scale-chem

Topic 3: Life Science Vocabulary Terms
Core Concept/Application: Having an idea of some of the terms you may encounter will be helpful. As you know, terms in science sometimes have different meaning than what you may encounter every day. This is a fairly comprehensive list, and we will not hit all of them in our topics, but you will feel smarter after reading through this list!
Recommended reading:
https://www.stmargaretsch.org/documents/2018/7/Life-Science.pdf

Topic 4: Macromolecules
Core Concept/Application: Carbon is an essential element for living things. Looking at the four main categories of biological molecules will help you understand why living things function the way they do. Lipids, Nucleic Acids, Carbohydrates, and Proteins all have specific structures and roles in biology.
Recommended reading:
An introduction to macromolecules: https://www.cancerquest.org/cancer-biology/biological-building-blocks

A comprehensive overview of carbon and the structures carbon can form: https://opentextbc.ca/biology/chapter/2-3-biological-molecules/
A more in-depth look at the macromolecules: https://en.wikipedia.org/wiki/Macromolecules

Topic 5: Cellular Structures.
Core Concept/Application: Understanding the different parts of the cell and how they function, both independently and dependently, is essential to understanding how living things work. Looking at both cell types--prokaryotes and eukaryotes—and knowing the differences between them will help you understand the complexity of living things.
Recommended reading:
A quick look at cell theory: https://www.ck12.org/c/life-science/cell-theory/lesson/Cell-Biology-MS-LS/
A basic introduction to cell structure and how it relates to cell function: https://www.ck12.org/book/ck-12-biology-advanced-concepts/section/3.9/
A look at prokaryotic and eukaryotic cells and their structures: https://en.wikipedia.org/wiki/Cell_(biology)
Quiz yourself and see what you remember about the cell: https://www.ck12.org/section/cellular-structure-and-function-%3a%3aof%3a%3a-cellular-structure-and-function-assessments-%3a%3aof%3a%3a-ck-12-biology-quizzes-and-tests/