Chemistry
King – Fall 2015

1. Which of the following is a qualitative statement?
    a. The compound is contaminated.
    b. The reactants are 99.95% pure.
    c. The sample has a mass of 85 grams.
    d. The reaction produced 112 g of a pure white solid.
    e. The gas volume is twenty-two liters.

2. What is a statement summarizing a group of scientific facts called?
    a. law
    b. theory
    c. model
    d. qualitative statement
    e. hypothesis

3. A comfortable room temperature is 72 °F. Correctly estimating this temperature in Celsius
    yields:
    a. 8.0 °C.
    b. 14 °C.
    c. 22 °C.
    d. 54 °C.
    e. 98 °C.

4. Which of the following is not a physical property?
    a. pressure
    b. heat capacity
    c. hardness
    d. reactivity
    e. temperature

5. All of the following properties of a substance can aid in its identification except:
    a. density.
    b. temperature.
    c. reactivity.
    d. melting point.
    e. boiling point

6. A sample of gold has a mass of 63.49 g. What is its volume? (Density of gold = 19.3 g/mL)
    a. 1225 mL
    b. 63.5 mL
    c. 44.2 mL
    d. 3.29 mL
    e. 0.304 mL

7. Water is an unusual substance in that the density of the solid state (ice) is normally *lower* than
    the density of the liquid state. Suppose a friend brings you a glass of ice water. If you leave
    the glass untouched, what will happen over time?

a. The ice will melt and the resulting water level will be lower than before.
b. The ice will melt and the resulting water level will be unchanged.
c. The ice will melt and the resulting water level will be higher than before.
d. The ice will only melt if the mixture is stirred.
e. None of the above.

8. Which of the following is not a chemical property of water?
    a. Water interacts with some metals to produce hydrogen gas.
    b. Water combines with carbon dioxide in plants to produce starches and sugars.
    c. Water boils at 100 degrees Celsius.
    d. Water combines with sulfur dioxide and oxygen to produce sulfuric acid.
    e. Water and carbon dioxide are produced by the combustion of fossil fuels.

9. Which of the following substances is homogeneous?
    a. wood
    b. a jelly bean
    c. vegetable soup
    d. salt dissolved in water
    e. a mirror

10. Aluminum, salt, and coffee are:
    a. an element, a homogeneous mixture, and a pure substance.
    b. a pure substance, a heterogeneous mixture, and a pure substance.
    c. a homogeneous mixture, a pure substance, and a homogeneous mixture.
    d. an element, a pure substance, and a homogeneous mixture.
    e. none of the above.

11. Which is the best definition of a pure substance?
    a. A material that contains two or more types of atoms
    b. A material in the gas phase
    c. A material whose properties cannot be changed by further physical separation
    d. A material whose properties have been measured
    e. A material that has been heated

12. Three length scales ordered from smallest to largest are:
    a. microscale, nanoscale, macroscale.
    b. microscale, macroscale, nanoscale.
    c. macroscale, nanoscale, microscale.
    d. nanoscale, microscale, macroscale.
    e. none of the above.

13. Which characteristic below best fits the description of a solid?
    a. large distances between the molecules
    b. molecules that are close together but are moving past one another
    c. highly disordered molecules
    d. rapid molecular motion

e. highly ordered molecules

14. Which characteristics apply to the gaseous state?
    I.   low density
    II. high density
    III. rapid molecular motion
    IV. slow molecular motion
    V.   large distance between particles

    a. I, V
    b. II, V
    c. II, III, V
    d. I, IV, V
    e. I, III, V

15. In a chemical reaction, 36 g of water is broken down to yield 32 g of oxygen gas and 4 g of hydrogen gas. This is an example of:
    a. The Law of Constant Composition.
    b. The Law of Multiple Proportion .
    c. The Law of Conservation of Energy.
    d. The Law of Conservation of Mass.
    e. Dalton's Atomic Theory.

16. Methane is always composed of three parts by weight of carbon and one part by weight of hydrogen. This is an example of:
    a. The Law of Conservation of Mass.
    b. Dalton's Atomic Theory.
    c. The Law of Constant Composition.
    d. The Law of Multiple Proportion.
    e. The Law of Conservation of Energy.

17. How many of each types of atoms does the compound $Al_2(SO_4)_3$ contain?
    a. 2 aluminum, 1 sulfur and 4 oxygen
    b. 2 aluminum, 2 sulfur and 4 oxygen
    c. 2 aluminum, 3 sulfur and 4 oxygen
    d. 2 aluminum, 1 sulfur and 12 oxygen
    e. 2 aluminum, 3 sulfur and 12 oxygen

18. Which statement about electrons is true?
    a. Electrons are found in the nucleus of the atom.
    b. Electrons are attracted to negatively charged electrodes.
    c. All atoms have electrons as part of their structure.
    d. Electrons have much more mass than any atom.
    e. Electrons are positively charged.

19. Which of the following is the most correct for the cathode ray experiments?

a. The ray bent towards the positive exterior plate, proving that the ray was made up of negative particles.
b. The cathode ray experiment can be considered equivalent with the discovery of electrons.
c. The behavior of the ray was independent of the metal chosen to make the plates in side the vacuum tube, proving that all metals contain a common particle.
d. All of the above.
e. None of the above.

20. The Millikan oil drop experiment was used to determine
   a. whether the atom was radioactive.
   b. the electron distribution in the atom.
   c. the atomic number of an atom.
   d. the charge of an electron.
   e. the nuclear character of the atom.

21. When an atom loses electrons, _____ are formed.
   a. nuclei
   b. alpha particles
   c. protons
   d. neutrons
   e. ions

22. In Rutherford's gold foil experiment:
   a. the alpha particles used were attracted to the positive particles in the gold foil.
   b. Rutherford's expectations for the experiment were proven to be correct.
   c. neutrons were discovered.
   d. the alpha particles mostly bounced off the foil, with most particles undergoing sharp deflections.
   e. Rutherford concluded that there must be a compact, massive, positively charged particle inside the gold atoms.

23. What is the proper answer and number of significant figures for the following calculation:
   $0.421 + 7.70/12.245$?
   a. 0.663
   b. 0.6632
   c. 1.0498
   d. 1.05
   e. 1.050

24. Which of the following statements is not true ?
   a. $_{42}^{95}\text{Mo}$ contains 53 neutrons.
   b. $_{23}^{51}\text{V}$ has an atomic number of 23.
   c. $_{6}^{12}\text{C}$ has the same number of protons, neutrons and electrons.
   d. $_{30}^{66}\text{Zn}$ has the same number of electrons and protons.
   e. $_{26}^{56}\text{Fe}$ has the same number of neutrons and protons.

25. Which statement best describes isotopes?
    a. atoms in the same vertical family
    b. atoms with the same number of protons and different numbers of neutrons
    c. atoms with the same number of neutrons and a different number of protons
    d. atoms with the same numbers of protons and neutrons
    e. atoms in the same horizontal period

26. Suppose the isotopic ratio of the two boron isotopes ^{10}B (10.013 amu) and ^{11}B (11.009 amu) in a sample has been altered from the ratio found in nature and now contains 58.73% ^{10}B in the sample. Determine the atomic weight of this sample of boron.
    a. 10.511 amu
    b. 10.013 amu
    c. 11.009 amu
    d. 10.424 amu
    e. 10.498 amu

27. Which sample contains the fewest atoms?
    a. 10 g of C
    b. 10 g of Ne
    c. 10 g of F
    d. 10 g of N
    e. 10 g of O

28. How many atoms are in a 10.0 g sample of titanium (Ti)?
    a. 1.16×10^{27}
    b. 1.26×10^{23}
    c. 2.20×10^{23}
    d. 2.86×10^{23}
    e. 5.06×10^{26}

29. Which element can be classified as a halogen?
    a. He
    b. H
    c. O
    d. Cl
    e. La

30. Which element is the least reactive and is found uncombined in nature?
    a. Au
    b. Fe
    c. Ne
    d. N
    e. Cu

31. The formula $CH_3CH_2CH_2OH$ is an example of a(n):

a. structural formula.
b. functional group formula.
c. inorganic formula.
d. ball and stick model.
e. condensed formula.

32. Which of the following is not a binary compound?
   a. H_2O
   b. $CaCl_2$
   c. NH_3
   d. HCN
   e. NaBr

33. Which formula name combination is incorrect?
   a. CS_2 and carbon disulfide
   b. SO_2 and sulfur dioxide
   c. P_2O_3 and diphosphorus trioxide
   d. CCl_4 and carbon tetrachloride
   e. SCl_2 and sulfur bichloride

34. What is the correct general formula for an alkane?
   a. C_nH_{2n}
   b. C_nH_{n+2}
   c. C_nH_n
   d. C_nH_{2n+2}
   e. C_nH_{2n-2}

35. Which compound will have the highest boiling point?
   a. pentane
   b. methanol
   c. propanol
   d. pentanol
   e. butane

36. Find the correct combination of protons and electrons below for the fluoride ion.
   a. 9 protons and 8 electrons
   b. 9 protons and 9 electrons
   c. 9 protons and 10 electrons
   d. 19 protons and 18 electrons
   e. 19 protons and 20 electrons

37. Which of the following is not an ionic compound?
   a. $MgCl_2$
   b. NaOH

c. NaF

d. FCl_3

e. CaO

38. Give the formula for the ionic compound that forms between strontium and fluorine.

a. Sr_2F

b. Sr_2F_3

c. Sr_2F_4

d. SrF

e. SrF_2

39. Which compound is incorrectly named?

a. MgO   magnesium oxide

b. Fe_2O_3 iron(II) oxide

c. CsCl cesium chloride

d. K_2S potassium sulfide

e. NaN_3 sodium nitride

40. A combustion reaction produces 49.4 g of CO_2. Determine the number of moles of carbon dioxide present.

a. 1.78 moles

b. 1090 moles

c. 0.891 moles

d. 0.882 moles

e. 1.12 moles

41. Determine the number of molecules in a drop of water that has a mass of 0.050 g.

a. 6.50×10^{26} molecules

b. 5.02×10^{21} molecules

c. 5.42×10^{23} molecules

d. 2.17×10^{26} molecules

e. 1.67×10^{21} molecules

42. Determine the percent platinum in cisplatin, $PtCl_2(NH_3)_2$.

a. 0.650%

b. 78.9%

c. 58.5%

d. 65.0%

e. 23.6%

43. An organic compound has an empirical formula of CH_2O and had an approximate molecular weight of 117. What is its molecular formula?
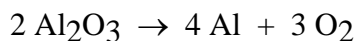
a. $C_{3.9}H_{7.8}O_{3.9}$

b. $C_{3.9}H_{3.9}O_{3.9}$

c. $C_4H_4O_4$

d. $C_8H_4O_8$

e. $C_4H_8O_4$

44. An organic compound contains 49.3% carbon, 6.9% hydrogen and the remainder oxygen. Determine the empirical formula of the compound.

a. CH_2O

b. C_3H_2O

c. C_3H_5O

d. $C_3H_5O_2$

e. $C_6H_{10}O_5$

45. In the reaction given below, if 12 moles of aluminum oxide are consumed, how many moles of oxygen gas are produced?
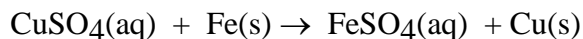
$$2\ Al_2O_3\ \rightarrow\ 4\ Al\ +\ 3\ O_2$$

a. 3

b. 4

c. 6

d. 12

e. 18

46. Classify the following reaction.

$$CaCO_3(s) \rightarrow CaO(s)\ +\ CO_2(g)$$

a. decomposition

b. displacement

c. combustion

d. exchange

e. combination

47. Classify the following reaction.

$$CuSO_4(aq)\ +\ Fe(s) \rightarrow\ FeSO_4(aq)\ +\ Cu(s)$$

a. combustion

b. exchange

c. combination

d. decomposition

e. displacement

48. The Roman numerals in the reaction given represent the coefficients in the balanced chemical equation. What are the values of the coefficients?
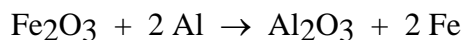
$$I\ CO\ +\ II\ NO\ \rightarrow\ III\ CO_2\ +\ IV\ N_2$$
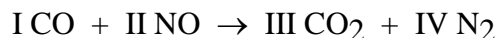
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     I  II  III  IV
a.   2   2   2   3
b.   2   2   2   1
c.   1   1   1   2
d.   2   1   2   1
e.   1   2   2   1
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49. How many mol of ammonia will be formed from the complete reaction of 45.0 g of H_2?
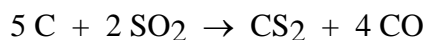
$$N_2 + 3 H_2 \rightarrow 2 NH_3$$
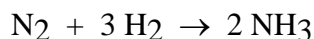
a. 11.1 mol
b. 14.9 mol
c. 16.7 mol
d. 7.43 mol
e. 22.3 mol

50. How many grams of Al_2O_3 are formed by the complete reaction of 48.5 g of Fe_2O_3?

$$Fe_2O_3 + 2 Al \rightarrow Al_2O_3 + 2 Fe$$

a. 26.1 g
b. 31.0g
c. 37.7 g
d. 62.4 g
e. 139 g

51. If 225 g of carbon reacts with excess sulfur dioxide to produce 195 g of carbon disulfide, what is the percent yield for the reaction?
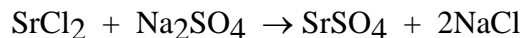
$$5 C + 2 SO_2 \rightarrow CS_2 + 4 CO$$

a. 78.9%
b. 68.4%
c. 22.5%
d. 19.5%
e. 15.7%

52. The complete combustion of a hydrocarbon produces 90.36 g of CO_2 and 46.25 g of H_2O. What is the empirical formula of the hydrocarbon?
a. CH
b. CH_2
c. C_2H_5
d. C_3H_8
e. C_3H_4

53. Which statement about the reaction below is true, given large amounts of reactants?

$$SrCl_2 + Na_2SO_4 \rightarrow SrSO_4 + 2NaCl$$

a. $SrSO_4$ is soluble in water and will not precipitate.

b. NaCl is a spectator ion and will not precipitate.

c. SO_4^{2-} is a spectator ion and will not precipitate.

d. Na^+ is a spectator ion and will not precipitate.

e. All compounds in the reaction are soluble in water and no reaction occurs.

54. Which statement about strong acids is true?
   a. Strong acids are weak electrolytes.
   b. Strong acids are very concentrated.
   c. Strong acids are mostly converted to ions when dissolved in water.
   d. Citric acid is a strong acid.
   e. Strong acids react only with strong bases.

55. Which statement about neutralization reactions is true?
   a. A weak acid cannot neutralize a strong base.
   b. The net ionic equation for a neutralization reaction shows the formation of hydrogen gas
   c. The net ionic equation for a neutralization reaction shows the formation of soluble salts.
   d. The net ionic equation for a neutralization reaction shows the formation of water.
   e. Organic acids neutralize bases by forming hydrogen gas.

56. Which substance is reduced in the reaction below?

$$Na_2SO_4 + 4\,C \rightarrow Na_2S + 4CO$$
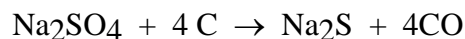
   a. CO
   b. S
   c. Na_2S
   d. Na_2SO_4
   e. none of the above

57. What is the molarity of a solution that results when 21.3 g of $(NH_4)_3PO_4$ is dissolved in water and diluted to exactly 250.0 mL?
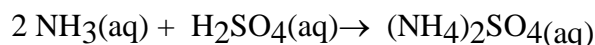   a. 1.61×10^{-4} M
   b. 0.357 M
   c. 0.572 M
   d. 2.28 M
   e. 85.2 M

58. How many grams of KCl are in 125.0 mL of 0.375 M KCl?
   a. 3.49 g
   b. 0.0469 g
   c. 3.49×10^{-3} g
   d. 46.9 g

e. 0.938 g

59. Ammonia and sulfuric acid react according to the equation given below. How many milliliters of 0.110 M sulfuric acid are required to exactly neutralize 25.0 mL of 0.0840 M NH_3 solution?

$$2\ NH_3(aq) +\ H_2SO_4(aq) \rightarrow\ (NH_4)_2SO_4(aq)$$

a. 1.46 mL
b. 1.82 mL
c. 3.64 mL
d. 5.85 mL
e. 9.55 mL

60. Determine if each of the four situations below describes kinetic or potential energy.
  I   the bonds in propane molecules
  II   a reservoir of water behind a dam
  III   water molecules colliding into each other
  IV   the electrical current in a light bulb that is turned on

I	II	III	IV

a. potential   potential   potential   kinetic
b. potential   potential   kinetic   potential
c. potential   potential   kinetic   kinetic
d. kinetic   potential   kinetic   potential
e. kinetic   potential   kinetic   kinetic

61. If a system heats and compresses its surroundings then:
  a. ΔE_{system} is positive
  b. ΔE_{system} is negative
  c. ΔE_{total} is positive
  d. ΔE_{total} is negative
  e. Not enough information to determine which of the above is true.

62. Which property can be used to distinguish one substance from another substance?
  a. specific heat capacity
  b. kinetic energy
  c. temperature
  d. enthalpy
  e. internal energy

63. A sample of water containing 2.00 moles is initially at 30.0°C. If the sample absorbs 2.00 kJ of heat, what is the final temperature of the water? (specific heat of water = 4.184 J g^{-1} °C^{-1})
 a. 13.3°C
  b. 30.2°C
  c. 43.3°C

d. 46.7°C

e. 269°C

64. Determine if each of the four processes below describes positive or negative changes to the internal energy of the system.

  I   water absorbs heat from the surroundings and becomes steam
  II steam expands and pushes against the surrounding air
  III fuel molecules burn and heat the surroundings
  IV air is compressed into an inner tube by an external pump

I	II	III	IV
a. positive	negative	positive	negative
b. positive	negative	negative	positive
c. negative	positive	positive	negative
d. negative	positive	negative	positive
e. positive	positive	negative	negative

65. The complete combustion of 1.47 g of methanol produces 29.3 kJ of heat. Determine the $\Delta H°$ for the reaction and its sign.

$$CH3OH(l) + 3/2O2(g) \rightarrow CO2(g) + 2H2O(g)$$
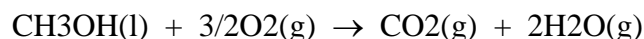
a. -938 kJ

b. -638 kJ

c. -1.35 kJ

d. +638 kJ

e. +938 kJ

66. The temperature of 3.50 kg of water is raised by 1.17°C when 1.00 g of hydrazine N_2H_4 is burned in a bomb calorimeter. The calorimeter has a heat capacity of 883 J/°C. How much heat is given off by the sample?

a. 0.944 kJ

b. 16.3 kJ

c. 17.1 kJ

d. 18.2 kJ

e. 21.5 kJ

67. Determine the heat of reaction for the process

$$Fe2O3(s) + FeO(s) \rightarrow Fe3O4(s)$$

using the information given below:

|	
$2Fe(s) + O2(g) \rightarrow 2FeO(s)$	$\Delta H° = -544.0$ kJ
$4Fe(s) + 3O2(g) \rightarrow 2Fe2O3(s)$	$\Delta H° = -1648.8$ kJ
$3Fe(s) + 2O2(g) \rightarrow Fe3O4(s)$	$\Delta H° = -1118.4$ kJ

a. -1074.0 kJ
b. -22.0 kJ
c. 22.2 kJ
d. 249.8 kJ
e. 1074.0 kJ

68. The standard enthalpies of formation for several substances are given below:

$CO_{(g)}$	-110.5 kJ/mol	$CO_{2(g)}$	-393.5 kJ/mol
$H_2O_{(l)}$	-285.8 kJ/mol	$H_2O_{(g)}$	-241.8 kJ/mol
$H_2O_{2(l)}$	-187.8 kJ/mol	$CH_3OH_{(g)}$	-200.7 kJ/mol
$C_2H_5OH_{(l)}$	-277.7 kJ/mol	$C_2H_5OH_{(g)}$	-235.1 kJ/mol

Determine the $\Delta H°$ for the reaction below.

$$2CO_{(g)} + 4H_{2(g)} \rightarrow C_2H_5OH_{(g)} + H_2O_{(g)}$$
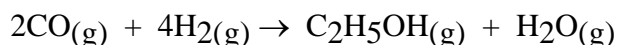
a. -366.4 kJ
b. -299.9 kJ
c. -298.5 kJ
d. -255.9 kJ
e. 255.9 kJ

69. Light has a wavelength of 444 nm. What is its frequency? The speed of light is 3.00×10^8 m/s.

a. 1.48×10^{-6} Hz
b. 1.48×10^{-15} Hz
c. 1.48×10^2 Hz
d. 6.76×10^{14} Hz
e. 6.76×10^{-4} Hz

70. Determine the energy of a photon that has a wavelength of 714 nm. The speed of light is 3.00×10^8 m/s and h = 6.63×10^{-34} J s.

a. 1.58×10^{-48} J
b. 1.42×10^{-31} J
c. 1.42×10^{-22} J
d. 6.34×10^{-21} J
e. 2.79×10^{-19} J

71. Which statement regarding the Bohr model of the atom is true?
a. An element produces a continuous spectrum.
b. Electrons lose quantized amounts of energy when moving to the ground state.
c. Electrons cannot be located between energy levels.
d. Light is emitted when an electron moves from the ground state to an excited state.
e. Electrons in the lowest energy level are in an excited state.

72. Which idea was proposed by Werner Heisenberg?
    a. Certain metals emit electrons when illuminated by light with low enough wavelength.
    b. Light waves passing through a diffraction parting produce a diffraction pattern.
    c. Light waves have particle properties, and particles of matter have wave-like properties.
    d. Photons used to determine the location of electrons have no measurable effect on
        electrons.
    e. Simultaneously determining the exact momentum and exact position of an electron is
        impossible.

73. Match the names of the four quantum numbers with their symbols.
    azimuthal magnetic   principal   spin

    a. n, l, m_l, m_s
    b. l, m_s, n, m_l
    c. m_l, m_s, l, n
    d. l, m_l, n, m_s
    e. m_l, l, n, m_s

74. Which set of quantum numbers is not allowed?
    a. n = 0, l = 0, m_l = 0, m_s = +1/2
    b. n = 1, l = 0, m_l = 0, m_s = +1/2
    c. n = 2, l = 1, m_l = 1, m_s = +1/2
    d. n = 3, l = 1, m_l = 0, m_s = +1/2
    e. n = 4, l = 3, m_l = 0, m_s = -1/2

75. What is the correct shorthand notation for the electron configuration given?

$$1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^2$$
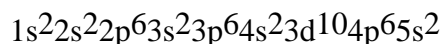
    a. $[Ar]5s^2$
    b. $[Ar]3s^23p^63d^{10}4p^65s^2$
    c. $[Ca]3d^{10}4p^65s^2$
    d. $[Kr]5s^2$
    e. $[Rb]5s^1$

76. Assume the compounds below contain only single bonds. Which compound is
    cyclopentane?
    a. CH_4
    b. C_3H_8
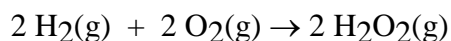   c. C_5H_{10}
    d. C_8H_{18}
    e. C_9H_{20}

77. Which molecule does not contain a double bond?

a. CO_2
b. CH_2O
c O_2
d HCOOH
e HCN

78. Which molecule does not contain a multiple bond?
   a. H_2O_2
   b. C_2H_2
   c. CH_2O
   d. CO_2
   e. O_2

79. From the data given below, calculate the approximate enthalpy change of reaction for the reaction below.

$$2 H_2(g) + 2 O_2(g) \rightarrow 2 H_2O_2(g)$$

bond enthalpy kJ/mol
O-O	146
O-H	463
O=O	498
H-H	436

   a. -490 kJ
   b. -276 kJ
   c. -138 kJ
   d. +138 kJ
   e. +325 kJ

80. What is the formal charge on sulfur in SO_2?
   a. +2
   b. +1
   c. 0
   d. -1
   e. -2

81. Which of the following statements about resonance are true?

   I. Resonance hybrids occur because a compound changes back and forth between two or more resonance structures.
   II. Resonance structures differ in the arrangement of electrons but not in the arrangement of atoms.
   III. Resonance hybrids contain delocalized electrons.
   IV. Resonance structures for a given compound always contribute equally to the resonance hybrid.

V. Resonance structures occur when there are two or more valid Lewis structures for a given compound.

VI. Resonance hybrids are a composite of resonance structures.

    a. I, II, V, VI
    b. I, II, V, VI
    c. II, III, IV, VI
    d. II, III, V, VI
    e. II, IV, V, VI

82. VSEPR is based upon what principle?
    a. The size of the electrons in the valence shell of a molecule determines the shape of the molecule.
    b. The velocity of the electrons in the valence shell of a molecule determines the shape of the molecule.
    c. The repulsion of electrons in the valence shell of a molecule determines the shape of the molecule.
    d. The attraction of electrons in the valence shell of a molecule determines the shape of the molecule.
    e. The mass of the electrons in the valence shell of a molecule determines the shape of the molecule.

83. How many lone pairs of electrons does the Lewis dot structure of H_2S have around its central atom and what is the shape of the molecule?
    a. 0, linear
    b. 0, bent
    c. 1, triangular planar
    d. 2, tetrahedral
    e. 2, bent

84. Determine the hybridization around the central atom in SF_5^+
    a. sp
    b. sp^2
    c. sp^3
    d. sp^3d
    e. sp^3d^2

85. Which description of a sigma bond is false?
    a. head-to-head orbital overlap
    b. electron density always lies along the bonding axis
    c. orbital overlap is always between atomic orbitals
    d. valence electrons are involved
    e. orbital overlap is always along the interatomic axis

86. Which molecule is polar?

a. BF_3
b. H_2Se
c. N_2
d. GeF_4
e. CO_2

87. List whether the following molecules are polar or nonpolar.

CH_2Cl_2 SiH_4 SO_2

a. nonpolar, nonpolar, nonpolar
b. nonpolar, nonpolar, polar
c. polar, nonpolar, polar
d. polar, polar, nonpolar
e. polar, polar, polar

88. On the basis of London forces, molecules with _____ molecular weights tend to have _____ melting points.
a. lower, higher
b. higher, lower
c. higher, higher
d. even, higher
e. odd, higher

89. DNA is a _____.
a. polymer
b. single helix
c. double helix
d. a and c
e. b and c

90. What happens to a helium balloon at a party on a hot day if the balloon was filled on a cold morning?

a. The balloon shrinks because the warmer day temperature speeds up the helium atoms and increases the number of atoms that escape through the inner wall of the balloon.
b. The balloon expands because the warmer day temperature causes the helium atoms to be less attracted to each other and allows them to occupy more space inside the balloon.
c. The balloon expands because the warmer day temperature speeds up the helium atoms and increases the force and frequency of gas collisions on the inner wall of the balloon.
d. The balloon shrinks because the warmer day temperature causes the helium atoms to be more attracted to each other and allows them to occupy less space inside the balloon.
e. The balloon keeps the same volume because the amount of gas inside the balloon does not change.

91. Which of the following correctly describes the relationship between the pressure of a gas and the volume of a gas at constant temperature?
    a. as one increases the other increases
    b. unrelated
    c. directly proportional
    d. irreversibly proportional
    e. inversely proportional

92. At 20°C, a sample of gas has a volume of 2.51 L at 795 torr. What is the new pressure (in atm) if the volume is increased to 6.46 L at the same temperature?

    a. 2.69
    b. 0.813
    c. 0.406
    d. 309
    e. 2050

93. What is the pressure (in atm) exerted by a 2.00 mole sample of gas that occupies 2.50 L at 307.15K? The value of R = 0.0821 L atm mol^{-1} K^{-1}.
    a. 40.3
    b. 20.2
    c. 80.7
    d. 0.0496
    e. 38.1

94. The following is the reaction that occurs in automobile airbags:
$$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$$

How many grams of sodium azide (NaN_3) are required to produce 19.00 L of N_2 at 293K and 775 mm Hg?
    a. 34.9
    b. 52.0
    c. 2.66 × 10^4
    d. 3.89 × 10^5
    e. 5.80 × 10^5

95. Which two assumptions of the Kinetic-Molecular Theory need to be altered to account for the behavior of real gases?
    I.   gas molecules have no volume
    II. gas molecules move in random motion
    III. gas molecules undergo no attractive or repulsive force toward one another
    IV. gas molecules undergo perfectly elastic collision

    a. I and II
    b. I and III

c. II and III
d. II and IV
e. III and IV

96. Which property of a liquid is paired with an **incorrect** explanation for that property?
    a. fluid, because the molecules retain some mobility
  b. transmit pressure equally in all directions, because their molecules can move in all directions
    c. capillary action, because the molecules are less attracted to each other than to the walls of
        the container
    d. incompressible, because the molecules are relatively far apart
    e. viscous, because the molecules can become entangled as they move past each other

97. Which group includes only **endothermic** processes?
    a. freezing, vaporization, deposition
    b. freezing, condensation, deposition
    c. melting, condensation, deposition
    d. melting, evaporation, sublimation
    e. melting, condensation, sublimation

98. Which statement about heat of fusion and heat of condensation is correct?
    a. There is no general relationship between these two quantities and the values depend on the
        substance involved.
    b. The heat of fusion is always less than the heat of condensation.
    c. The heat of fusion is exactly equal to the heat of condensation.
    d. The heat of fusion represents the heat released when a gas becomes a liquid, and the heat
        of condensation represents the heat required for a liquid to become a gas.
    e. The heat of condensation is equal in magnitude but opposite in sign when compared to the
        heat of fusion

99. A positive slope for a region of a heating curve indicates that _____ in that region.
    a. no energy is being absorbed by the system
    b. energy is being given off by the system, but it cannot be measured
    c. energy is being absorbed by the system and is being used for a phase change
    d. additional data is needed to explain this observation
    e. energy is being absorbed by the system and is being used to increase the temperature

100. Which choice is an example of a metallic solid?
    a. NaCl
    b. crystal
    c. iron
    d. quartz
    e. glass

101. A composite material is one which
    a. is either plastic or brittle and does not conduct heat or electricity.
    b. has a shiny surface and is a good conductor of heat and electricity.

c. occurs naturally and can be purified to use in manufacturing alloys.
d. is brittle, nonmetallic, resistant to heat and chemically unreactive.
e. combines properties of metals, polymers, and ceramics to perform a specific function.