Name: _____

Answer all questions on the answer document. This is a TAKE HOME TEST due on Wednesday, June 7.

1. The graph below shows the radioactive decay of rubidium-87.

What percentage of rubidium-87 atoms will be left after four half-lives?

A. 25.0%
B. 12.5%
C. 6.25%
D. 3.125%

2. Given the equation representing a reaction at equilibrium:

$$H_2S(aq) + CH_3NH_2(aq) \rightleftharpoons HS^-(aq) + CH_3NH_3^+(aq)$$

According to one acid-base theory, the forward reaction is classified as an acid-base reaction because

A. H_2S is a H^+ donor and CH_3NH_2 is a H^+ acceptor
B. CH_3NH_2 is a H^+ donor and H_2S is a H^+ acceptor
C. HS^- and $CH_3NH_3^+$ are both H^+ donors
D. $CH_3NH_3^+$ and HS^- are both H^+ acceptors

3. Which ionic equation represents a spontaneous reaction that can occur in a voltaic cell?

A. $Cu(s) + Zn(s) \rightarrow Cu^{2+}(aq) + Zn^{2+}(aq)$
B. $Cu(s) + Zn^{2+}(aq) \rightarrow Cu^{2+}(aq) + Zn(s)$
C. $Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$
D. $Cu^{2+}(aq) + Zn^{2+}(aq) \rightarrow Cu(s) + Zn(s)$

4. Given the equation representing a reaction:

$Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$

Which term best describes this reaction?

A. ionization
B. neutralization
C. oxidation
D. Reduction

5. The table below shows the atomic mass and natural abundance of the two naturally occurring isotopes of lithium.

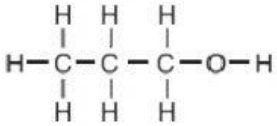
Naturally Occurring Isotopes of Lithium

Isotope	Atomic Mass (u)	Natural Abundance (%)
Li-6	6.015	7.6
Li-7	7.016	92.4

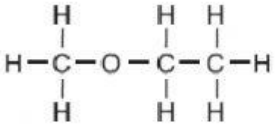
Which numerical setup can be used to determine the atomic mass of naturally occurring lithium?

A. (7.6)(6.015 u) + (92.4)(7.016 u)
B. (0.076)(6.015 u) + (0.924)(7.016 u)
C. $\frac{(7.6)(6.015u) + (92.4)(7.016u)}{2}$
D. $\frac{(0.076)(6.015u) + (0.924)(7.016u)}{2}$

6. Given the formulas representing two compounds at standard pressure:



1 – propanol

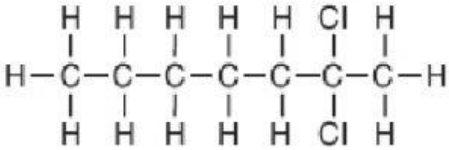


methyl ethyl ether

The compounds can be differentiated by their

A. boiling points
B. gram-formula masses
C. numbers of hydrogen atoms
D. percent compositions by mass of carbon

7. Given the formula representing a compound:



What is the IUPAC name of this compound?

A. 2-chloroheptane
B. 6-chloroheptane
C. 2,2-dichloroheptane
D. 6,6-dichloroheptane

LIVEWORKSHEETS

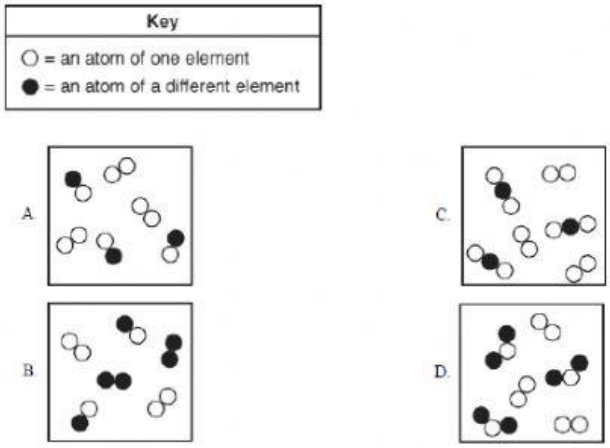
8. Given the equation representing a system at equilibrium:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

Which statement describes this system?

A. The concentration of $PCl_5(g)$ is increasing.
B. The concentration of $PCl_5(g)$ is decreasing.
C. The concentrations of $PCl_5(g)$ and $PCl_3(g)$ are equal.
D. The concentrations of $PCl_5(g)$ and $PCl_3(g)$ are constant.

9. Which particle diagram represents a mixture of three substances?



10. Which change in the H^+ ion concentration of an aqueous solution represents a *decrease* of one unit on the pH scale?

A. a tenfold increase
B. a tenfold decrease
C. a hundredfold increase
D. a hundredfold decrease

11. How many joules of heat are absorbed to raise the temperature of 435 grams of water at 1 atm from 25°C to its boiling point, 100.°C?

A. 4.5×10^4 J
B. 1.4×10^5 J
C. 2.5×10^7 J
D. 7.4×10^7 J

12. Based on Table *F*, which compound is *least* soluble in water?

A. $AlPO_4$
B. Li_2SO_4
C. $Ca(OH)_2$
D. $AgC_2H_3O_2$

13. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

Which statement describes the energy changes that occur in this reaction?

A. Energy is absorbed as bonds are formed, only.
B. Energy is released as bonds are broken, only.
C. Energy is absorbed as bonds are formed, and energy is released as bonds are broken.
D. Energy is absorbed as bonds are broken, and energy is released as bonds are formed.

14. What is the gram-formula mass of $Ca(OH)_2$?

A. 29 g/mol
B. 54 g/mol
C. 57 g/mol
D. 74 g/mol

15. Given the balanced equation representing a reaction:

$$2H_2 + O_2 \rightarrow 2H_2O + \text{energy}$$

Which mass of oxygen completely reacts with 4.0 grams of hydrogen to produce 36.0 grams of water?

A. 8.0 g
B. 16.0 g
C. 32.0 g
D. 40.0 g

16. Which molecular formula is also an empirical formula?

A. C_6H_6
B. H_2O_2
C. N_2H_4
D. N_2O_5

17. What is the chemical name for Na_2SO_3?

A. sodium sulfite
B. sodium sulfate
C. sodium sulfide
D. sodium thiosulfate

18. Which general trends in atomic radius and electronegativity are observed as the elements in Period 3 are considered in order of increasing atomic number?

A. Atomic radius decreases and electronegativity increases.
B. Atomic radius increases and electronegativity decreases.
C. Both atomic radius and electronegativity increase.
D. Both atomic radius and electronegativity decrease.

LIVEWORKSHEETS

19. At STP, which element is malleable and a good conductor of electricity?

A. xenon
B. silicon
C. platinum
D. hydrogen

20. Which electron configuration represents the distribution of electrons in a potassium atom in the ground state?

A. 2-8-8-1
B. 2-8-7-2
C. 2-8-5
D. 2-7-6

21. Which term represents a nuclear reaction?

A. combustion
B. fermentation
C. transmutation
D. Saponification

22. A sample of which radioisotope emits particles having the greatest mass?

A. ^{137}Cs
B. ^{53}Fe
C. ^{220}Fr
D. ^{3}H

23. An electrolytic cell differs from a voltaic cell because an electrolytic cell

A. generates its own energy from a spontaneous physical reaction
B. generates its own energy from a nonspontaneous physical reaction
C. requires an outside energy source for a spontaneous chemical reaction to occur
D. requires an outside energy source for a nonspontaneous chemical reaction to occur

24. The electrical conductivity of an aqueous solution depends on the concentration of which particles in the solution

A. molecules
B. electrons
C. atoms
D. ions

25. Which type of equation can represent the oxidation occurring in a reaction?

A. a double-replacement reaction equation
B. a half-reaction equation
C. a neutralization reaction equation
D. a transmutation reaction equation

26. In a redox reaction, the total number of electrons lost is

A. less than the total number of electrons gained
B. greater than the total number of electrons gained
C. equal to the total number of electrons gained
D. unrelated to the total number of electrons gained

27. Which type of reaction includes esterification and polymerization?

A. decomposition
B. neutralization
C. organic
D. nuclear

28. Which term represents a chemical reaction?

A. deposition
B. combustion
C. sublimation
D. vaporization

29. Which formula represents an alkane?

A. C_2H_2
B. C_2H_4
C. C_3H_4
D. C_3H_8

30.Which term is defined as a measure of the randomness of a system?

A. heat
B. entropy
C. pressure
D. temperature

31. Which sample of matter has particles arranged in a crystalline structure?

A. Ne(g)
B. $Br_2(\ell)$
C. NaCl(aq)
D. $CuSO_4(s)$

LIVEWORKSHEETS

32. Which term represents an intermolecular force in a sample of water?

A. hydrogen bonding
B. covalent bonding
C. metallic bonding
D. ionic bonding

33. Which process is a chemical change?

A. evaporating an alcohol
B. subliming of iodine
C. melting an ice cube
D. rusting of iron

34. Differences in which property allow the separation of a sample of sand and seawater by filtration?

A. concentration of ions
B. volume of sample
C. mass of sample
D. particle size

35. Which sample of matter represents a mixture?

A. aqueous ammonia
B. gaseous ethane
C. liquid mercury
D. solid iodine

36. Which substance can be decomposed by chemical means?

A. cobalt
B. krypton
C. methane
D. zirconium

37. In a chemical reaction, a catalyst provides an alternate reaction pathway that

A. decreases the concentration of the products
B. increases the concentration of the reactants
C. has a lower activation energy
D. has a higher activation energy

38. Which property is used to determine the degree of polarity between two bonded atoms?

A. density
B. electronegativity
C. pressure
D. temperature

39. A molecule must be nonpolar if the molecule

A. is linear
B. is neutral
C. has ionic and covalent bonding
D. has a symmetrical charge distribution

40. How many pairs of electrons are shared between the nitrogen atoms in a molecule of N_2?

A. 5
B. 2
C. 3
D. 6

41. Which element has the highest boiling point at standard pressure?

A. Mg
B. Na
C. Rb
D. Sr

42. A compound is a substance composed of two or more elements that are

A. physically mixed in a fixed proportion
B. physically mixed in a variable proportion
C. chemically combined in a fixed proportion
D. chemically combined in a variable proportion

43. At STP, $O_2(g)$ and $O_3(g)$ have different properties because $O_3(g)$ has

A. more dense nuclei than in $O_2(g)$
B. more protons per atom than in $O_2(g)$
C. molecules with a different structure than in $O_2(g)$
D. molecules with fewer covalent bonds than in $O_2(g)$

44. What is the charge of the nucleus of a copper atom?

A. +1
B. +2
C. +29
D. +64

45. Which list of elements contains a metal, a metalloid, and a nonmetal?

A. Ag, Si, I_2
B. Ge, As, Ne
C. K, Cu, Br_2
D. S, Cl_2, Ar

46. Which group on the Periodic Table has two elements that exist as gases at STP?

A. Group 1
B. Group 2
C. Group 16
D. Group 17

LIVEWORKSHEETS

47. Which element has atoms in the ground state with the greatest number of valence electrons?

A. tin
B. sulfur
C. arsenic
D. fluorine

48. Which term identifies the most probable location of an electron in the wave-mechanical model of the atom?

A. anode
B. orbital
C. nucleus
D. cathode

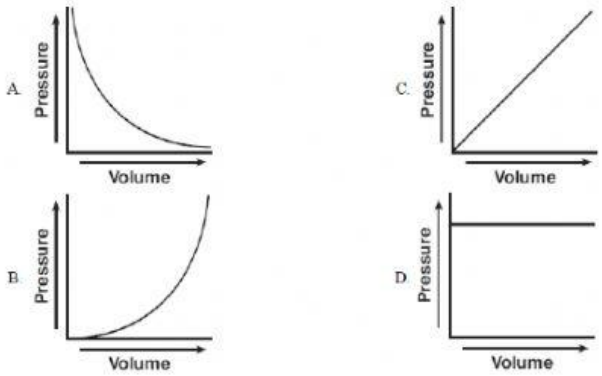
49. An atom that contains six protons, six neutrons, and six electrons has a mass of approximately

A. 12 u
B. 12 g
C. 18 u
D. 18 g

50. Which statement describes the location of two types of subatomic particles in a helium atom?

A. Protons and neutrons are located in the nucleus.
B. Protons and neutrons are located outside the nucleus.
C. Protons and electrons are located in the nucleus.
D. Protons and electrons are located outside the nucleus.

51. A rigid cylinder with a movable piston contains a sample of helium gas. The temperature of the gas is held constant as the piston is pulled outward. Which graph represents the relationship between the volume of the gas and the pressure of the gas?



52. Five cubes of iron are tested in a laboratory. The tests and the results are shown in the table below.

Iron Tests and the Results

Test	Procedure	Result
1	A cube of Fe is hit with a hammer.	The cube is flattened.
2	A cube of Fe is placed in 3 M HCl(aq).	Bubbles of gas form.
3	A cube of Fe is heated to 1811 K.	The cube melts.
4	A cube of Fe is left in damp air.	The cube rusts.
5	A cube of Fe is placed in water.	The cube sinks.

Which tests demonstrate chemical properties?

A. 1, 3, and 4
B. 1, 3, and 5
C. 2 and 4
D. 2 and 5

53. Which statement describes characteristics of a 0.01 M KOH(aq) solution?

A. The solution is acidic with a pH less than 7.
B. The solution is acidic with a pH greater than 7.
C. The solution is basic with a pH less than 7.
D. The solution is basic with a pH greater than 7.

54. Given the equation representing a reaction:

$$H_2CO_3 + NH_3 \rightarrow NH_4^+ + HCO_3^-$$

According to one acid-base theory, the compound NH_3 acts as a base because it

A. accepts a hydrogen ion
B. donates a hydrogen ion
C. accepts a hydroxide ion
D. donates a hydroxide ion

55. Which acid and base react to form water and sodium sulfate?

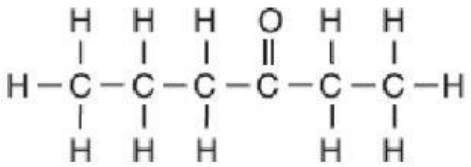
A. sulfuric acid and sodium hydroxide
B. sulfuric acid and potassium hydroxide
C. sulfurous acid and sodium hydroxide
D. sulfurous acid and potassium hydroxide

56. A voltaic cell converts chemical energy to

A. electrical energy with an external power source
B. nuclear energy with an external power source
C. electrical energy without an external power source
D. nuclear energy without an external power source

LIVEWORKSHEETS

57. Given the formula representing a compound:



What is an IUPAC name for this compound?

A. ethyl propanoate
B. propyl ethanoate
C. 3-hexanone
D. 4-hexanone

58. As the temperature of a reaction increases, it is expected that the reacting particles collide

A. more often and with greater force
B. more often and with less force
C. less often and with greater force
D. less often and with less force

59. What is the total amount of heat required to completely melt 347 grams of ice at its melting point?

A. 334 J
B. 1450 J
C. 116,000 J
D. 784,000 J

60. Which two notations represent isotopes of the same element?

A. $^{14}_{7}N$ and $^{18}_{7}N$
B. $^{20}_{7}N$ and $^{20}_{10}Ne$
C. $^{14}_{7}N$ and $^{17}_{10}Ne$
D. $^{19}_{7}N$ and $^{16}_{10}Ne$

61. Which pair of atoms has the most polar bond?

A. H–Br
B. H–Cl
C. I–Br
D. I–Cl

62. What occurs when potassium reacts with chlorine to form potassium chloride?

A. Electrons are shared and the bonding is ionic.
B. Electrons are shared and the bonding is covalent.
C. Electrons are transferred and the bonding is ionic.
D. Electrons are transferred and the bonding is covalent.

63. Given the balanced equation representing a reaction:

H_2 + energy → H + H

What occurs as bonds are broken in one mole of H_2 molecules during this reaction?

A. Energy is absorbed and one mole of unbonded hydrogen atoms is produced.
B. Energy is absorbed and two moles of unbonded hydrogen atoms are produced.
C. Energy is released and one mole of unbonded hydrogen atoms is produced.
D. Energy is released and two moles of unbonded hydrogen atoms are produced.

64. Which equation shows conservation of charge?

A. $Cu + Ag^{+} \rightarrow Cu^{2+} + Ag$
B. $Mg + Zn^{2+} \rightarrow 2Mg^{2}+ + Zn$
C. $2F_2 + Br^{-} \rightarrow 2F- + Br_2$
D. $2I^{-} + Cl_2 \rightarrow I_2 + 2Cl^{-}$

65. At STP, graphite and diamond are two solid forms of carbon. Which statement explains why these two forms of carbon differ in hardness?

A. Graphite and diamond have different ionic radii.
B. Graphite and diamond have different molecular structures.
C. Graphite is a metal, but diamond is a nonmetal.
D. Graphite is a good conductor of electricity, but diamond is a poor conductor of electricity

66. Which electron configuration represents an excited state for an atom of calcium?

A. 2-8-7-1
B. 2-8-7-2
C. 2-8-7-3
D. 2-8-8-2

67. Which list of elements is arranged in order of increasing electronegativity?

A. Be, Mg, Ca
B. F, Cl, Br
C. K, Ca, Sc
D. Li, Na, K

68. Which radioisotope has the fastest rate of decay?

A. ^{14}C
B. ^{37}Ca
C. ^{53}Fe
D. ^{42}K

LIVEWORKSHEETS

69. The table below gives the masses of two different subatomic particles found in an atom.

Subatomic Particles and Their Masses

Subatomic Particle	Mass (g)
X	1.67×10^{-24}
Z	9.11×10^{-28}

Which of the subatomic particles are each paired with their corresponding name?

A. *X*, proton and *Z*, electron
B. *X*, proton and *Z*, neutron
C. *X*, neutron and *Z*, proton
D. *X*, electron and *Z*, proton

70. The atomic mass of an element is the weighted average of the atomic masses of

A. the least abundant isotopes of the element
B. the naturally occurring isotopes of the element
C. the artificially produced isotopes of the element
D. the natural and artificial isotopes of the element

71. The stability of isotopes is related to the ratio of which particles in the atoms?

A. electrons and protons
B. electrons and positrons
C. neutrons and protons
D. neutrons and positrons

72. When the hydronium ion concentration of an aqueous solution is increased by a factor of 10, the pH value of the solution

A. decreases by 1
B. increases by 1
C. decreases by 10
D. increases by 10

73. Which compound is an electrolyte?

A. H_2O
B. C_2H_6
C. H_3PO_4
D. CH_3OH

74. Where do reduction and oxidation occur in an electrolytic cell?

A. Both occur at the anode.
B. Both occur at the cathode.
C. Reduction occurs at the anode, and oxidation occurs at the cathode.
D. Reduction occurs at the cathode, and oxidation occurs at the anode.

75. What occurs when Cr^{3+} ions are reduced to Cr^{2+} ions?

A. Electrons are lost and the oxidation number of chromium increases.
B. Electrons are lost and the oxidation number of chromium decreases.
C. Electrons are gained and the oxidation number of chromium increases.
D. Electrons are gained and the oxidation number of chromium decreases.

76. Systems in nature tend to undergo changes that result in

A. lower energy and lower entropy
B. lower energy and higher entropy
C. higher energy and lower entropy
D. higher energy and higher entropy

77. In terms of potential energy, PE, which expression defines the heat of reaction for a chemical change?

A. *PE products – PE reactants*
B. *PE reactants – PE products*
C. $\frac{PE_{products}}{PE_{reactants}}$
D. $\frac{PE_{reactants}}{PE_{products}}$

78. What occurs when a reaction reaches equilibrium?

A. The concentration of the reactants increases.
B. The concentration of the products increases.
C. The rate of the forward reaction is equal to the rate of the reverse reaction.
D. The rate of the forward reaction is slower than the rate of the reverse reaction.

79. Which changes can reach dynamic equilibrium?

A. nuclear changes, only
B. chemical changes, only
C. nuclear and physical changes
D. chemical and physical changes

80. Which expression could represent the concentration of a solution?

A. 3.5 g
B. 3.5 M
C. 3.5 mL
D. 3.5 mol

LIVEWORKSHEETS

81.Which change is most likely to occur when a molecule of H_2 and a molecule of I_2 collide with proper orientation and sufficient energy?

A. a chemical change, because a compound is formed
B. a chemical change, because an element is formed
C. a physical change, because a compound is formed
D. a physical change, because an element is formed

82. Which statement describes particles of an ideal gas, based on the kinetic molecular theory?

A. Gas particles are separated by distances smaller than the size of the gas particles.
B. Gas particles do not transfer energy to each other when they collide.
C. Gas particles have no attractive forces between them.
D. Gas particles move in predictable, circular motion.

83. Which substance can *not* be broken down by a chemical change?

A. butanal
B. propene
C. gold
D. water

84. One mole of liquid water and one mole of solid water have different

A. masses
B. properties
C. empirical formulas
D. gram-formula masses

85. Which sample of matter has a crystal structure?

A. Hg(ℓ)
B. H_2O(ℓ)
C. NaCl(s)
D. CH_4(g)

86. Which list of elements consists of a metal, a metalloid, and a noble gas?

A. aluminum, sulfur, argon
B. magnesium, sodium, sulfur
C. sodium, silicon, argon
D. silicon, phosphorus, chlorine

87. Which property can be defined as the ability of a substance to be hammered into thin sheets?

A. conductivity
B. malleability
C. melting point
D. solubility

88. Which element has a melting point higher than the melting point of rhenium?

A. iridium
B. osmium
C. tantalum
D. tungsten

89. Which element is *least* likely to undergo a chemical reaction?

A. lithium
B. carbon
C. fluorine
D. neon

90. Which formula represents a polar molecule?

A. O_2
B. CO_2
C. NH_3
D. CH_4

91. Which diatomic molecule is formed when the two atoms share six electrons?

A. H_2
B. N_2
C. O_2
D. F_2

92. The arrangement of the elements from left to right in Period 4 on the Periodic Table is based on

A. atomic mass
B. atomic number
C. the number of electron shells
D. the number of oxidation states

93. The formula mass of a compound is the

A. sum of the atomic masses of its atoms
B. sum of the atomic numbers of its atoms
C. product of the atomic masses of its atoms
D. product of the atomic numbers of its atoms

LIVEWORKSHEETS

94. Which phrase describes a compound that consists of two elements?

A. a mixture in which the elements are in a variable proportion
B. a mixture in which the elements are in a fixed proportion
C. a substance in which the elements are chemically combined in a variable proportion
D. a substance in which the elements are chemically combined in a fixed proportion

95. Which two elements have the most similar chemical properties?

A. beryllium and magnesium
B. hydrogen and helium
C. phosphorus and sulfur
D. potassium and strontium

96. The valence electrons in an atom of phosphorus in the ground state are all found in

A. the first shell
B. the second shell
C. the third shell
D. the fourth shell

97. Which change occurs when an atom in an excited state returns to the ground state?

A. Energy is emitted.
B. Energy is absorbed.
C. The number of electrons decreases.
D. The number of electrons increases.

98. Which type of organic reaction produces both water and carbon dioxide?

A. addition
B. combustion
C. esterification
D. fermentation

99. Which group consists entirely of organic molecules?

A. protein, oxygen, fat
B. protein, starch, fat
C. water, carbon dioxide, oxygen
D. water, starch, protein

100. Which particle has two neutrons?

A. ${}^{1}_{0}n$
B. ${}^{1}_{1}H$
C. ${}^{2}_{1}H$
D. ${}^{4}_{2}He$

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