Dougherty Valley HS AP Chemistry Practice Test

1. At 720 K, the value of $K_p$ for the reaction is 0.0300. In an experiment, a rigid container initially has 4.45 atm of $H_{2\,(g)}$, and 2.25 atm of $N_{2\,(g)}$, and 1.75 atm of $NH_{3\,(g)}$ and allowed to reach equilibrium at 720 K. Determine whether the pressure at equilibrium for $NH_{3\,(g)}$ will be greater than, equal to, or less than the initial pressure of $NH_{3\,(g)}$. In this reaction, hydrogen gas and nitrogen gas are the reactants.

   a) greater, with Q = 64.7
   b) greater, with a Q = 0.0154
   c) greater, with a Q = 0.0604
   d) less, with a Q = 0.0154
   e) less, with a Q = 0.0203

2. At a certain temperature, $K = 2.58 \times 10^{-7}$ for the reaction

$$2\ SO_{3\,(g)} \rightleftharpoons 2\ SO_{2\,(g)} + O_{2\,(g)}$$

   Calculate the concentrations of each ( at equilibrium ) in which there was 3.75 mol $SO_3$ initially in a one liter container.

   a) $\left[ O_2 \right] = 0.00968\ M\ ;\ \left[ SO_2 \right] = 0.00968\ M\ ;\ \left[ SO_3 \right] = 3.75\ M$
   b) $\left[ O_2 \right] = 0.00768\ M\ ;\ \left[ SO_2 \right] = 0.0154\ M\ ;\ \left[ SO_3 \right] = 3.75\ M$
   c) $\left[ O_2 \right] = 0.0154\ M\ ;\ \left[ SO_2 \right] = 0.0154\ M\ ;\ \left[ SO_3 \right] = 3.75\ M$
   d) $\left[ O_2 \right] = 0.0154\ M\ ;\ \left[ SO_2 \right] = 0.0307\ M\ ;\ \left[ SO_3 \right] = 3.75\ M$
   e) $\left[ O_2 \right] = 0.00968\ M\ ;\ \left[ SO_2 \right] = 0.0194\ M\ ;\ \left[ SO_3 \right] = 3.75\ M$

3. For the following process at 325 $^0$C, what are the partial pressures ( in atmospheres, atm ) of the gases at equilibrium for a reaction where nitrogen gas reacts with oxygen gas to form nitrogen monoxide. The equilibrium constant, $K_p$, at this temperature is equal to 1.75. The partial pressure (at this temperature) for nitrogen monoxide at equilibrium is 0.558 atm.

   a) nitrogen gas = 0.178 atm, oxygen gas = 0.178 atm, nitrogen monoxide = 0.558 atm
   b) nitrogen gas = 0.565 atm, oxygen gas = 0.565 atm, nitrogen monoxide = 0.558 atm
   c) nitrogen gas = 0.356 atm, oxygen gas = 0.356 atm, nitrogen monoxide = 0.558 atm
   d) nitrogen gas = 0.421 atm, oxygen gas = 0.421 atm, nitrogen monoxide = 0.558 atm
   e) nitrogen gas = 2.37 atm, oxygen gas = 2.37 atm, nitrogen monoxide = 0.558 atm

4. If the following reaction were at equilibrium in a closed vessel at a controlled temperature, what would be the effect of adding more $H_2$ to the reaction vessel and permitting the reaction to approach equilibrium again

$$CO + H_2O \rightleftharpoons CO_2 + H_2$$

   a) The concentrations of CO, $H_2O$ and $H_2$ would all increase.
   b) The concentrations of CO, $H_2O$ and $H_2$ would all decrease.
   c) The concentrations of CO and $H_2O$ would increase and the concentration of $CO_2$ would decrease.
   d) The concentrations of CO and $H_2O$ would decrease and the concentration of $CO_2$ would increase.
   e) There is no way to determine the correct answer from the information given.

5. [SKIP] For the reaction of hydrazine ( $N_2H_4$ ) in water at a certain temperature.

$$H_2NNH_{2\ (aq)} + H_2O_{\ (l)} \rightleftharpoons H_2NNH_3^{+1}{}_{(aq)} + OH^{-1}{}_{(aq)}$$

   $K_b = 5.12 \times 10^{-7}$. Calculate the pH of a 6.00 *M* solution of hydrazine in water.

   a) 5.51 b) 6.29 c) 8.49 d) 11.24 e) 12.72

6. [SKIP] The pOH of a 3236 mL solution of $HClO_3$ is 10.22. How many grams of $HClO_3$ are in solution?

   a) $1.65 \times 10^{-8}$ *grams* b) $4.54 \times 10^{-2}$ *grams* c) $1.40 \times 10^{-2}$ *grams* d) $3.45 \times 10^{-2}$ *grams*

7. [SKIP] Calculate the $K_a$ of a 0.00433 *M* weak monoprotic acid with a pH of 2.78.

a) 0.00166 b) 969 c) 0.383 d) 0.000636 e) 0.00103

8. [SKIP] Forty eight grams of solid sodium benzonate, $NaC_7H_5O_2$ , is added to 750. mL sample of a 1.58 *M* solution of benz acid, $HC_7H_5O_2$ ( $K_a = 6.4 \times 10^{-5}$ ). Assume no change in volume when the solid was added. Calculate the pH of this solution at equilibrium for this buffer solution.

a) 4.75 b) 2.67 c) 3.64 d) 10.35 e) 9.25

10. [SKIP] A solution contains 435 mL of a weak base, [ B ] = 3.47 *M,* ( [ B ], $K_b = 5.78 \times 10^{-5}$ ) and 183 mL of HI that h a concentration equal to 4.56 *M* . Calculate the pH for this solution.

a) 4.33 b) 9.67 c) 4.23 d) 9.76 e) 12.23

11. [SKIP] If 550 mL of 0.76 *M* $HClO_3$ are added to 600 mL of 0.45 *M* KOH, what is the final pH?

a) 0.89 b) 3.23 c) 7.00 d) 13.10 e) 13.45

12. In the table below are data that show the percent of $NH_{3\,(g)}$ in the equilibrium mixture at two different temperatures. Predict the sign for the change in enthalpy, $\Delta H$, and direction of "shift" (if any) for the data below:

a) $\Delta H$ = + , shift to the right
b) $\Delta H$ = + , shift to the left
c) $\Delta H$ = - , shift to the right
d) $\Delta H$ = - , shift to the left
e) none of the above

$$N_{2\,(g)} + H_{2\,(g)} \rightleftharpoons NH_{3\,(g)}$$

| Temperature | % $NH_{3\,(g)}$ |
|---|---|
| 255 $^0$C | 45 |
| 372 $^0$C | 22 |

13. A molecule whose central atom has $d^2sp^3$ hybridization can have which of the following shapes?

I Tetrahedral
II Square pyramidal
III Square planar

a) I only b III only c) I and II only d) II and III only e) I, II and III

14. A compound containing only sulfur and oxygen is 50% sulfur by weight. What is the empirical formula for the compound?

a) SO b) $SO_2$ c) $SO_3$ d) $S_2O$ e) $S_3O$

15. Which form of orbital hybridization can form molecules with shapes that are either trigonal pyramidal or tetrahedral?

a) *sp* b) $sp^2$ c) $sp^3$ d) $dsp^3$ e) $d^2sp^3$

16. [SKIP] A mixture of helium and neon gases has total pressure of 1.2 atm. If the mixture contains twice as many moles of helium as neon, what is the partial pressure due to neon?

a) 0.2 atm b) 0.3 atm c) 0.4 atm d) 0.8 atm e) 0.9 atm

Questions 17 – 20

a) Metallic bonding
b) Network covalent bonding
c) Hydrogen bonding
d) Ionic bonding
e) London dispersion forces

17. Solids exhibiting this kind of bonding are excellent conductors of heat.

18. [C] This kind of bonding is the reason that water is more dense than ice.

19. This kind of bonding exists between atoms with very different electronegativities.

20. [B] The stability exhibited by diamonds is due to this kind of bonding.

21. [SKIP] Which of the following elements is diamagnetic?
a) H b) Li c) Be d) B e) C

22. [SKIP] A gas sample is confined in a 5 liter container. Which of the following will occur if the temperature of the container is increased?
I. The kinetic energy of the gas will increase
II. The pressure of the gas will increase
III. The density of the gas will increase
a) I only b) II only c) I and III only d) I and II only e) I, II and III

23. Which of the following statements is true regarding sodium and chorine?
a) Chlorine has a greater electronegativity and a larger first ionization energy.
b) Sodium has a larger first ionization energy and a larger atomic radius.
c) Chlorine has a larger atomic radius and a greater electronegativity.
d) Sodium has a greater electronegativity and a larger first ionization energy.
e) Chlorine has a larger atomic radius and a larger first ionization energy.

24. [SKIP] Which of the following could be the quantum numbers ( $n$ , $l$ , $m_l$ , $m_s$ ) for the valence electron in a potassium atom in its ground state.
a) 4, 0, 1, ½ b) 4, 0, 0, ½ c) 3, 0, 0, ½ d) 3, 0, 1, ½ e) 4, 2, 1, ½

25. [SKIP] A 22.0 gram sample of an unknown gas occupies 11.2 liters at standard temperature and pressure. Which of the following could be the identity of the gas?
a) $CO_2$ b) $SO_2$ c) $O_2$ d) $N_2$ e) He

26. Which of the following ions has the smallest ionic radius?
a) $O^{-2}$ b) $F^{-1}$ c) $Na^{+1}$ d) $Mg^{+2}$ e) $Al^{+3}$

27. [SKIP] Which of the following represents the energy of the single electron in a hydrogen atom when it is in the n = 4 state?
a) $\left(\frac{-2.178\times10^{-18}}{2}\right) joules$ b) $\left(\frac{-2.178\times10^{-18}}{4}\right) joules$ c) $\left(\frac{-2.178\times10^{-18}}{8}\right) joules$
d) $\left(\frac{-2.178\times10^{-18}}{16}\right) joules$ e) $\left(\frac{-2.178\times10^{-18}}{64}\right) joules$

28. When ammonium carbonate reacts with magnesium chlorate the reaction will form a _____ precipitate(s).
a) ammonium chlorate
b) magnesium carbonate
c) no ( no reaction)
d) two (both products form a precipitate)

29. [SKIP] When an electron in a hydrogen atoms makes the transition from the n = 4 state to the n = 2 state, blue light with a wavelength of 434 nm is emitted. Which of the following expressions gives the energy released by the transition?
a) $\frac{\left(6.63\times10^{-34}\right)\left(3.00\times10^{8}\right)}{\left(4.34\times10^{-7}\right)} joules$ b) $\frac{\left(6.63\times10^{-34}\right)\left(4.34\times10^{-7}\right)}{\left(3.00\times10^{8}\right)} joules$
c) $\frac{\left(6.63\times10^{-34}\right)}{\left(4.34\times10^{-7}\right)\left(3.00\times10^{8}\right)} joules$ d) $\frac{\left(4.34\times10^{-7}\right)}{\left(6.63\times10^{-34}\right)\left(3.00\times10^{8}\right)} joules$
e) $\left(6.63\times10^{-34}\right)\left(4.34\times10^{-7}\right) joules$

30. A researcher listed the first five ionization energies for a silicon atom in order from first to fifth. Which of the following lists that corresponds to the ionization energies for silicon?
    a) 780 kJ, 13,675 kJ, 14,110 kJ, 15,650 kJ, 16,100 kJ
    b) 780 kJ, 1475 kJ, 14,110 kJ, 15,650 kJ, 16,100 kJ
    c) 780 kJ, 1475 kJ, 3,320 kJ, 15,650 kJ, 16,100 kJ
    d) 787 kJ, 1575 kJ, 3,220 kJ, 4350 kJ, 16,100 kJ
    e) 780 kJ, 1475 kJ, 3,320 kJ, 4050 kJ, 5,340 kJ

31. [SKIP] A gaseous mixture at a constant temperature contains $O_2$, $CO_2$, and He. Which of the following lists the three gases i order of increasing average molecular speed?
    a) $O_2$, $CO_2$, He  b) $O_2$, He, $CO_2$  c) He, $CO_2$, $O_2$  d) He, $O_2$, $CO_2$  e) $CO_2$, $O_2$, He

Questions 32 – 34
    a) $CH_4$
    b) $NH_3$
    c) NaCl
    d) $N_2$
    e) $H_2$

32. This substance undergoes ionic bonding.

33. This molecule contains two pi ( $\pi$ ) bonds.

34. [B] This substance undergoes hydrogen bonding.

Questions 35 – 37
    a) $BF_3$
    b) $CO_2$
    c) $H_2O$
    d) $CF_4$
    e) $PH_3$

35. The central atom in this molecule forms $sp^2$ hybrid orbitals.

36. This molecule has a molecular geometry that has a tetrahedral structure (there is only one correct choice).

37. This molecule has a linear structure.

38. [SKIP] A liquid whose molecules are held together by which of the following forces would be expected to have the lowest boiling point?
    a) Ionic bonds
    b) London dispersion forces
    c) Hydrogen bonds
    d) Metallic forces
    e) Network covalent bonds

39. [SKIP] Which of the following gases would be expected to have a rate of effusion that is three times as large as that of hydrogen has?
    a) $O_2$  b) $N_2$  c) He  d) $H_2O$  e) $CO_2$

40. When lithium phosphate reacts with silver nitrate the reaction will form (a) _____ precipitate(s).
    a) lithium nitrate
    b) silver phosphate
    c) no ( no reaction)
    d) two (both products form a precipitate)

41. The number of protons in the atom whose atomic mass is 89 and atomic number is 39, is
    a. 39  b. 50  c. 51  d. 89  e. 128

42. Which particle has a mass of approximately one atomic mass unit?
a. alpha particle b. oxygen-16 nucleus c. proton d. carbon-12 nucleus e. electron

43. An atom has atomic number of 13 and mass number 27, the number of valence electrons is
a. 2 b. 3 c. 4 d. 5 e. 6

44. One of the tin isotopes has 50 protons and 63 neutrons. Another isotope of tin might have
a. 50 protons and 0 neutrons
b. 50 protons and 62 neutrons
c. 49 protons and 63 neutrons
d. 63 protons and 63 neutrons
e. 63 protons and 50 neutrons

45. When an atom of a metal becomes an ion
a. it is reduced
b. it gains protons
c. it gains electrons
d. the ionic radius becomes less than the atomic radius
e. the ionic radius becomes greater than the atomic radius

46. A single burst of light is released from an atom. Which statement explains what happens in the atom?
a. An electron is changed from a particle to a wave.
b. An electron moved from a higher to a lower energy level.
c. An electron pulled a proton out of the nucleus.
d. An electron pulled a neutron out of the nucleus.

47. Which kind of bond predominates in Group 1A (alkali metal) halides?
a. ionic b. covalent c. hydrogen d. metallic e. van der Waals

48. Which compound is the most ionic?
a. $CCl_{4\,(l)}$ b. $SiO_{2\,(s)}$ c. $KCl_{\,(s)}$ d. $NH_{3\,(g)}$ e. $O_{2\,(g)}$

49. Which compound contains *both* ionic and covalent bonds?
a. KCl b. $NH_4Cl$ c. $CCl_4$ d. $CO_2$ e. $N_2$

50. Which represents a polar molecule?
a. $F_2$ b. $O_2$ c. HCl d. $PF_5$ e. $CO_2$

51. [SKIP] The elements of Group 5A, the nitrogen family, form compounds with hydrogen having these boiling points:

| Compound | Boiling Points |
|---|---|
| | |
| $SbH_3$ | $-17\ ^0C$ |
| $AsH_3$ | $-55\ ^0C$ |
| $PH_3$ | $-87\ ^0C$ |
| $NH_3$ | $-33\ ^0C$ |

Ammonia, $NH_3$ , does not follow the downward trend in boiling point because of
a. ionic bonding b. metallic bonding c. hydrogen bonding d. van der Waals forces

52. The four equivalent C-H bonds in methane, $CH_4$ , can be explained by assuming
a. the carbon atom has one "*s*" and three "*p*" valence electrons.
b. the carbon atom hybridizes to form four $sp^3$ orbitals.
c. the compound is a regular hexagon.
d. carbon forms more compounds than any other element.

53. The formula for ytterbium sulfate is $Yb_2(SO_4)_3$ . What is the formula for ytterbium chloride?
a. $YbCl_2$ b. $Yb_2Cl_3$ c. $Yb_2Cl_2$ d. $YbCl_3$ e. $Yb_3Cl_2$

54. The total number of atoms represented by $\underline{5}\ Al(C_2H_3O_2)_3$
a. 22 b. 60 c. 71 d. 84 e. 110

55. Using only these formulas,

$XY_2$ $X_2Z$ $QZ$

what formula would you expect for a compound of elements Q and Y ?

a. QY b. $QY_2$ c. $Q_2Y$ d. $QY_4$ e. $Q_4Y$

56. What formula is needed to balance this equation?

$$4\ RuP + ? \rightarrow 4\ RuP_2$$

a. P b. $P_2$ c. $P_3$ d. $P_4$

57. One mole of substance X reacts with one mole of water and produces one mole of oxygen and two moles of hydrogen fluoride.

$$X + H_2O \rightarrow O_2 + 2HF$$

a. $F_2$ b. $OF_2$ c. $O_2F$ d. $HOF_2$

58. How many moles of magnesium remain after 5.0 moles of magnesium is ignited in a closed vessel containing 2.0 moles of oxygen?

$$2\ Mg + O_2 \rightarrow 2\ MgO$$

a. 1.0 b. 2.0 c. 3.0 d. 2.5 e. 4.0

59. [SKIP] A gas is compressed and then cooled to its original temperature. Compared to the original conditions the molecules now

a. move faster b. move slower c. are farther apart d. are closer together

60. [SKIP] At the same temperature which gas has the fastest average molecular speed?

a. $H_2$ b. $N_2$ c. $CO_2$ d. $CH_4$ e. Kr

61. [SKIP] The temperature of a sample of helium gas is a measure of its

a. kinetic and potential energy
b. average potential energy
c. average kinetic energy
d. total potential energy

62. [SKIP] Equal volumes of oxygen, carbon dioxide, and methane under the same conditions of temperature and pressure contain the same number of

a. atoms b. molecules c. protons d. electrons e. neutrons

63. If the temperature and pressure are the same, one gram of hydrogen has about the same number of atoms as

a. 1 g of oxygen b. 2 g of oxygen c. 8 g of oxygen d. 16 g of oxygen e. 32 g of oxygen

64. [SKIP] One liter of a certain gas has a mass of 4 grams at STP. From this fact, it follows that

a. the gas is helium.
b. the molar mass of the gas is 4 g $mol^{-1}$.
c. the molar mass of the gas is 89.6 g $mol^{-1}$.
d. $6.02 \times 10^{23}$ molecules of the gas have a mass of 4 grams.
e. there are two atoms in each molecule of the gas.

65. A sample of sulfur dioxide gas has a mass of 16 grams. The mass of the same number of molecules of nitrogen gas is

a. 7 grams b. 14 grams c. 16 grams d. 28 grams e. 56 grams

66. [SKIP] The approximate number of molecules of hydrogen is 1.00 L of $H_2$ gas at STP is

a. $1.35 \times 10^{22}$ b. $3.01 \times 10^{23}$ c. $6.02 \times 10^{23}$ d. $2.69 \times 10^{22}$ e. $5.38 \times 10^{22}$

67. [SKIP] A gas occupies a volume of 2.0 cubic meters at 13 atm. How many cubic meters does this gas occupy at 1.0 atm (the temperature remains constant)?

a. 6.5 b. 13 c. 15 d. 26 e. 52

68. [SKIP] For a given amount of dry gas at constant temperature, when the pressure is doubled the volume is

a. halved b. unchanged c. doubled d. increased, but not doubled

69. [SKIP] One liter of a gas has a mass of 1.25 grams at 273 K and 760 torr. The gas

a. is neon b. is fluorine c. is oxygen d. is nitrogen e. is argon

70. [SKIP] A gas having a density of 3.5119 g $L^{-1}$ and a temperature of 125 $^0$C and a pressure of 1230 torr is
a. neon gas b. chlorine gas c. argon gas d. nitrogen gas e. sulfur dioxide gas

71. [SKIP] The root-mean-square speed for a gas at 310 $^0$C is 603 meters per second. The gas is
a. helium b. neon c. argon d. krypton e. xenon

72. [SKIP] When 0.5 mol of nitrogen gas and 1.0 mol of sulfur dioxide gas are mixed (there is no reaction), the total pressure is 600 mm Hg. What is the partial pressure of the $SO_2$ ?
a. 200 mm Hg b. 300 mm Hg c. 400 mm Hg d. 600 mm Hg e. 350 mm Hg

73. Which formula represents a nonpolar molecule?
a. HCl b. $CF_4$ $NH_3$ d. $H_2S$ e. $ClF_3$

74. What is the molecular geometry for perfluoroammonium ion, $NF_4^{-1}$ ?
a. tetrahedral b. square pyramidal c. see-saw d. trigonal pyramid e. linear

75. Which hybridization of orbitals is present in the phosphorus trichloride molecule?
a. *sp* b. $sp^2$ c. $sp^3$ d. $dsp^3$ e. $d^2sp^3$

76. Upon analysis a compound is found to contain 22.85% sodium, 21.49% boron, and 55.66% oxygen. Its empirical formula is
a. NaBO b. $Na_3BO_4$ c. $Na_3B_4O$ d. $NaB_2O_5$ e, $Na_2B_4O_7$

77. A compound is composed of 79.82% carbon and 20.18% hydrogen. What is its empirical formula?
a. CH b. $CH_2$ c. $CH_3$ d. $C_2H_6$ e. $C_4H$

78. A 500 mL sample of gas at STP has a mass of 0.5812 grams. The composition of gas is carbon = 92.258% and hydrogen = 7.742%. The molecular formula is
a. $CH_4$ b. $C_2H_2$ c. $C_2H_4$ d. $C_3H_6$ e. $C_4H_{10}$

79. How many sugar molecules are there in 1.00 mL of 0.100 *M* sugar solution?
a. $1.20 \times 10^{24}$ b. $6.02 \times 10^{23}$ c. $3.01 \times 10^{19}$ d. $6.02 \times 10^{19}$ e. $3.01 \times 10^{18}$

80. The volume of pure oxygen needed to burn completely 800 mL of acetylene ( $C_2H_2$ ) gas is
a. 800 mL b. 1600 mL c. 2000 mL d. 10000 mL e. 20000 mL

81. What is the energy for a photon of light with a wavelength of 345 nm?
a. $5.77 \times 10^{-19}$ J b. $1.73 \times 10^{18}$ J c. $2.28 \times 10^{-40}$ J d. $4.37 \times 10^{39}$ J e. $2.33 \times 10^{-18}$ J

82. [SKIP] Hydrogen gas is how many times faster than krypton gas?
a. 6.45 b. 41.6 c. 83.1 d. 9.12 e. 0.155

83. Which of the following has the largest radius?
a. $N^{+1}$ b. $N^{+3}$ c. $N^{-3}$ d. $N^{+5}$ e. $N^{+4}$

84. [SKIP] Molecules of different gases have the same average kinetic energies at the same
a. pressure b. temperature c. volume d. density

85. Which number has the greatest number of significant figures?
a) 965. b) 0.440 c) 100.0 d) 0.00070 e) $2.22 \times 10^1$

86. Iridium ( symbol Ir, atomic weight 192.217 amu ) consists of only two naturally occurring isotopes. One of these isotopes is iridium-191, accounting for 37% of the iridium on earth. Which must be the other isotope?
a) Ir-77 b) Ir-189 c) Ir-190 d) Ir-192 e) Ir-193

87. Calculate the mass of copper that occupies the same volume as 75.0 g of magnesium. The density of copper is 8.96 g/cm$^3$. The density of magnesium is 1.74 g/cm$^3$.
a) 0.0689 g b) 43.1 g c) 15.0 g d) 386 g e) 0.00259 g

88. About how many hydrogen atoms are in 0.050 moles $CH_4$ gas?
a) $1.2 \times 10^{23}$ b) $3.0 \times 10^{22}$ c) $4.8 \times 10^{25}$ d) $6.0 \times 10^{23}$ e) $7.5 \times 10^{21}$

89. Which of the following is NOT a correct match of name and formula?
a) $Cs_2SO_4$, cesium sulfate b) $NH_4SO_3$, ammonium sulfate
c) $PbCl_2$, lead(II) chloride d) $Fe(CH_3CO_2)_3$, iron(III) acetate
e) All of the above are correct.

90. Which has the greatest percent by weight of nitrogen?
a) $NH_3$ b) HCN c) $HNO_3$ d) $(NH_3)_3PO_4$ e) $NaNO_3$

91. The compounds $XSO_4$ and $Na_2Z$ suggest the existence of:
a) XZ b) ZX c) $X_2Z$ d) $XZ_2$ e) $XZ_3$

92. What is the mass of one molecule of $C_{12}H_{24}$?
a) 168 g b) 82. G c) $4.6 \times 10^{22}$ g d) $2.8 \times 10^{-17}$ g e) $2.8 \times 10^{-22}$ g

91. Suppose 88.24 mL of 0.1005 M HCl (*aq*) is required to neutralize 100. mL $Ca(OH)_2$ (*aq*). What is the concentration of the calcium hydroxide solution?
a) 0.04434 M b) 0.08868 M c) 0.1774 M d) 0.1005 M e) 0.2010 M

92. Calculate the number of moles of oxygen atoms in 2 mol of the hydrate, $CuSO_4 \cdot 5\ H_2O$.
a) 4 mol b) 5 mol c) 8 mol d) 9 mol e) 18 mol

93. Of the following molecules, which two have the same geometry (shape)?
$CO_2$ $O_3$ $CH_2O$ $SO_2$
a) $CO_2$ & $O_3$ b) $O_3$ & $CH_2O$ c) $O_3$ & $SO_2$ d) $CO_2$ & $SO_2$ e) $CO_2$ & $CH_2O$

94. [SKIP] What are the hybrid orbitals for iodine in the molecule $IF_3$?
a) sp b) $sp^2$ c) $sp^3$ d) $sp^3d$ e) $sp^3d^2$

95. [SKIP] A balloon occupies 4.0 L at 20$^0$C. How cold must it be to reduce the volume to one fourth the original size? Assume the pressure remains the same.
a) 0$^0$C b) 0.25$^0$C c) 5$^0$C d) 20 K e) 73 K

96. [SKIP] If a 1.0 L flask contains 42.9 g of a gas at a pressure of 4.0 atm at 100. K, what is the molecular weight of the gas?
a) 22.4 g/mol b) 42.9 g/mol c) 86 g/mol d) 88 g/mol e) 90. g/mol

97. What is the value of the equilibrium constant, $K_c$ at 1000$^0$C, for the reaction below:

$$C(s) + 2\ H_2\ (g) \leftrightarrow CH_4\ (g)$$

The equilibrium amount of $CH_4$ is 0.050 M and $H_2$ is 0.45 M at 1000$^0$C.
a) 0.0159 b) 0.247 c) 127 d) $3.82 \times 10^3$ e) $5.14 \times 10^4$

98. What is the equilibrium concentration of $F_2$ at 100$^0$C if the initial concentration of HF is 0.25 M and $K_c$ is $2.7 \times 10^{-3}$?
a) $2.7 \times 10^{-5}$ b) $3.5 \times 10^{-3}$ c) $1.3 \times 10^{-2}$ d) $5.4 \times 10^{-1}$ e) $2.6 \times 10^{-2}$

99. [SKIP] What is the pH of a 0.10 M $HC_4H_7O_2$ solution? The $K_a$ of $HC_4H_7O_2$ is $1.5 \times 10^{-5}$ .
a) 1.91 b) 2.91 c) 2.41 d) 11.09 e) 10.31

100. [SKIP] Which of the following will be acidic?
a) NaOH (*aq*) b) $NH_3$ (*aq*) c) NaCl (*aq*) d) $NH_4Cl$ (*aq*) e) $CH_3CONH_2$ (*aq*)