New Jersey Science League
Chemistry II Exam January 2014

Answer the following questions on the answer sheet provided. Each correct response is worth 4 points. Use the letters in parentheses for your answers. Choose the letter that best completes or answers the item. Be certain that erasures are complete. Please **PRINT** your name, school area code, and which test you are taking on the scan-tron.

1. Potassium perchlorate is prepared by three successive chemical reactions.

$$Cl_2(g) + 2\,KOH(aq) \rightarrow KCl(aq) + KClO(aq) + H_2O(l)$$
$$3\,KClO(aq) \rightarrow 2\,KCl(s) + KClO_3(s)$$
$$4\,KClO_3(s) \rightarrow 3\,KClO_4(s) + KCl(s)$$

If the overall reaction percent yield is 50%, how many moles of potassium perchlorate will be produced from 284 grams of Cl_2 gas?

A. 0.25 mol B. 0.50 mol C. 1.0 mol D. 2.0 mol

2. The correct chemical formula of ammonium arsenite is

A. $AmAsO_4$ B. Am_3AsO_4 C. NH_4AsO_3 D. $(NH_4)_3AsO_3$

3. The thermal decomposition of mercury (II) thiocyanate is known as Pharaoh's Snake experiment. The equation is given below.

$$\_\_\ Hg(SCN)_2 + \_\_\ O_2 \rightarrow \_\_\ HgS + \_\_\ C_3N_4 + \_\_\ CO_2 + \_\_\ SO_2$$

If the equation is balanced using the smallest whole number coefficients, what will be the coefficient of O_2?

A. 3 B. 4 C. 5 D. 6

4. A student prepares a calibration curve for Cu^{2+} ions by dissolving 9.66 grams of $Cu(NO_3)_2 \cdot 3H_2O$ in water to make 1.00 liter of aq. solution. The student runs out of $Cu(NO_3)_2 \cdot 3H_2O$ and wants to use $CuSO_4 \cdot 5H_2O$ instead. In order to obtain the same Cu^{2+} ion concentration, how many grams of $CuSO_4 \cdot 5H_2O$ should she dissolve in water to make 1.00 liter aqueous solution?

A. 9.34 g B. 9.66 g C. 9.98 g D. $\frac{5}{3} \times 9.66$ g

5. Which of the following quantities contain the highest number of carbon atoms?

A. 2.0 g $CaCO_3$ B. 0.92 g $Ca(CN)_2$ C. 0.80 g CaC_2 D. 0.36 g $C_6H_{12}O_6$

6. 250.0 mL of 0.24 M HCl solution are added to a beaker containing 250.0 mL 0.12 M NaOH solution. After the reaction is completed, the contents of the beaker are evaporated to dryness. What is the mass of the residue in the beaker?

A. 0.88 g B. 1.8 g C. 3.6 g D. 5.4 g

7. Which one of the following is equivalent to 1.020 dm^3 ?

A. 1020. cm^3 B. 102.0 cm^3 C. 102 cm^3 D. 1060. cm^3

8. A compound consists of C, H, O and B. The combustion of 388 mg of this compound releases 880 mg of CO_2, 270 mg of H_2O and 70 mg of B_2O_3. What is the empirical formula of the compound?
C = 12; B = 11; O = 16 and H = 1.

A. $C_2H_3BO_3$ B. $C_5H_{10}BO_3$ C. $C_{10}H_{10}BO$ D. $C_{10}H_{15}BO_3$

9. 2.0 moles of X and 2.0 moles of Y react according to the equation given below. The reaction yield 1.75 mol of Q. What is the percent yield of the reaction?

$$2\ X + 3\ Y \rightarrow 3\ Q$$

A. 50% B. 67% C. 75% D. 88%

10. What is the oxidation state of Mo in ammonium molybdate, $(NH_4)_2MoO_4$?

A. +6 B. +5 C. +4 D. +2

11. Which of the following equations is **NOT** a redox reaction?

A. $KO_2(s) + CO_2(g) \rightarrow O_2(g) + K_2CO_3(s)$
B. $Cr(s) + S_8(s) \rightarrow Cr_2S_3(s)$
C. $NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$
D. $C_6H_6(l) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$

12. The average atomic mass of chlorine is 35.5. Chlorine-35 and chlorine-37 are the two naturally occurring isotopes of chlorine. What is the ratio of the natural abundances of these two isotopes?

A. 1:4 B. 4:1 C. 1:2 D. 3:1

13. The following conversion factors are given.

1 foot = 12 inches 1 yard = 3 feet 1760 yards = 1 mile
3 miles = 1 league 1 inch = 2.54 cm

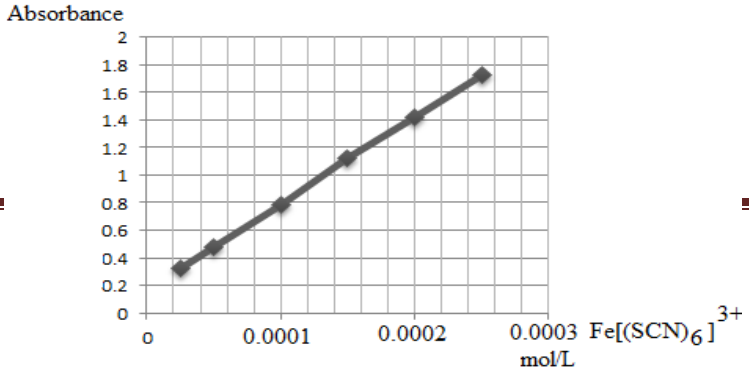
How many ***kilometers*** are there in 1.00 *league*?

A. 1.76 km B. 4.38 km C. 4.83 km D. 5.28 km

14. The third ionization energy of vanadium is required to carry out which of the following processes?

A. $V^{3+}(g) + e^- \rightarrow V^{2+}(g)$ B. $V^{2+}(g) \rightarrow V^{3+}(g) + e^-$
C. $3V(g) \rightarrow 3V^{3+}(g) + 3e^-$ D. $V(g) \rightarrow V^{3+}(g) + 3e^-$

15. A chemist wants to determine the iron content in a breakfast cereal. For this purpose, the chemist prepares the following calibration curve for the complexed iron (III) ion in the aqueous solution.



The chemist obtained a 30.0 grams sample of cereal, dissolved it in a nitric acid solution and added thiocyanate in order to

form the red complex iron (III) ion as is represented by the graph.

$$Fe^{3+} + 6\ SCN^- \rightarrow Fe[(SCN)_6]^{3+}$$

The total volume of the final solution is 1.00 L. It has an absorbance of 0.790 at the calibration wavelength. What is the iron content of the cereal sample?

A. 1.29 mg B. 2.82 mg C. 5.59 mg D. 18.2 mg

16. When the following chemical equation is balanced in acidic medium, what is the smallest whole-number coefficient of Cl_2?

$$\_\_\ H^+ + \_\_\ Cl^- + \_\_\ MnO_4^- \rightarrow \_\_\ Cl_2 + \_\_\ Mn^{2+} + \_\_\ H_2O$$

A. 1 B. 3 C. 5 D. 7

17. Which reaction does NOT produce a solid precipitate?

A. $AgNO_3(aq) + Na_2S(aq) \rightarrow$

B. $BaCl_2(aq) + (NH_4)_2SO_4(aq) \rightarrow$

C. $Pb(NO_3)_2(aq) + K_2SO_4(aq) \rightarrow$

D. $NaOH(aq) + HC_2H_3O_2(aq) \rightarrow$

18. A sample of 5.00 g of an unknown metal carbonate, MCO_3, is strongly heated. The decomposition reaction is represented by the following equation:

$$MCO_3 \rightarrow MO + CO_2$$

If only 2.80 g of MO are produced, what is the identity of the unknown metal?

A. Ca B. Mg C. Zn D. Fe

19. Which of the following equations correctly represents the ***net ionic*** reaction when a solution of potassium hydroxide and a solution of iron (III) sulfate are mixed?

A. $6K^+ + 3SO_4^{2+}(aq) \rightarrow 3K_2SO_4(s)$

B. $6OH^-(aq) + 2Fe^{3+}(aq) \rightarrow 2Fe(OH)_3(s)$

C. $3OH^- + Fe^{3+} \rightarrow Fe(OH)_3(s)$

D. $6K^+(aq) + 6OH^-(aq) + 2Fe^{3+}(aq) + 3SO_4^{2-} \rightarrow 2Fe(OH)_3(s) + 6K^+(aq) + 3SO_4^{2-}(aq)$

20. When ammonium nitrite, NH_4NO_2, dissolves in water to form an aqueous solution, which ions will be present in this solution?

A. $N_2H_4^+$ and O_2^- B. NH_4^+ and NO_2^- C. NH_4^+ and NO_3^- D. NH_4^+, N^+ and O^{2-}

21. Complete combustion of a sample of a compound made only of carbon and hydrogen in excess oxygen produces equimolar quantities of CO_2 and H_2O. Which of the following could be the molecular formula of this compound?

A. C_6H_{14} B. C_6H_{12} C. C_6H_{10} D. C_6H_6

22. Green light has sufficient energy to break the bond between two chlorine atoms. Yellow light cannot break the bond between two chlorine atoms. Which of the following statements are correct? Use these values for the average bond strengths: Br-Br (193 kJ/mol) and Cl-Cl (233 kJ/mol).

I. Blue light can break the bond between two chlorine atoms.

II. Red light can break the bond between two chlorine atoms.

III. Green light can break the bond between two bromine atoms.

A. Only I and II B. Only II and III C. Only I and III D. I, II and III

23. A student wants to determine the density of a plastic piece. Preliminary experiments indicate that the density of the plastic is greater than 0.85 g/ml, but less dense than water. In order to determine the density of the plastic piece, the student will form an aqueous solution having the same density as the plastic piece. Which of the following liquids should be mixed with water to form a solution having the same density as the plastic piece?

Liquid	Density g/ml	Miscibility with water
Mineral Oil	0.85	Not miscible
Alcohol	0.78	Miscible
Glycerol	1.26	Miscible
Methylene chloride	1.33	Not miscible

A. Alcohol B. Mineral Oil C. glycerol D. methylene chloride

24. When mixed, which of the following set of solutions will produce the largest mass of precipitate?

	0.10 M of $CaCl_2$	0.20 M Na_2CO_3
A.	2.0 mL	1.0 mL
B.	1.0 mL	3.0 mL
C.	2.5 mL	2.0 mL
D.	3.0 mL	1.0 mL

25. A student determines the density of a solid substance (not soluble in water) using the method of water displacement. Assuming that the substance is totally submerged into water, which of the following statements regarding the density of the object is(are) correct?

The calculated density of the substance would be

I. too **high** if some of the water in the graduated cylinder splashes out when the sample is dropped into the cylinder.

II. too **low** if the air bubbles are adhered to the submerged sample when the volume of the sample plus water is determined.

A. Only I B. Only II C. Both I and II D. Neither I nor II

Chemistry II January 2014 Answer Key **Yellow test**

1. B	**6. B**	**11. C**	**16. C**	**21. B**
2. D	**7. A**	**12. D**	**17. D**	**22. C**
3. A	**8. D**	**13. C**	**18. A**	**23. A**
4. C	**9. D**	**14. B**	**19. C**	**24. C**
5. C	**10. A**	**15. C**	**20. B**	**25. C**

CHEMISTRY 11 ***For all second year and AP level students. 25 multiple choice questions per exam.***

JANUARY: matter and measurement, atomic theory (sub-atomic particles, atomic masses), spectroscopy (Beer's Law) chemical formulas, chemical equations (precipitation reactions, ionic equations, solubility, acid-base reactions, gas forming reactions, oxidation reduction reactions, balancing redox reactions by oxidation state method, activity series, mole relationships, mass-mass problems, stoichiometry of redox solutions, solutions stoichiometry, electronic structure and periodic table/periodicity.

FEBRUARY: chemical bonding, photon-electron spectroscopy, doping and semiconductors, given molecular orbital diagram determine bond order, paramagnetism, and diamagnetism, electronegativity, Lewis structures, molecular geometry, polarity of molecules, hybridization(sp, sp^2, sp^3), liquids, solids, vapor pressure, intermolecular forces, thermo chemistry (enthalpy, Hess's Law, heats of formation, bond energies, calorimetry), phase changes, gases, plus January topics.

MARCH: non-metals, metals(not unit cells), solutions, rates of reactions, reaction mechanisms, descriptive chemistry of the elements, plus Jan and Feb topics.

APRIL: chemical equilibrium, acids, bases, and salts, K_a, K_b, K_{sp}, buffers, redox, voltaic cells, ΔS, ΔH, ΔG, descriptive chemistry of the elements, plus Jan, Feb., and Mar topics.

Dates for 2014 Season

Thursday January 9, 2014 Thursday February 13, 2014

Thursday March 13, 2014 Thursday April 10, 2014

New Jersey Science League

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What is to be mailed back to our office?

PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER SCANTRONS(ALL STUDENTS PLACING 1ST, 2ND, 3RD, AND 4TH).

If you return scantrons of alternates, then label them as ALTERNATES.

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Chemistry II Exam February 2014

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When balancing chemical equations, reduce all coefficients to the lowest whole numbers**.**

1. Two identical containers are at the same temperature. First one contains one mole of CH_4 and the second contains one mole of SF_4. Which of following statements is **true**?

A. The SF_4 gas has a higher pressure.
B. The CH_4 gas has a greater density.
C. Deviations from ideal gas behavior are smaller for the CH_4 gas.
D. The average kinetic energy of SF_4 molecules is greater than that of CH_4 molecules.

2. Which one of the following molecules has an overall dipole moment?

A. CO_2 B. XeF_4 C. BF_3 D. SO_2

3. Which of the following best describes the molecular geometry of $XeOF_4$?

A. See-saw B. "T" shaped C. trigonal bipryamidal D. Square pyramidal

4. The density of a pure CH_4 sample confined in a rigid container is 1.60 g/L at -73.0°C. What would be the pressure in the container if the temperature is changed to 127.0°C?

A. 1.64 atm B. 2.46 atm C. 0.820 atm D. 3.28 atm

5. For the following reactions, the given enthalpy changes are expressed per mole of product formed.

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ $\Delta H = -241.8$ kJ mol^{-1}
$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5$ kJ mol^{-1}
$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$ $\Delta H = -84.68$ kJ mol^{-1}

Given the thermochemical equations above, what is the standard enthalpy change, in kJ, for the complete combustion of one mole of C_2H_6?

A. −985.3 B. −1428 C. −720.0 D. −866.2

6. A rigid box contains some oxygen at 25°C. A second gas is introduced into the box. The mass of the gas in the box is doubled and the number of moles is tripled. What is the identity of the second gas?

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

7. Calculate the energy (in eV) needed to excite an electron in a H atom from its ground state to $n = 4$? 1 eV = 1.609×10^{-19} J.

A. -13.6 eV B. -12.7 eV C. 12.7 eV D. 13.6 eV

8. Two gases, Y and Z, are simultaneously introduced from the opposite ends into a 100-cm glass tube. If the two gases meet at the midpoint of the glass tube which of the following choices is most probable?

Gas Y Gas Z

A.	CO	HCl
B.	NH_3	CO_2
C.	CO	N_2
D.	CH_3NH_2	CO_2

9. Which of the following pure substances does not exhibit hydrogen bonding in the liquid state?

A. CH_3F B. HF C. CH_3NH_2 D. CH_3COOH

10.

Substance	**Vapor pressure at 25°C**
CH_3OH (*l*)	127 torr
C_6H_6 (*l*)	98 torr
HCHO (*l*)	25 torr
CH_3COOH (*l*)	15 torr

Based on the data table given above, which of the following substances has the strongest intermolecular forces in their liquid state?

A. CH_3OH B. C_6H_6 C. HCHO D. CH_3COOH

11. 100.0 mL of a 0.10 M $Ca(NO_3)_2$ are added to 100.0 mL of a 0.20 M Na_2CO_3 solution. What is the molar concentration of the nitrate ions in the final solution?

A. 0.020 M B. 0.10 M C. 0.20 M D. 0.40 M

12. An *sp* hybridized central atom can be used to describe the bonding in

A. H_2O B. NH_3 C. HCN D. H_2CO

13. When 1.50 grams of a compound containing only carbon, hydrogen, nitrogen and oxygen is burned completely in excess O_2, 1.72 g CO_2, 0.585 g NO and 1.23 g H_2O are produced. What is the empirical formula for the compound?

A. $C_2H_7O_2N$ B. $C_2H_{14}O_2N$ C. CH_7ON D. $C_2H_7ON_2$

14. Based on periodic trends and the table below, which of the following are the most probable values of the atomic radius, ionic radius and the first ionization energy of sodium, respectively?

Element	Atomic radius	Ionic Radius	First Ionization Energy
Lithium	152 pm	76 pm	520 kJ/mole
Magnesium	160 pm	66pm	737 kJ/mole
Sodium	_____pm	____pm	____kJ/mole

A. 190 pm, 66 pm, 496 kJ/mol
B. 190 pm, 97 pm, 496 kJ/mol
C. 148 pm, 66 pm, 597 kJ/mol
D. 148 pm, 97 pm, 597 kJ/mol

15. Which statement about the properties of water is **incorrect**?

A. Water is a good solvent for CH_4.
B. Water expands as it freezes.
C. The density of water is greater than that of ice.
D. Water molecules are V-shaped (bent).

16. Which of the following compounds has the most covalent character?

A. SnI_4 B. SnF_4 C. LiF D. CS_2

17. When added to 10.0 mL 0.10 M $AgNO_3$ solution, which of the following solutions will give the largest mass of precipitate?

A. 10.0 mL 0.10 M KBr
B. 10.0 mL 0.30 M KBr
C. 40.0 mL 0.20 M KCl
D. 10.0 mL 0.10 M KI

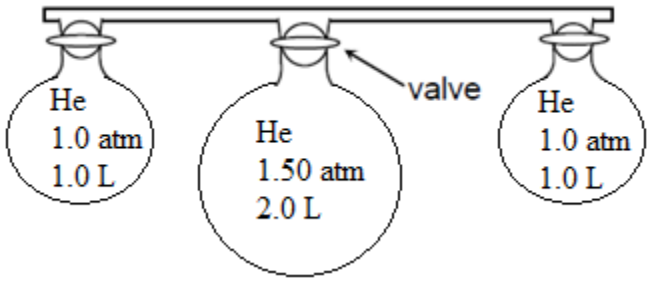
18. The reaction involved in the purification of nickel is given below.

$$Ni(s) + x\,CO(g) \rightarrow Ni(CO)_x(g)$$

If a 11.74 g sample of nickel sample requires 3.32 L of CO at 10.0 atm and 500 K, what is the value of *x*?

A. 2 B. 3 C. 4 D. 6

19. The following figure shows the contents and pressures of three vessels of gas which are joined by a completely evacuated connecting tube. After the valves on the vessels are opened, the final pressure is measured and found to be 0.952 atm. What is the total volume of the **<u>connecting tube</u>**? All vessels are at a constant temperature of 25ºC?



A. 0.50 L B. 1.25 L C. 0.10 L D. 0.050 L

20. The electrical conductance of a $Ba(OH)_2$ solution slowly decreases upon addition of a dilute solution of Na_2SO_4 to a minimum, and then, slowly increases. Which of the following choices help to explain this observation?

I. Ions are removed from the solution due to precipitation
II. Water is formed in the reaction.

A. Only I B. Only II C. Both I and II D. Neither I nor II

21. In which of the following is the nitrogen-to-nitrogen distance the greatest?

A. N_2 B. N_3^- C. N_2H_4 D. N_2H_2

22. During the complete combustion of C_2H_2, what change in hybridization do the carbon atoms undergo?

A. *sp* to *sp* B. sp^2 to sp^3 C. *sp* to sp^2 D. sp^3 to *sp*

23. Refer to the unbalanced equation shown below.

$$CrO_4^{2-}{}_{aq} + HSnO_2^-{}_{aq} + H^+{}_{aq} \rightarrow HSnO_3^-{}_{aq} + CrO_2^-{}_{aq} + H_2O.$$

Which of the following statements is CORRECT?

A. In the balanced equation the coefficient of $H^+{}_{aq}$ is equal to that of H_2O.
B. Total number of electrons exchanged in the balanced reaction is 6.
C. Cr is oxidized.
D. O is reduced.

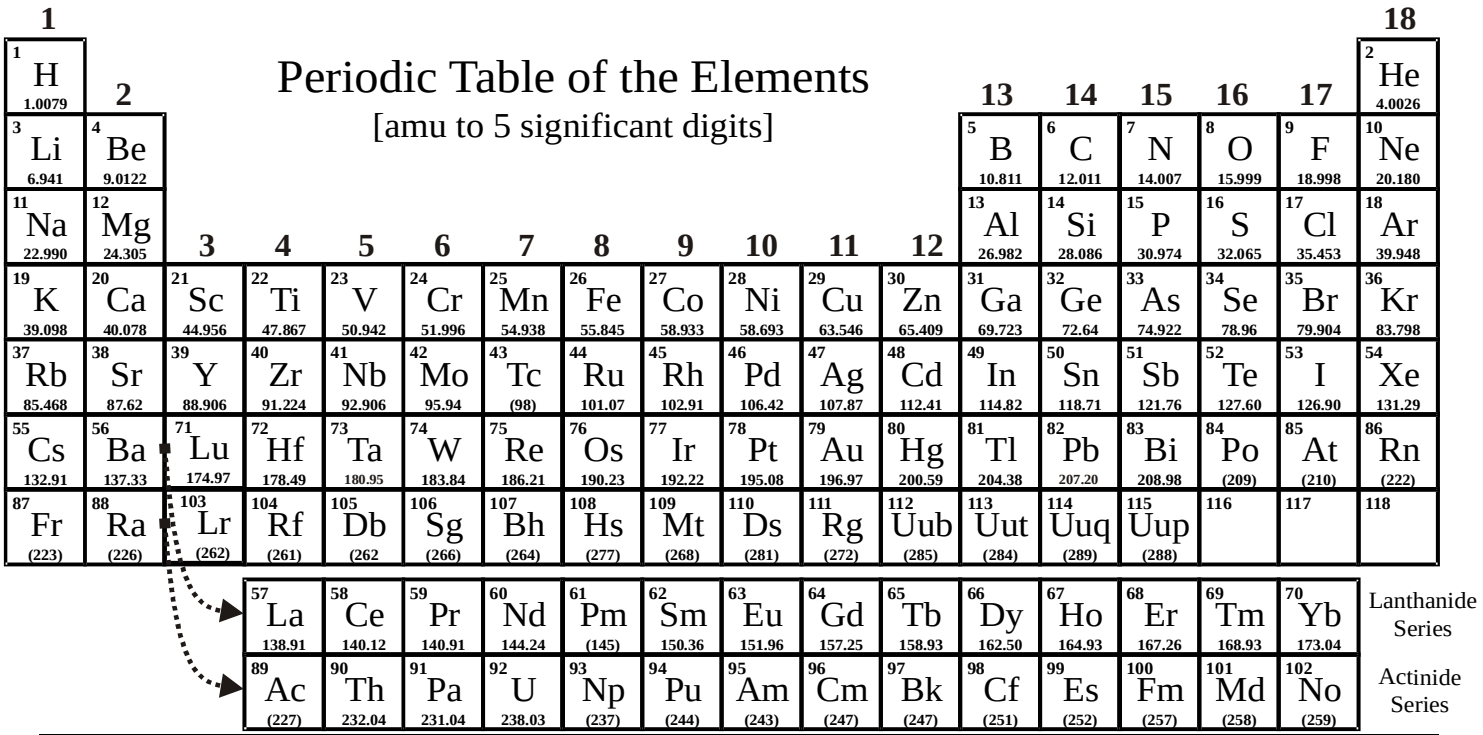
24. Which of the following orbitals has a radial node?

A. 1*s* B. 2*s* C. $2p_y$ D. $2p_z$

25. Based on the information provided in the table provided below, which compound has the largest molecular mass?

	Compound	**Comment**	**Percentage by weight**
A.	Chlorophyll	Responsible of green color of the plants**; it has 1 atom of Mg per molecule**	2.72% Mg
B.	Cobalamine	Vitamin B-12; **it has 1 atom of Co per molecule**	4.25% Co
C.	2,3,7,8-tetrachlorodibenzodioxin (TCDD)	Potent poison, environmental pollutant; **it has 4 atoms of chlorine per molecule.**	44.1% Cl
D.	FK506	Immunosuppressant; **it has 1 atom of N per molecule.**	1.74% N

Periodic Table and Chemistry Formulas



GASES, LIQUIDS, SOLUTIONS

$PV = nRT$

$\frac{(P + n^2a)(V - nb)}{V^2} = nRT$

$P_A = P_{total} \bullet X_A$

$P_{total} = P_A + P_B + P_C + \ldots$

$n = \frac{m}{M}$

Kelvin = $^oC + 273$

$P_1V_1 = P_2V_2$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$d = \frac{m}{V}$

$u_{rms} = \sqrt{\frac{3kt}{m}} = \sqrt{\frac{3RT}{M}}$

$KE_{per\ molecule} = \frac{mv^2}{2}$

$KE_{per\ mole} = \frac{3RT}{2}$

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

M, molarity = $\frac{\text{moles solute}}{\text{liter of solution}}$

molality = $\frac{\text{moles of solute}}{\text{kg of solvent}}$

$\Delta T_f = iK_f \bullet$ molality

$\Delta T_b = iK_b \bullet$ molality

P = pressure
V = volume
T = Temperature
n = number of moles
d = density
m = mass
v = velocity
where $X_A = \frac{\text{moles A}}{\text{total moles}}$

u_{rms} = root-mean-square-root
KE = Kinetic energy
r = rate of effusion
M = Molar mass
π = osmotic pressure
i = van't Hoff factor
K_f = molal freezing point constant
K_b = molal boiling point constant
Q = reaction quotient
I =current in amperes
q = charge in coulombs
t = time
E^o = standard reduction potential

R, Gas constant = $\frac{8.31 \text{ Joules}}{\text{Mole Kelvin}}$
= $0.0821 \frac{\text{liter atm}}{\text{mole Kelvin}}$
= $8.31 \frac{\text{volts coulombs}}{\text{mole Kelvin}}$

Boltzmann's constant,
$k = 1.38 \times 10^{-23} \frac{\text{Joule}}{\text{K}}$

$K_{f\ water} = 1.86$ Kelvin /molal
$K_{b\ water} = 0.512$ Kelvin /molal

STP = 0.00 ^oC, 1.00 atm (101.3 kPa)

1 faraday $\Im$ = 96,500 coulombs/ mole of electrons

ATOMIC STRUCTURE

$\Delta E = h\nu$

$c = \nu\lambda$

$\lambda = \frac{h}{m v}$

$p = m v$

$E_n = \frac{-2.178 \times 10^{-18}}{n^2}$ joule

E = energy

ν = frequency

λ = wavelength

p = momentum

v = velocity

n = principal quantum number

c = speed of light 3.00×10^8 m/s

h = Planck's constant = 6.63×10^{-34} Joule s

k = Boltzmann constant = 1.38×10^{-23} joule/K

Avogadro's number = 6.02×10^{23} molecules/mole

e = electron charge = -1.602×10^{-19} coulomb

1 electron volt/atom = 96.5×10^{23} kj/mole

OXIDATION-REDUCTION ELECTROCHEMISTRY

$Q = \frac{[C]^c[D]^d}{[A]^a[B]^b}$

where $a\,B + b\,B \Leftrightarrow c\,C + d\,D$

$I = q/t$ I = amperes, q = charge in coulombs, t = time in seconds.

$E_{cell} = E^o_{cell} - \frac{RT\ln Q}{n\Im} = E^o_{cell} - \frac{0.0592 \log Q}{n}$ @ 25°C

$\log K = \frac{nE^o}{0.0592}$

1 Faraday $\Im$ = 96,500 coulombs/mole

EQUILIBRIUM

$K_w = 1 \times 10^{-14}$ at 25°C

$pH = -\log[H^+]$; $pOH = -\log[OH^-]$

$pH + pOH = 14$

$pH = pK_a + \log \frac{[A^{-1}]}{[HA]}$

$pOH = pK_b + \log \frac{[HB^+]}{[B]}$

$pK_a = -\log K_a$, $pK_b = -\log K_b$

$K_p = K_c (RT)^{\Delta n}$

Δn = moles product gas – moles reactant

EQUILIBIRUM TERMS

K_a = weak acid

K_b = weak base

K_w = water

K_p = gas pressure

K_c = molar concentration

KINETICS EQUATIONS

$A_o - A = kt$ A_0 is initial concentration, amount.

$$\ln\frac{A_o}{A} = kt$$

$$\frac{1}{A} - \frac{1}{A_o} = kt$$

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

THERMOCHEMISTRY

$\Delta S^o = \sum \Delta S^o$ products $- \sum \Delta S^o$ reactants

$\Delta H^o = \sum \Delta H^o$ products $- \sum \Delta H^o$ reactants

$\Delta G^o = \sum \Delta G^o$ products $- \sum \Delta G^o$ reactants

$\Delta G^o = \Delta H^o - T\Delta S^o$

$\Delta G^o = -RT \ln K = -2.303\ RT \log K$

$\Delta G^o = -n\Im E^o$

$\Delta G = \Delta G^o + RT \ln Q = \Delta G^o + 2.303\ RT \log Q$

$q = m\ C\Delta T$

$C_p = \frac{\Delta H}{\Delta T}$

$q = mH_f$

$q = mH_v$.

S^o = standard entropy
H^o = standard enthalpy
G^o = standard free energy
E^o = standard reduction potential
T = temperature
q = heat
c = specific heat capacity

C_p = molar heat capacity at constant pressure
1 faraday $\Im$ = 96,500 coulombs/mole

$C_{water} = \frac{4.18 \text{ joule}}{\text{g K}}$

$H_f = \frac{330 \text{ joules}}{\text{gram}}$ for water

$H_v = \frac{2260 \text{ joules}}{\text{gram}}$ for water

METAL ACTIVITY SERIES

Metal	*Metal Ion*
Lithium	Li^{+1}
Potassium	K^{+1}
Calcium	Ca^{+2}
Sodium	Na^{+1}
Magnesium	Mg^{+2}
Aluminum	Al^{+3}
Manganese	Mn^{+2}
Zinc	Zn^{+2}
Chromium	Cr^{+2}, Cr^{+3}
Iron	Fe^{+2}, Fe^{+3}
Lead	Pb^{+2}, Pb^{+4}
Copper	Cu^{+1}, Cu^{+2}
Mercury	Hg^{+2}
Silver	Ag^{+1}
Platinum	Pt^{+2}
Gold	Au^{+1}, Au^{+3}

Chemistry II February 2014 Answer Key **Yellow test**

1. C	**6. A**	**11. B**	**16. D**	**21. C**
2. D	**7. C**	**12. C**	**17. D**	**22. A**
3. D	**8. C**	**13. A**	**18. C**	**23. B**
4. D	**9. A**	**14. B**	**19. B**	**24. B**
5. B	**10. D**	**15. A**	**20. A**	**25. B**

Chemistry II Topics 2014 Season

CHEMISTRY 11 ***For all second year and AP level students. 25 multiple choice questions per exam.***

JANUARY: matter and measurement, atomic theory (sub-atomic particles, atomic masses), chemical formulas, chemical equations (precipitation reactions, ionic equations, solubility, acid-base reactions, gas forming reactions, oxidation reduction reactions, activity series, mole relationships, mass-mass problems), stoichiometry of redox solutions, solutions stoichiometry, electronic structure and periodic table.

FEBRUARY: chemical bonding, electronegativity, Lewis structures, molecular geometry, polarity of molecules, hybridization, liquids, solids, vapor pressure, intermolecular forces, thermochemistry (enthalpy, Hess's Law, heats of formation, bond energies, calorimetry), phase changes, gases, plus January topics.

MARCH: non-metals, metals, solutions, colligative properties, rates of reactions, reaction mechanisms, descriptive chemistry of the elements, plus Jan and Feb topics.

APRIL: chemical equilibrium, acids, bases, and salts, K_a, K_b, K_{sp}, buffers, coordination compounds, redox, voltaic cells, ΔS, ΔH, ΔG, descriptive chemistry of the elements, plus Jan, Feb., and Mar topics.

Dates for 2014 Season

Thursday January 9, 2014 Thursday February 13, 2014

Thursday March 13, 2014 Thursday April 10, 2014

All areas and schools must complete the last exam and mail in the results by April 25th, 2014

New Jersey Science League

PO Box 65 Stewartsville, NJ 08886-0065

phone # 908-213-8923 fax # 908-213-9391 email newjsl@ptd.net **Web address: www://entnet.com/~personal/njscil/html**

PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER SCANTRONS(ALL STUDENTS PLACING 1ST, 2ND, 3RD, AND 4TH).

If you return scantrons of alternates, then label them as ALTERNATES.

Dates for 2015 Season

Thursday January 8, 2015 Thursday February 12, 2015

Thursday March 12, 2015 Thursday April 9, 2015

New Jersey Science League

Chemistry II Exam March 2014

Answer the following questions on the answer sheet provided. Each correct response is worth 4 points. Use the letters in parentheses for your answers. Choose the letter that best completes or answers the item. Be certain that erasures are complete. Please **PRINT** your name, school area code, and which test you are taking on the scan-tron.

1. What mass of propane, C_3H_8, would need to be combusted in order to convert 2.00 kg of water that is initially at 20.0°C to steam at 100.0°C? Assume that all of the heat generated goes directly into heating the water. Enthalpy of combustion of gaseous propane is -2202 kJ/mol. Heat of vaporization of water is 2260 kJ/kg.

A. 61.3 g B. 74.8 g C. 92.5 g D. 104 g

2. According to the VSEPR Theory, which of the following species has a different shape than the others?

A. SNF_3 B. SO_2Cl_2 C. XeO_3 D. SO_4^{2-}

3. Given the following bond energies, calculate the enthalpy change of the following substitution reaction.

$$C_2H_6 + Br\bullet \rightarrow C_2H_5Br + H\bullet$$

Bond	Bond Energy kJ/mol
H-H	435
Br-Br	193
H-C	414
H-Br	366
C-C	348
C-Br	285

A. 0 kJ B. -128 kJ C. 129 kJ D. 698 kJ

4. Windex® is a commercial cleansing product used to clean windows. One of the active ingredients in Windex® is ammonia. The ammonia content of this product can be determined by converting first the ammonia to ammonium ions. Then, the ammonium ions are precipitated with chloroplatinic acid to form solid ammonium hexachloroplatinate, $(NH_4)_2PtCl_6$. Lastly, the salt is decomposed by heat to give solid platinum according to the reaction given below.

$$(NH_4)_2PtCl_6 \xrightarrow{heat} Pt(s) + 2NH_3(g) + 2HCl(g) + 2Cl_2(g)$$

When the reaction is terminated, the precipitate was filtered, washed and dried completely. What is the percent ammonia in Windex if a 2.000 g sample of Windex gave rise to 0.650 g of solid platinum?

A. 11.7 % B. 5.67% C. 23.4% D. 35.8%

5. The following table summarizes the specific gravities of commercial concentrated acids.

Reagent	Percent concentration	Specific gravity
Acetic acid	99.7% (w/w)	1.05
Hydrochloric acid	37.2% (w/w)	1.19
Nitric acid	70.5% (w/w)	1.42
Perchloric acid	86.0% (w/w)	1.71

Which of the above reagents has the highest molar concentration?

A. acetic acid B. hydrochloric acid C. nitric acid D. perchloric acid

6. A bomb calorimeter is calibrated by combusting 1.558 g of benzoic acid (MW = 122.2 g/mol) in the chamber. The temperature of the water is increased by 2.34 K. The enthalpy of combustion of benzoic acid is -3230 kJ/mol. After determining the calorimetric constant, the very same bomb calorimeter is used to determine the enthalpy of combustion of liquid benzene (MW = 78.0 g/mol). The combustion of 1.234 g of benzene increased the temperature of the surrounding water by 2.93°C .What is the enthalpy of combustion of benzene?

A. -3259 kJ/mol B. -789 kJ/mol C. -323 kJ/mol D. -1250 kJ/mol

7. Which of the following statements is(are) correct for elemental sulfur?

I. It has more than one allotrope.

II. It is a solid at 1 atm and 25°C.

A. Only I B. Only II C. Both I and II D. Neither I nor II

8. A syringe is filled with 139-mL of air and then connected to a conical flask containing wet iron powder in excess. When the reaction ceases, the volume of the gas in the syringe is 112-mL. What is the volume percent content of oxygen of the air sample used in this experiment?

A. 19.4 B. 20.7 C. 27.0 D. 29.3

9. The data table below summarizes the abundances of the major elements of the human body.

Element	**Abundance (by mass)**	**Element**	**Abundance (by mass)**
Oxygen	61.0 %	Phosphorus	1.1 %
Carbon	23.8 %	Sulfur	0.2 %
Hydrogen	10.0 %	Silicon	0.02 %
Nitrogen	2.6 %	Potassium	0.02 %
Calcium	1.4 %	Sodium	0.012 %

Which of the following is another way to express the abundance of sodium?
Note: ppt = parts per thousand, ppm = parts per million, ppb = parts per billion.

A. 120 ppb B. 120 ppm C. 12 ppm D. 120 ppt

10. An oxide of vanadium is 43.99% oxygen by mass. What is the empirical formula of this oxide?

A. VO_2 B. VO_3 C. V_2O_3 D. V_2O_5

11. A cylinder of unknown volume contains neon gas, Ne(g), at 4.0 atm and 400 K. The neon gas is then transferred to a 10.0 L gas cylinder containing Ar(g), at 6.0 atm and 400 K. If the final total pressure at 400 K is 9.0 atm, then what is the volume of the cylinder that initially contained the neon gas?

A. 5.0 L B. 6.0 L C. 7.0 L D. 7.5 L

12. $Fe_2O_3 + NH_3 \rightarrow Fe_3O_4 + N_2 + H_2O$

When the above reaction is balanced using the smallest-whole-number coefficients, what will be the coefficient of Fe_2O_3?

A. 2 B. 3 C. 6 D. 9

13. In which choice are the oxides listed in order of increasing lattice energy?

A. MgO, Na_2O, Al_2O_3
B. CaO, MgO, Al_2O_3
C. Na_2O, Al_2O_3, MgO
D. Al_2O_3, MgO, Na_2O

14. What is the OH^- ion concentration in the solution formed by mixing 50.0 mL 0.40 M NaOH and 20.0 mL of 0.40 M $Ba(OH)_2$ solutions with 80.0 mL of distilled water?

A. 0.20 M B. 0.24 M C. 0.10 M D. 0.50 M

15. 1.00 g of ethanol, C_2H_5OH, is introduced into a 2-L evacuated flask at 35°C. The flask is then sealed. What mass of alcohol is present as liquid when vapor-liquid equilibrium is established? The vapor pressure of alcohol at 35°C is 100 mmHg.

A. 0.48 g B. 0.52 g C. 0.63 g D. 0.37 g

16. For a first order reaction, the reactant concentration decreases to 42.0% of its initial value in 15 minutes. What is the value of the rate constant?

A. 0.0578 min^{-1} B. 0.693 min^{-1} C. 0.0693 min^{-1} D. 0.0139 min^{-1}

17. The following data were obtained when the following reaction was studied.

$4A + B + 2C \rightarrow 3D + E$

Initial concentration of A mol/L	**Initial concentration of B mol/L**	**Initial concentration of C mol/L**	**Reaction rate mol/L.s**
0.01	0.02	0.01	1.0×10^{-5}
0.02	0.02	0.01	2.0×10^{-5}
0.02	0.04	0.01	2.0×10^{-5}
0.01	0.04	0.02	2.0×10^{-5}

What is the unit of the rate constant for this reaction?

A. s^{-1} B. $mol \times L^{-1} \times s^{-1}$ C. $L \times mol^{-1} \times s^{-1}$ D. $L^2 \times mol^{-1} \times s^{-1}$

18. The atmospheric pressure varies with height according to the following barometric formula:

$$P = P_{gas} \cdot e^{(-gMh/RT)}$$

P_{gas} is the partial pressure of the gas at atmospheric pressure and sea level. *M is the molecular mass of the gas, h* is the height in meters and $g = 9.8\ m.s^{-2}$.
Assuming that air is 20% O_2 and 80% N_2 at sea level and the atmospheric pressure is 1.00 atm, what is the partial pressure of O_2 at a height of 46,200 feet? The temperature at this altitude is -73.0^oC. *Note: 1 yard = 3 feet and 1 m = 1.1 yards.*

A. 0.014 atm B. 0.028 atm C. 0.14 atm D. 0.28 atm

19. 100.0 mL of 0.10 M HCl is mixed with 100.0 mL of 0.10 M NaOH solution. The temperature of the solution rises by 0.60°C. Calculate the molar enthalpy of neutralization of HCl. Assume volumes are additive, that the specific heat of the solution is the same as that of water, and the density of the solution after mixing is 1.15 g/mL.

A. -57.7 kJ/mol B. 57.7 kJ/mol C. 115 kJ/mol D. -115 kJ/mol

20. 3.40 g of $Na_2C_2O_4 \bullet xH_2O$ were heated to drive off the water of hydration. If 2.68 g of solid remains, what is the percent mass content of water in the hydrate?

A. 21.2 % B. 25.6 % C. 33.3 % D. 36.4 %

21. When the following reaction is balanced, what will be the coefficient of O_2?

$$C_nH_{2n}O_2 + \_\_\_\ O_2 \rightarrow nCO_2 + nH_2O$$

A. 3n B. $\frac{3n}{2}$ C. $\frac{3n-2}{2}$ D. $\frac{2n-3}{n-1}$

22. The kinetic energy of an electron ejected from a metal surface that is exposed to an electromagnetic radiation of single wavelength depends on the all of the following EXCEPT

A. Energy of the electron
B. Frequency of the monochromatic light
C. Intensity of the light
D. Nature of the metal used

23. The activation energy of most reactions is on the order of 50 kJ/mol. Assume k_1 is the rate constant at 300 K . Which of the following best approximates the rate constant at 310 K?

A. $2k_1$ B. $k_1^{\,2}$ C. $k_1^{\,½}$ D. $10k_1$

24. In order to calculate the lattice energy of KF using Born-Haber cycle, which value is NOT needed?

A. Enthalpy of sublimation of K(s)
B. Enthalpy of formation of KF(s)
C. Bond dissociation energy of $F_2(g)$
D. First ionization energy of F(g)

25. When treated with excess hydrochloric acid solution, a 10.0 g sample of which of the following metals will produce the largest volume of hydrogen at P = 101.3 kPa and T = 25°C?

A. Al B. Cr C. Zn D. Li

Chemistry II March 2014 Answer Key **Yellow test**

1. D	**6. A**	**11. D**	**16. A**	**21. C**
2. C	**7. C**	**12. D**	**17. C**	**22. C**
3. C	**8. A**	**13. B**	**18. A**	**23. A**
4. B	**9. B**	**14. B**	**19. A**	**24. D**
5. A	**10. D**	**15. B**	**20. A**	**25. D**

Chemistry II Topics 2014 Season

CHEMISTRY 11 ***For all second year and AP level students. 25 multiple choice questions per exam.***

JANUARY: matter and measurement, atomic theory (sub-atomic particles, atomic masses), chemical formulas, chemical equations (precipitation reactions, ionic equations, solubility, acid-base reactions, gas forming reactions, oxidation reduction reactions, activity series, mole relationships, mass-mass problems), stoichiometry of redox solutions, solutions stoichiometry, electronic structure and periodic table.

FEBRUARY: chemical bonding, electronegativity, Lewis structures, molecular geometry, polarity of molecules, hybridization, liquids, solids, vapor pressure, intermolecular forces, thermochemistry (enthalpy, Hess's Law, heats of formation, bond energies, calorimetry), phase changes, gases, plus January topics.

MARCH: non-metals, metals, solutions, colligative properties, rates of reactions, reaction mechanisms, descriptive chemistry of the elements, plus Jan and Feb topics.

APRIL: chemical equilibrium, acids, bases, and salts, K_a, K_b, K_{sp}, buffers, coordination compounds, redox, voltaic cells, ΔS, ΔH, ΔG, descriptive chemistry of the elements, plus Jan, Feb., and Mar topics.

Testing Dates for 2014

Thursday March 13, 2014 Thursday April 10, 2014

***The April 2014 exam can be changed based upon the Schools spring break.**

The April exam must be completed by **April 25th**. No area may take the April exam during the first week of April or during the first week of May.

New Jersey Science League

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Dates for 2015 Season

Thursday January 8, 2015 Thursday February 12, 2015

Thursday March 12, 2015 Thursday April 9, 2015

New Jersey Science League

Chemistry II Exam April 2014

Answer the following questions on the answer sheet provided. Each correct response is worth 4 points. Use the letters in parentheses for your answers. Choose the letter that best completes or answers the item. Be certain that erasures are complete. Please **PRINT** your name, school area code, and which test you are taking onto the scan-tron.
When balancing chemical equations, reduce all coefficients to the lowest whole numbers.

1. One way to free metallic gold (Au) from a gold-bearing rock is to treat the rock with sodium cyanide in the presence of excess oxygen, according to the reaction

$$4\ Au(s) + 8\ NaCN(aq) + O_2(g) + 2\ H_2O(l) \rightarrow 4\ NaAu(CN)_2(aq) + 4\ NaOH(aq)$$

If a particular rock containing gold required 254 mL of 0.0275 M NaCN solution in order for all the gold to fully react, what mass of gold was in the rock?

A. 0.688 g B. 0.233 g C. 1.97 g D. 2.15 g

2. Use the following information to calculate the first ionization energy of Li.

$LiF(s) \rightarrow Li^+(g) + F^-(g)$	1050 kJ/mol
$Li(s) + \frac{1}{2}F_2(g) \rightarrow LiF(s)$	- 617 kJ/mol
$F_2(g) \rightarrow 2\ F(g)$	160 kJ/mol
$Li(s) \rightarrow Li(g)$	161 kJ/mol
$F(g) + e^- \rightarrow F^-(g)$	- 328 kJ/mol

A. -1580 kJ/mol B. 1580 kJ/mol C. -520 kJ/mol D. 520 kJ/mol

3. Which one of the following mixtures creates a buffer solution?

A. 10.0 mL 0.10 M NaOH, 10.0 mL 0.10 M HF
B. 20.0 mL 0.10 M NaOH, 15.0 mL 0.10 M HF
C. 15.0 mL 0.10 M NaOH, 20.0 mL 0.10 M HF
D. 10.0 mL 0.10 M NaOH, 5.0 mL 0.20 M HF

4. When the pressure increases, which of the following reversible reactions will shift to the product side?

A. $N_2(g) + O_2(g) \leftrightarrows 2\ NO(g)$
B. $2\ SO_2(g) + O_2(g) \leftrightarrows 2\ SO_3(g)$
C. $4\ NH_3(g) + 5\ O_2(g) \leftrightarrows 4\ NO(g) + 6\ H_2O(g)$
D. $CusO_4 \bullet 5H_2O(s) \leftrightarrows CuSO_4(s) + 5\ H_2O(g)$

5. A student constructed an $A \mid A^{2+} \parallel B^{2+} \mid B$ cell and measured a cell potential of 0.90 V. The next student constructed a $J \mid J^{2+} \parallel A^{2+} \mid A$ cell and measured a cell potential of 0.70 V. Then, they decided to construct a cell using the metals J and B along with their respective aqueous solutions. What will be the cell potential of the newly constructed cell?

A. 1.60 V B. -1.60 V C. 0.20 V D. -0.20 V

6. The following data were collected at 25 °C for the reaction between HB^{2-} and Y^- ions, shown in the equation below:

$$HB^{2-}(aq) + Y^-(aq) \leftrightarrows B^{3-}(aq) + HY(aq)$$

Trial	$[HB^{2-}]$	$[Y^-]$	time, s
1	3.0×10^{-3}	0.40	98
2	3.0×10^{-3}	0.10	401
3	1.5×10^{-3}	0.40	195

Assuming a small, but constant, amount of HB^{2-} is consumed, what is the overall order of the above reaction?

A. 2 B. 1 C. 0 D. 3

7. A student titrated 0.643 g of an unknown weak monoprotic acid with 0.100 M NaOH. The student collected the following data:

V_{NaOH} mL	*p*H	V_{NaOH} mL	*p*H
0.00	3.10	21.00	5.65
3.00	4.25	24.00	5.90
6.00	4.75	27.00	6.10
9.00	5.01	30.00	6.70
12.00	5.20	33.00	10.98
15.00	5.30	36.00	11.75
18.00	5.50	39.00	11.90

Identify the unknown acid from the data provided below:

Weak acid	Chloroacetic acid	Mandelic acid	Acetic acid	KHP
pK_a	2.86	3.41	4.76	5.40
Molar mass	94.5	152.2	60.05	204.2

A. Mandelic acid B. Acetic acid C. Chloroacetic acid D. KHP

8. A liter of solution containing 0.10 mole of acetic acid, CH_3COOH and 0.100 mole of sodium acetate, CH_3COONa, provides a buffer of 4.74. Calculate the pH of the solution after addition of 0.020 mole of NaOH. $K_a = 1.8 \times 10^{-5}$.

A. 3.74 B. 4.74 C. 4.92 D. 5.74

9. What is the pH of a 0.2 M KCN solution? K_a (HCN) = 4.0×10^{-10}

A. 1.35 B. 1.4 C. 11.35 D. 11.4

10. What is indicated when a chemical cell's voltage E^o has dropped to zero?

A. the concentration of the reactants has increased.
B. the concentration of the products has decreased.
C. the cell reaction has reached equilibrium.
D. the cell reaction has completely stopped.

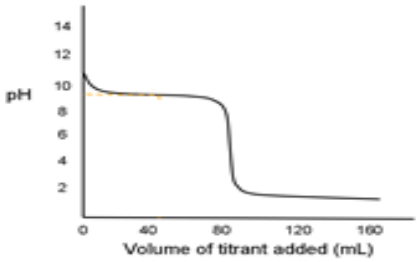
11. Which of the following sets of molecular compounds are ranked in order of increasing bond angles?

A. $BeCl_2$, BCl_3, CCl_4, PCl_5 B. H_2O, NH_3, CH_4, BH_3
C. CH_4, NH_3, H_2O, CO_2 D. CCl_4, $BeCl_2$, PCl_5, SF_6

12. What concentration of aqueous NH_3 is necessary to just start precipitation of $Mg(OH)_2$ from a 0.035 M solution $MgSO_4$? K_b for NH_3 is 1.8×10^{-5} and K_{sp} for $Mg(OH)_2$ is 7.0×10^{-12}.

A. 2.0×10^{-6} M B. 2.0×10^{-7} M C. 1.1×10^{-5} M D. 4.0×10^{-9} M

13. The figure on the right represents a titration curve of



A. strong acid with a strong base
B. a strong acid with a weak base
C. a strong base with a strong acid
D. a weak base with a strong acid.

14. It is determined that for a particular process, ΔH = +200.0 kJ and ΔS = +200.0 J/K. At what temperature does the reaction become spontaneous?

A. 20 K B. 200 K C. 0 °C D. 1000 K

15. A concentrated solution of sodium chloride is electrolyzed using Pt electrodes. The mass of chlorine gas collected at the anode is 355 grams. What is the volume of the hydrogen gas collected at the cathode at a pressure of 1.0 atm and 27 °C? The vapor pressure of water at 27 °C is 26.7 mmHg.

A. 6.40 L B. 12.8 L C. 123 L D. 128 L

16. When elements 11, 12 and 13 are arranged by their increasing first ionization energies, the correct order is

A. Na < Al < Mg B. Al < Mg < Na C. Al < Na < Mg D. Mg < Al < Na

17. Which of the following choices is NOT correct?

	ion	electron pair distribution on the central atom	shape according to VSEPR theory
A.	NH_2^-	*tetrahedral*	*linear*
B.	NH_4^+	*tetrahedral*	*tetrahedral*
C.	I_3^-	*trigonal bipyramid*	*linear*
D.	PCl_6^-	*octahedral*	*octahedral*

18. Some students were doing an experiment using copper (II) and thiocyanate ions to form the thiocyanatocopper (II) ion. The thiocyanatocopper(II) ion absorbance can be used to determine the equilibrium constant. There is an equilibrium among Cu^{2+} (blue), SCN^- (colorless) and $CuSCN^+$ (colorless). The equation for the formation of the $CuSCN^+$ is

$$Cu^{2+}(aq) + SCN^-(aq) \leftrightarrows CuSCN^+(aq).$$

This reaction can be studied spectrophotometrically at 380 nm because

A. Cu^{2+} absorbs visible light.
B. $CuSCN^+$ does not absorb visible light but absorbs UV radiation.
C. Both Cu^{2+} and SCN^- absorb visible light.
D. $CuSCN^+$ absorbs 380 nm radiation whereas Cu^{2+} and SCN^- do not.

19. Instant cold packs contain solid NH_4NO_3 and a pouch of water. When the pack is squeezed, the pouch breaks and the solid dissolves, lowering the temperature:

$$NH_4NO_3(s) \leftrightarrows NH_4NO_3(aq)$$

The final temperature in a squeezed cold pack that contains 100.0 g of NH_4NO_3 dissolved in 250.0 mL of water is 3.00 °C. Calculate the enthalpy change of the solution. Assume a specific heat of 4.18 J/g°×C for the solution, an initial temperature of 25.0 °C, and no heat transfer between the cold pack and the environment. (density of solution ≅ 1.0 g/mL)

A. -25.8 kJ/mol B. 25.8 kJ/mol C. 36.7 kJ/mol D. -36.7 kJ/mol

20. A sample of sodium hydrogen carbonate-sodium chloride mixture heated in a crucible. Based on the experimental data provided below, determine the percent mass composition of sodium hydrogen carbonate in the mixture.

The mass of crucible and cover	=	29.123 g
The mass of crucible + cover + sample	=	30.023 g
The mass of crucible + cover + residue	=	29.725 g (after first heating)
The mass of crucible + cover + residue	=	29.713 g (after second heating)

A. 31.2 % B. 62.4 % C. 79.8 % D. 93.3 %

21. The predicted mechanism of a reaction is shown below. What is(are) the intermediate in the reaction?

$HOOH + I^- \rightarrow HOI + OH^-$ (slow)
$HOI + I^- \rightarrow I_2 + OH^-$ (fast)
$2OH^- + 2H_3O^+ \rightarrow 4\,H_2O$ (fast)

A. OH^- B. HOI C. OH^- and HOI D. HOI, OH^- and I_2

22. The simplest complex reaction consists of two consecutive, irreversible elementary steps e.g.

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

An example of such a process is radioactive decay. This is one of the few kinetic schemes in which it is fairly straightforward to solve the rate equations analytically. The change in concentration of B, at any given time, $\frac{\Delta[B]}{\Delta t}$, is calculated as:

A. k_1[A] B. $-k_2$[B] C. k_1[A] – k_2[B] D. $\frac{k_1}{k_2}$ [B]

23. If equal volumes of equi molar concentrations of NaH_2PO_4 and H_3PO_4 solutions are mixed, which of the following best describes the resulting solution? (pKa's for H_3PO_4 are 2.0, 6.8 and 12.1)

A. A good buffer solution at pH = 2.0
B. A good buffer solution at pH = 4.4
C. A good buffer at pH = 6.8
D. A good buffer at pH = 12.1

24. Which of the following species has a pK_a = 25?

A. H_2SO_4 B. H–C≡C–H C. HNO_3 D. HI

25. Some physical properties of CH_3F and NH_3 are given in the following table. Which of the following statements is(are) correct?

Compound	Melting Point °C	Boiling Point °C	Solubility in water
CH_3F	-141.2	-78.2	2.9 g/L
NH_3	-77.7	-33.3	Very soluble

I. Both molecular compounds are capable of making hydrogen bonds in their liquid states.
II. CH_3F has higher molecular mass therefore boils at lower temperature.

A. Only I B. Only II C. Both I and II D. Neither I nor II

Chemistry II Answer Key

Date: April 2014 Yellow test

Record the % correct onto the area record (Corrections)

1. A	**6. A**	**11. B**	**16. A**	**21. C**
2. D	**7. D**	**12. C**	**17. A**	**22. C**
3. C	**8. C**	**13. D**	**18. D**	**23. A**
4.B	**9. C**	**14. D**	**19. B**	**24. B**
5. A	**10. C**	**15. D**	**20. D**	**25. D**

CHEMISTRY 11 ***For all second year and AP level students. 25 multiple choice questions per exam.***

JANUARY: matter and measurement, atomic theory (sub-atomic particles, atomic masses), spectroscopy (Beer's Law) chemical formulas, chemical equations (precipitation reactions, ionic equations, solubility, acid-base reactions, gas forming reactions, oxidation reduction reactions, balancing redox reactions by oxidation state method, activity series, mole relationships, mass-mass problems¸ stoichiometry of redox solutions, solutions stoichiometry, electronic structure and periodic table/periodicity.

FEBRUARY: chemical bonding, photon-electron spectroscopy, doping and semiconductors, given molecular orbital diagram determine bond order, paramagnetism, and diamagnetism, electronegativity, Lewis structures, molecular geometry, polarity of molecules, hybridization(sp, sp^2, sp^3), liquids, solids, vapor pressure, intermolecular forces, thermo chemistry (enthalpy, Hess's Law, heats of formation, bond energies, calorimetry), phase changes, gases, plus January topics.

MARCH: non-metals, metals(not unit cells), solutions, rates of reactions, reaction mechanisms, descriptive chemistry of the elements, plus Jan and Feb topics.

APRIL: chemical equilibrium, acids, bases, and salts, K_a, K_b, K_{sp}, buffers, redox, voltaic cells, ΔS, ΔH, ΔG, descriptive chemistry of the elements, plus Jan, Feb., and Mar topics.

Dates for 2014 Season

Thursday April 10, 2014

New Jersey Science League

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What is to be mailed back to our office?

PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER SCANTRONS(ALL STUDENTS PLACING 1ST, 2ND, 3RD, AND 4TH).

If you return scantrons of alternates, then label them as ALTERNATES.

Dates for 2015 Season

Thursday January 8, 2015 Thursday February 12, 2015

Thursday March 12, 2015 Thursday April 9, 2015