New Jersey Science League
Chemistry II Exam January 2015   YELLOW TEST

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 #, and which test you are taking on the scan-tron.

1. The density of marble chips is determined by water displacement method and the following data are obtained.

Mass (g)	Volume (mL)
4.0	2.0
6.0	3.0
9.0	4.0
12.0	5.0
15.0	6.0
25.0	10.0

The density of marble is 2.50 g/mL. What is the closest to the percent error of the student's experimental determination?

A. 5.0%   B. 15%   C. 20%   D. 83%

2. The photoelectron spectrum (PES) below shows the binding energies for all electrons in neutral element Q.
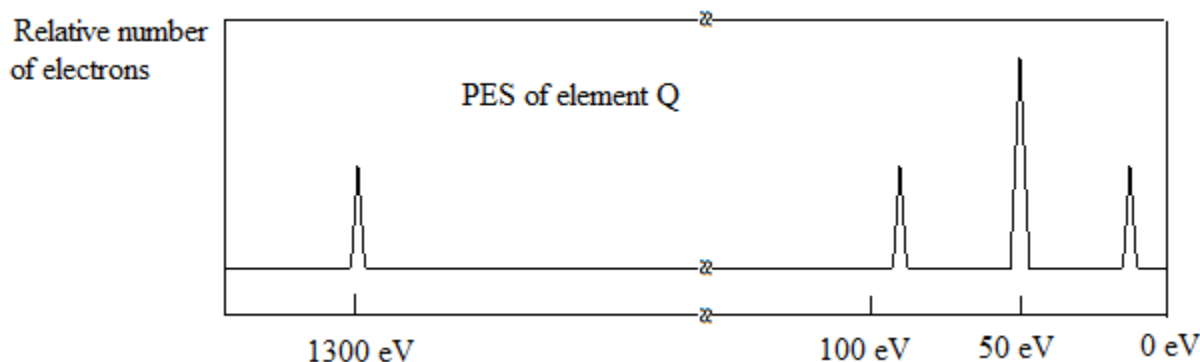
The element Q belongs to the Group _____ of the periodic table.

A. 2   B. 5   C. 14   D. 18

3. Which has the most C atoms?

A. 10.0 mg of $CaCO_3$ B. 12.0 mg of CaC_2 C. 4.0 mg of CO_2 D. 8.0 mg of CO

4. For which pair of species is the difference in radii the greatest?
    A. Na and Cl   B. Na^+ and Cl^- C. Na^+ and S^{2-} D. Cl^- and S^{2-}

5. 100.0 mL of a 0.10 M $Pb(NO_3)_2$ *aq.* solution is added to 100.0 mL of a 0.30 M $CaCl_2$ *aq.* solution. Which ion has the highest concentration in solution after the chemical reaction is terminated?
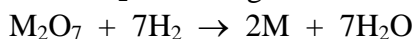
    A. Pb^{2+} B. NO_3^- C. Ca^{2+} D. Cl^-

6. $Cu_2S + HNO_3 \rightarrow Cu(NO_3)_2 + CuSO_4 + NO_2 + H_2O$

When the above equation is balanced using the smallest whole-number coefficients, the coefficient of NO_2 will be equal to

    A. 12   B. 10   C. 8   D. 6

7. 20.0 g of M_2O_7 react with excess H_2 according to the following equation:
$$M_2O_7 + 7H_2 \rightarrow 2M + 7H_2O$$
If only 5.20 g of water are produced, what is the identity of the metal?
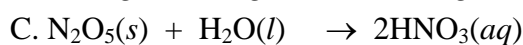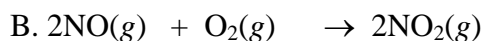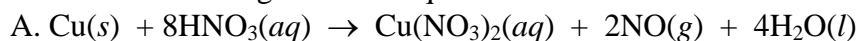
    A. Mn   B. Mo   C. Ru   D. Re

8. 250.0 mL of a 0.10 M HCl are added to a beaker containing 1.00 g of $CaCO_3$. The beaker is heated to dryness. What is the mass of the dry residue in the beaker?

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

    A. 1.73 g   B. 1.11 g   C. 1.29 g   D. 1.91 g

9. In which of the following chemical equations did the oxidation state of N remain unchanged?
        A. $Cu(s) + 8HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO(g) + 4H_2O(l)$
        B. $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
        C. $N_2O_5(s) + H_2O(l) \rightarrow 2HNO_3(aq)$
        D. $NH_4NO_3(s) \rightarrow N_2O(g) + 2H_2O(g)$

10. A compound is made of Mg, P and O. Which of the following compounds contains approximately 50% of oxygen by mass?
        A. $Mg_3(PO_4)_2$ B. $Mg_2P_2O_7$ C. $Mg_3(PO_3)_2$ D. $MgPO_2$

11.   What is the oxidation state of phosphorus in the compound $POCl_3$?

   A.+5   B. +3   C. 0   D. -3

12. Copper has two naturally occurring isotopes: copper-63 and copper-65. The average atomic mass of copper is 63.54 amu. What is the ratio of the natural abundances of these two isotopes (copper-63:copper-65)?

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

13. The term "ALUM" refers to a class of compounds of general formula $QZ(SO_4)_2 \bullet 12H_2O$ where Q and Z are two different metals. A 25.00 g sample of a certain alum is heated to drive off the crystal water; the anhydrous residue weighs 14.264 g. Treatment of the residue with excess NaOH precipitates all the Z as $Z(OH)_3$ which weighs 5.355 g. Identify the two metals.

    A. K and Al   B. Na and Al   C. K and Cr   D. K and Fe

14. A bleach sample is analyzed for its NaClO content. It is found that a 10.0 g sample of bleach requires 40.50 mL of 0.500 M $Na_2S_2O_3$ solution to reach the endpoint of titration. What is the mass percent of NaClO in the bleach?

$$NaClO + 2Na_2S_2O_3 + 2HCl \rightarrow 3NaCl + Na_2S_4O_6 + H_2O$$
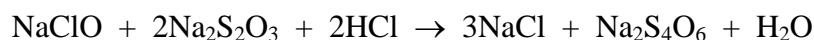
    A. 7.54%   B. 13.4%   C. 20.1%   D. 26.4%

15. A 1.500 g sample of solid $CaCO_3$ is dissolved in 25.00 mL of 1.000 M of HCl solution. The excess amount of HCl is titrated with 0.100 M NaOH solution. The endpoint of the titration required 23.40 mL NaOH solution. What is the percent $CaCO_3$ in the sample?

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

    A. 96.7%   B. 75.3%   C. 50.8%   D. 25.4%

16. Oxygen (O_2) and Ozone (O_3) are allotropes of the element oxygen. Which of the following pairs is NOT an allotropic pair?
    A. $C_{graphite}$ and $C_{diamond}$
    B. rhombic sulfur and amorphous sulfur
    C. white tin and gray tin
    D. nitrogen-14 and nitrogen-15

17. Green light breaks the bond between two chlorine atoms. Which of the following lights can also break the bond between the chlorine atoms?
    A. Blue   B. Yellow   C. Red   D. Orange

18. The correct name of $Cr(CO_2)_3$ is
    A. Chromium carbonate   C. Chromium(VI) carbonate
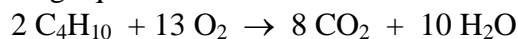   B. Chromium carbonite   D. Chromium(VI) carbonite

19. Which species can act as an oxidizing agent but NOT as a reducing agent?

    A. NO_2 B. NO_3^- C. Cu^+ D. ClO^-

20. What is the ground state electron configuration of the nickelous ion?

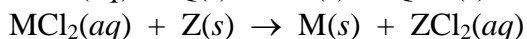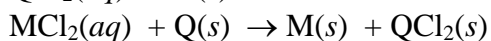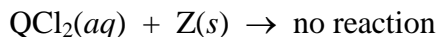   A. [Ar] $3d^8 4s^2$ B. [Ar] $3d^6 4s^2$ C. [Ar] $3d^8$ D. [Ar] $3d^7 4s^1$.

21. Consider the following equation:
$$2\ C_4H_{10}\ +\ 13\ O_2\ \rightarrow\ 8\ CO_2\ +\ 10\ H_2O$$

When 100.0 g of C_4H_{10} react with 100.0 g of O_2, the maximum amount of CO_2 produced is

A. 84.6 g   B. 42.3 g   C. 194 g   D. 304 g

22. Consider the following reactions:
$$QCl_2(aq)\ +\ Z(s)\ \rightarrow\ \text{no reaction}$$
$$MCl_2(aq)\ +\ Q(s)\ \rightarrow M(s)\ +\ QCl_2(s)$$
$$MCl_2(aq)\ +\ Z(s)\ \rightarrow\ M(s)\ +\ ZCl_2(aq)$$

What is the correct order of increasing activity for the metals M, Q and Z?
A. $M < Q < Z$ B. $M < Z < Q$ C. $Z < Q < M$ D. $Z < M < Q$

23. Which of the following compounds is insoluble in pure water, but soluble in acidic solutions?
I. $AgCl$ II. $CaCO_3$ III. $Fe(OH)_3$ IV. $(NH_4)_2CO_3$
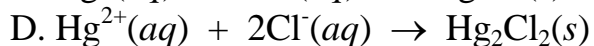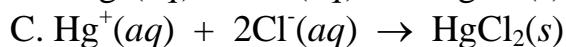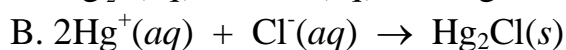
A. Only I and II   B. Only II and III   C. II, III and IV   D. All of these

24. Mixing which combination produces a gaseous product?
I. solid NaOH and solid NH_4NO_3
II. silver metal and 6.0 M HNO_3 solution
III. solid $CaCO_3$ and vinegar

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

25. Which of the following equations correctly represents the net ionic reaction between a solution of mercury(I) nitrate and a solution of sodium chloride?

A. $Hg_2^{2+}(aq)\ +\ 2Cl^-(aq)\ \rightarrow\ Hg_2Cl_2(s)$
B. $2Hg^+(aq)\ +\ Cl^-(aq)\ \rightarrow\ Hg_2Cl(s)$
C. $Hg^+(aq)\ +\ 2Cl^-(aq)\ \rightarrow\ HgCl_2(s)$
D. $Hg^{2+}(aq)\ +\ 2Cl^-(aq)\ \rightarrow\ Hg_2Cl_2(s)$

1. A	6. B	11. A	16. D	21. A
2. A(all full credit)	7. D	12. C	17. A	22. B
3. D(B not D)	8. B	13. D	18. D	23. B
4. C	9. C	14. A	19. B	24. (C and)D
5. D	10. B(A&B)	15. B	20. C	25. A

New Jersey Science League
Chemistry II Exam Yellow test
February 12, 2015 (Correction)

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. A sample of hydrogen is in a 2L flask and a sample of oxygen is in a different 2 L flask. Both samples are at the same temperature and pressure. You determine each of the following:

      I. # of atoms   II. Density   III. Average Kinetic energy.

Which property or properties would be different for the two samples?

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

2. Salt substitute is a mixture of NaCl and KCl. If 61.0 mL of 0.250 M $AgNO_3$ is needed to precipitate the chloride ions from a 1.00 g sample of salt substitute, what is the mass percent composition of NaCl in the sample?

    A. 50.0%   B. 40.0%   C. 30.0%   D. 10.0%

3. Na^+ ions increase the systolic blood pressure in humans. In contrast, K^+ ions tend to lower it. These two ions concentrations are needed to be in delicate balance, otherwise the adverse effects can be harmful. Which of the following statements explain the chemical basis of these physiological facts?

        I. Na^+ ions are smaller than the K^+ ions, therefore exhibit stronger ion-dipole interactions with the water molecules.
        II. K^+ ions are bigger than the Na^+ ions, therefore exhibit stronger dipole-dipole interactions with the water molecules.

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

4. Under the same conditions of temperature and pressure, the density of the gas A is twice of that of the gas B. What is the rate of effusion of the gas B compared to the rate of effusion of the gas A?
    A. 1   B. 1.44   C. 2   D. 4

5. How many neutrons are there in 53 atoms of iodine-131?
    A. $78 \times 6.02 \times 10^{23}$ B. 78   C. 78×10^{23} D. 78×53

6. In which of the following choices are the species ordered in increasing numbers of lone pairs of electrons on their central bonded atom?
    A. I_3^-, NH_3, H_2O, CH_4
    B. I_3^-, H_2O, NH_3, CH_4
    C. CH_4, NH_3, H_2O, I_3^-
    D. CH_4, H_2O, I_3^-, NH_3

7. Which of the pairs of species have the same molecular shapes according to the VSEPR Theory?

$$\text{I. } SO_2 \text{ and } SO_3$$
$$\text{II. } O_3 \text{ and } SO_3$$
$$\text{III. } SF_2 \text{ and } H_2O$$

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

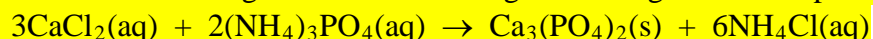8. Which of the following molecular compounds has a no net dipole moment?

     I. SeF_2 II. SeF_4 III. SeF_6

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

9. How many $4d$ electrons are there in an ion of Cs^+?

   A. 10   B. 20   C. 1   D. 0

10. Which set of the following combinations will give the largest mass of precipitate?
$$3CaCl_2(aq) + 2(NH_4)_3PO_4(aq) \rightarrow Ca_3(PO_4)_2(s) + 6NH_4Cl(aq)$$

	0.020 M $CaCl_2$	0.030 M $(NH_4)_3PO_4$
A.	10.0 mL	1.0 mL
B.	2.0 mL	1.0 mL
C.	2.0 mL	2.0 mL
D.	1.0 mL	10.0 mL

11. Which of the following pairs of anions does NOT have the same charge?

     A. Phosphite and phosphate
     B. Nitrite and nitride
     C. Nitrite and nitrate
     D. Carbonite and Sulfite

12. Two ice cubes at 0.0 ^{o}C are dropped in an insulated container containing 93.8 g of water at 27.0°C. After all the ice is melted, the final temperature of the system is 17.0 °C. What is the mass of the ice cubes dropped? **Assume that the container has a heat capacity of 12.00 J/ ^{o}C and ΔH_{fus} of ice is 333.0 J/g. The specific heat of water is 4.18 J/g°C.**

   A. 40.0 g   B. 33.3   C. 20.0 g   D. 10.0 g

13. Which of the following ions has the largest ionic radius?

    A. Mg^{2+} B. Ca^{2+} C. Na^+ D. K^+

14. Which of the following compounds does NOT exist?

    A. NI_3 B. NF_5 C. OF_2 D. TeF_6

15. Calculate the standard enthalpy change of the following reaction:

$$A(s) + B(g) \rightarrow C(s) + D(g)$$
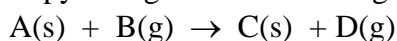
Given ΔH kJ

         $3E(s) + B(g) \rightarrow 2F(s) + D(g)$ -40.0

         $E(s) + 3B(g) \rightarrow 2C(s) + 3D(g)$ -10.0

         $F(s) + B(g) \rightarrow 3A(s) + D(g)$ +20.0

    A. -5.0 kJ   B. -10.0 kJ   C. +5.0 kJ   D. -10.0 kJ

16. Scuba stands for self-contained underwater breathing apparatus. **A scuba tank is a gas cylinder used to store and transport high pressure gases for scuba divers.** When high pressure gases in the scuba tank come in contact with water in the blood stream, these gases dissolve into the blood stream. As a diver swims to the surface, the gases are released. This can cause a very painful condition, called the bends. Decompression sickness is one danger of diving. **In order to prevent the bends from happening, a scuba tank is filled with gases that are not very soluble in water. Which of the following gases is <u>LEAST</u> soluble in water that is used in scuba tanks along with oxygen?**

    A. N_2 B. He   C. CO_2 D. Ar

17. A student heated a white crystalline substance until all the crystal water was removed. The following experimental data was obtained by the student:

The mass of the beaker and the glass watch before heating:	57.890 g
The mass of the beaker and the glass watch after heating:	57.880 g
The mass of the beaker + glass watch + sample:	59.993 g
The mass of the beaker + glass watch + sample after first heating:	59.710 g
The mass of the beaker + glass watch + sample after second heating:	59.700 g
The mass of the beaker + glass watch + sample after third heating:	59.697 g

    A. $CuSO_4 \bullet 2H_2O$ B. $ZnSO_4 \bullet 7H_2O$ C. $BaCl_2 \bullet 2H_2O$ D. $NiCl_2 \bullet 6H_2O$

18. In which of the compounds is the carbon-carbon bond the longest?

    A. C_2H_2 B. C_2H_4 C. C_2H_6 D. $C_2H_2F_2$

19. Which is the correct order when the elements K, Ca, and Ga, are arranged in order of increasing first ionization energy?

        A.   K, Ca, Ga
        B.   Ca, K, Ga
        C.   Ca, Ga, K
        D.   K, Ga, Ca

20. Which compound has the lowest vapor pressure at 25°C?

A. CH_3OCH_3

B. CH_3COOH

C. CH_3OH

D. CH_2OHCH_2OH

21. Which of the pairs of ions concentrations cannot be determined quantitatively by UV-vis spectroscopy? Assume no other reagents are used.

A. Ag^+ and Zn^{2+} B. Cu^{2+} and Ni^{2+} C. Fe^{2+} and Cr^{3+} D. Co^{2+} and Ni^{2+}

22. During the complete combustion of C_2H_4, what change in shape do the carbon atoms undergo?

        A. linear to trigonal planar
        B. pyramidal to trigonal planar
        C. trigonal planar to linear
        D. pyramidal to linear

23. The electron configuration [Ar] $3d^3$ belongs to

A. Cr^{2+} B. Cr^{3+} C. V^{3+} D. Sc

24. A sample of 4.00 g of gas occupies a volume of 1.47 L at 20.0 psi and - 40.0 °F. What is the identity of this gas?

A. F_2 B. BH_3 C. NH_3 D. N_2

25. Which of the following molecules present hydrogen bonding within a sample of the pure substance?

        I. CH_3NH_2 II. HF   III. CH_3COOH IV. CH_3OH V. CH_3F

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

Chemistry II January 2015 Answer Key <u>Yellow test</u>
Date: Thursday February 12, 2015 (Corrections)

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

New Jersey Science League
Chemistry II Exam March 2015 <u>YELLOW TEST</u>

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 butane, C_4H_{10}, would need to be combusted in order to convert 100.0 g of ice that is initially at 0.0°C to steam at 175.0°C? Assume that all of the heat generated goes directly into heating the ice. Enthalpy of combustion of gaseous butane is −2874 kJ/mol. Heat of vaporization of water is 2260 J/g, and heat of fusion of ice is 333 J/g. specific heat(c) of water = 4.18 J/g°C.
specific heat(c) of steam = 2.05 J/g°C.

      A. 123 g   B. 12.7 g   C. 6.38 g   D. 4.45 g

2. The rate of formation of B is 0.012 mol/L×s. What is the rate of decomposition of A?

$$2A(g) \rightarrow 3B(g)$$
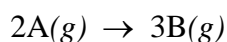
    A. 0.0080 mol/L×s   B. 0.018 mol/L×s   C. 0.024 mol/L×s   D. 0.0060 mol/L×s

3. Three gases effuse through a pinhole represented in the scheme below at different velocities. Which gases were present in the original container at 338 K? *Note: Sizes of the gas particles are not drawn to scale. D is deuterium(the heavy hydrogen) with atomic mass of 2 amu.*
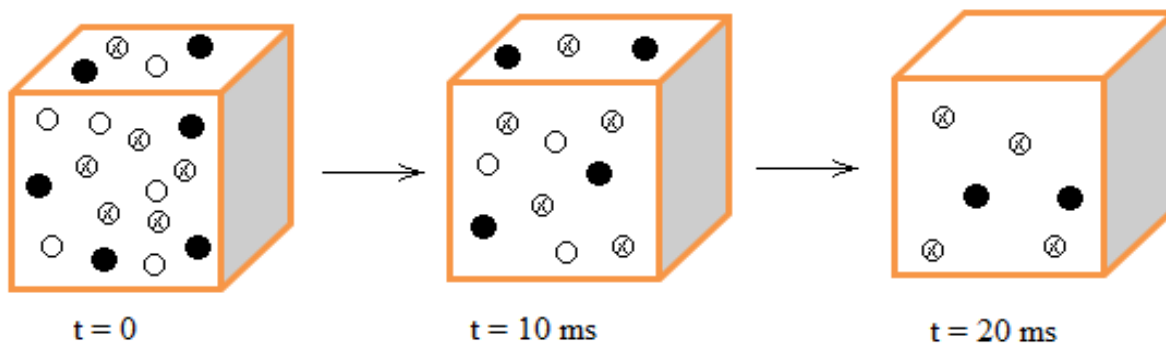
      A. He, CH_4, and Xe   B. He, CH_4, and CO_2
      C. He, N_2, and CO   D. He, CH_4, and CD_3OD

4. A 1.000 g sample of nickel ore is dissolved in acid. The nickel(II) ions are precipitated by DMGO (dimethyl glyoxime) solution according to the following equation:

$$Ni^{2+}(aq) + 2C_4H_8N_2O_2 \rightarrow Ni(C_8H_{14}ON_4O_4)_2(s) + 2H^+(aq)$$
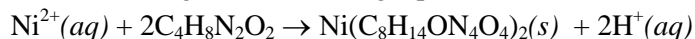
The precipitate is filtered and washed. Then, it is heated gently to dryness. The precipitate weighs 3.601 g. What is the mass percentage of Ni in the ore? $Ni(C_8H_{14}ON_4O_4)_2$ = 288.94 g/mol and $C_4H_8N_2O_2$ = 116 g/mol.

      A. 73.0 %   B. 36.2 %   C. 65.1 %   D. 48.9 %
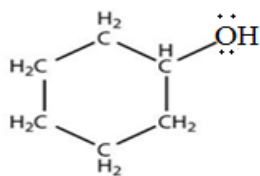
5. Concentrated hydrochloric acid is 36.5 % (w/w) and has a density of 1.20 g/mL. What is the molar concentration of this solution?

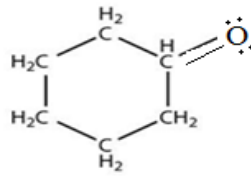   A. 36.5 *M*   B. 12.0 M   C. 1.20 M   D. 3.65 *M*

6. Below are four cyclo hexane molecules with different functional groups attached. Which one has the highest boiling point?
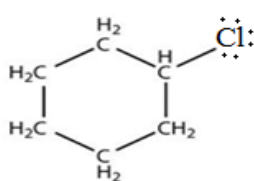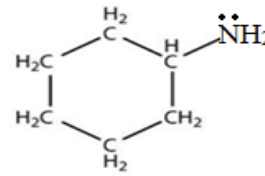

| A | B | C | D |

7. The presence of a high-altitude ozone layer in the atmosphere was first determined in the 1920s from observations of the solar UV spectrum. Chapman proposed that the ozone layer originates from the photolysis of atmospheric O_2. The bond energy of the O_2 molecule is 498 kJ/mol. What is the wavelength of the photons responsible of photolysis of the oxygen molecules? $c = 300000$ km/s and $h = 6.62 \times 10^{-34}$ J×s.

  A. 240 nm   B. 280 nm   C. 320 nm   D. 360 nm

8. Which one of the following metals has the following properties?
    I. *Most powerful reducing agent.*   III. *Lowest density.*
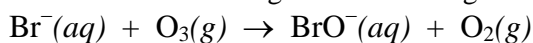   II. *Lowest melting point.*   IV. *Reacts vigorously with water.*

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

9. Ozone oxidizes bromide ion to bromite ion according to the following reaction:
$$Br^-(aq) + O_3(g) \rightarrow BrO^-(aq) + O_2(g)$$
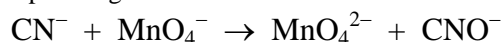where $k = 160\ M^{-1} \times s^{-1}$. What is the order of the reaction?

  A. zeroth   B. first   C. second   D. third

10. Cyanide ions are oxidized by the permanganate ions in basic solution according to unbalanced equation:
$$CN^- + MnO_4^- \rightarrow MnO_4^{2-} + CNO^-$$
What volume of 0.0020 M MnO_4^- solution are needed to oxidize 1.00 L of $4.0 \times 10^{-3}\ M$ CN^- solution?
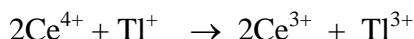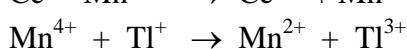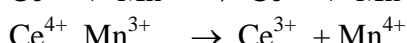 A. 1.0 L   B. 2.0 L   C. 4.0 L   D. 8.0 L

11. Consider the following reaction between Ce^{4+} and Tl^+ ions:
$$2Ce^{4+} + Tl^+ \rightarrow 2Ce^{3+} + Tl^{3+}$$

The following mechanism is proposed:
$$Ce^{4+} + Mn^{2+} \rightarrow Ce^{3+} + Mn^{3+}$$
$$Ce^{4+}\ Mn^{3+} \rightarrow Ce^{3+} + Mn^{4+}$$
$$Mn^{4+} + Tl^+ \rightarrow Mn^{2+} + Tl^{3+}$$
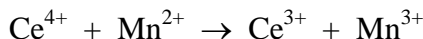
Based on the above mechanism, which of the following choices is correct?

Choice	Mn^{2+}	Mn^{3+}	Mn^{4+}
A	Inhibitor	Catalyst	Intermediate
B	Catalyst	Intermediate	Intermediate
C	Catalyst	Intermediate	Catalyst
D	Intermediate	Catalyst	Catalyst

12. Which of the following choices is correct if GaP, SrS, MgO, and RbF are arranged in order of **increasing** lattice energy?

$$\text{A. GaP} < \text{SrS} < \text{MgO} < \text{RbF}$$
$$\text{B. RbF} < \text{MgO} < \text{SrS} < \text{GaP}$$
$$\text{C. RbF} < \text{SrS} < \text{MgO} < \text{GaP}$$
$$\text{D. GaP} < \text{MgO} < \text{SrS} < \text{RbF}$$

13. The complete combustion of 5.2 mg of a hydrocarbon, compound containing C and H only, gave 17.6 mg of CO_2 and 3.6 mg of H_2O. What is the molecular formula of this hydrocarbon?

    A. C_4H_{10} B. C_5H_{10} C. C_7H_{12} D. C_8H_8

14. Which of the following compounds is <u>ionic</u>?

    A. Al_2Cl_6 B. BF_3 C. NH_4NO_3 D. P_2O_5
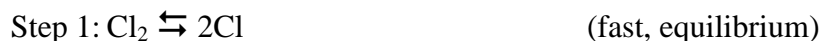
15. In the azide ion, N_3^-, the central nitrogen atom is,
    A. *sp* hybridized   B. sp^2 hybridized   C. sp^3 hybridized   D. dsp^3 hybridized

16. The following reaction is studied in room temperature.
$$Cl_2(g) \ + \ H_2O(g) \ \rightleftarrows \ HCl(g) \ + \ HClO(g)$$
The first step is promoted by light. The following proposed mechanism using three elementary steps gives the same rate law expression determined by experiments.
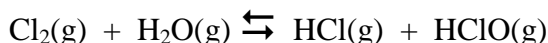
    Step 1: $Cl_2 \rightleftarrows 2Cl$ (fast, equilibrium)
    Step 2: $Cl \ + \ H_2O \ \rightarrow \ HCl \ + \ OH$ (slow)
    Step 3. $Cl \ + \ OH \ \rightarrow \ HClO$ (fast)

Which of the following rate laws is correct?

    A. rate $= k[Cl][H_2O]$ B rate $= k[Cl]^{1/3}[H_2O]$
   C. rate $= k[Cl]^2[H_2O]$ D. rate $= k[Cl_2]^{1/2}[H_2O]$

17. Which of the following statements is(are) correct?
    I. *Intermolecular forces between a liquid and the substance comprising the surface of*
      the capillary are called cohesive forces.
    II. *The viscosity of a liquid is its resistance to flow.*
    A. Only I   B. Only II   C. Both I and II   D. Neither I nor II

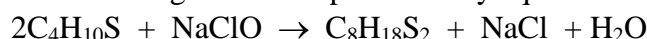18. Consider the following reaction:

$$2A(g) \rightarrow B(g) + 2C(g) \qquad\qquad \Delta H = 228 \text{ kJ}$$
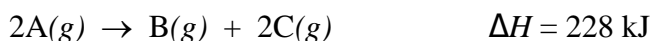
If 2.0 mol of A are converted into products at a pressure of 1.25 atm and 1000.0°C, calculate the ΔE for the reaction? 1 liter × atm = 101.3 J

    A. 220 kJ   B. −220 kJ   C. 6.20 kJ   D. −6.20 kJ

19. When elements with electron configuration $1s^2\,2s^2\,2p^6\,3s^2\,3p^2$ and $1s^2\,2s^2\,2p^4$ combine, they form a(n) _____ compound.

    A. Ionic   B. Metallic   C. Network covalent   D. A, B, and C

20. The odor of skunks is caused by butanethiol, $C_4H_{10}S$. The household bleach can deodorize the smell according to the following reaction represented by equation:?
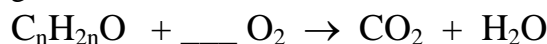
$$2C_4H_{10}S + NaClO \rightarrow C_8H_{18}S_2 + NaCl + H_2O$$

where the two sulfurdryl bonds form a disulfide bond as represented below:
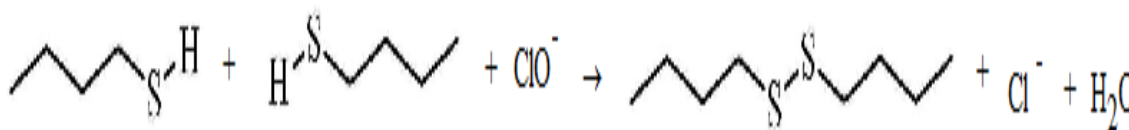
Identify the **oxidized** element in this reaction.

    A. H   B. Cl   C. S   D. O

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

$$C_nH_{2n}O + \underline{} O_2 \rightarrow CO_2 + H_2O$$

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

22. Consider, B_2H_6 (diborane) and Al_2Cl_6 (dialuminum hexachloride), the dimeric forms of BH_3 and $AlCl_3$, respectively. Which of the following statements is(are) correct for these compounds?

    I. *In both compounds, all the bond angles and distances are equal.*
    II. *In B_2H_6, two boron atoms have six electrons each, however, in Al_2Cl_6, the aluminum*
      atoms satisfy the octet rule.
    A. Only I   B. Only II   C. Both I and II   D. Neither I nor II

23. Equal volumes of 0.200 M $NaNO_3$ and 0.0300 M $Ba(NO_3)_2$ solutions are mixed. What is the molar concentration of nitrate ions in the final solution?

    A. 0.130 M B. 0.230 M C. 0.260 M D. 0.013 M

24. What volume of 0.0250 M lead(II) nitrate solution is needed to precipitate all the bromide ions present in 25.0 mL 0.0250 M barium bromide solution?

    A. 25.0 mL   B. 50.0 mL   C. 12.5 mL   D. 100. mL

25. How many valence electrons are in triphosphate ion, $P_3O_{10}^{5-}$?

    A. 5   B. 70   C. 75   D. 80

Chemistry II March 2015 Answer Key: <u>Yellow test</u>

Date: Thursday March 12, 2015

<u>Record onto the area record the # correct</u>

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

Answer the following questions on the answer sheet provided. Each correct response is worth 4 points. Use the letters 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. Nitinol, an alloy of Ni and Ti exhibits shape memory. Nitinol has the ability to undergo deformation at one temperature, then recover its original undeformed shape upon heating above its transformation temperature. The width of the transformation temperature is related to the Nitinol composition. When 1.00 g Nitinol sample reacts with <u>dilute sulfuric acid</u>, the volume of the gas collected at 756 mmHg and 27.0 °C is 478 mL. What is the mass composition of Ni in the sample? $P_{H2O} = 26$ mmHg at 27.0 °C. *Note:* Both Ti and Ni react with H_2SO_4 to produce Ti^{3+} and Ni^{2+} ions, respectively. Ti = 48; Ni = 59

      A. 73.0 %   B. 88.0 %   C. 62.0 %   D. 58.0 %

2. Which of the following solutions will form a buffer upon mixing?

      A. 10 mL 0.10 *M* HCl + 10 mL 0.10 *M* HF
      B. 10 mL 0.10 *M* HCl + 10 mL 0.10 *M* NaOH
      C. 10 mL 0.10 *M* HF + 10 ml 0.050 *M* NaF
      D. 10 mL 0.10 *M* CH_3COOH + 10 mL 0.10 *M* NaOH

3. Which of the following compounds is the contains the most acidic H?

	pK_a
A. H-C≡C-H	25
B. $H_2C=CH_2$	44
C. H_3C-CH_3	50
D. H-C≡N:	9.1

4. A 0.10 M solution of which of the following substances is most basic?

      A. K_2SO_4 B. $NaC_2H_3O_2$ C. $AlCl_3$ D. CH_3OH

5. The K_{sp}'s of some silver compounds at 25°C are given below:

Ag_2SO_4	$1.2×10^{-12}$
Ag_2SO_3	$1.5×10^{-15}$
AgI	$8.5×10^{-17}$
Ag_3AsO_4	$1.0×10^{-22}$

Which salt has the largest concentration of $[Ag^+]$ in pure water at 25°C?

      A. Ag_2SO_4 B. Ag_2SO_3 C. AgI   D. Ag_3PO_4

6. 25.0 mL of 0.10 *M* HCl solution is titrated with 0.10 *M* of NaOH solution. The final pH of the solution is 12.00. How many mL of NaOH solution are added?

      A. 25.0   B. 27.8   C. 55.6   D. 50.0

7. What would be the result of increasing the pressure upon the following equilibrium system?

$$A(g) + B(g) \leftrightarrows C(g) + 3D(g)$$

A. The amount of C would increase.   C. The amount of D would increase.
B. The amount of A would increase.   D. There would be no change.

8. The use of CFC's is banned because of their ozone depleting property. The stockpiles of CFC's are destroyed by heating them with solid sodium oxalate which is represented with the equation below:

$$CF_2Cl_2(g) + 2Na_2C_2O_4(s) \rightarrow C(s) + 2NaF(s) + 2NaCl(s) + 4CO_2(g)$$
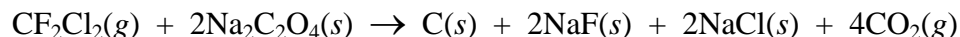
In this reaction, 15.0 g of Freon-12 react with excess oxalate. If the reaction produces 11.2 L of CO_2 at 27.0°C and 1.0 atm, what is the percent yield of the reaction?

  A. 91.7   B. 75.1   C. 67.3   D. 59.0

9. Which of the following CANNOT behave as a **Lewis acid**?

  A. Al^{3+} B. BF_3 C. CH_3^+ D. $CHCl_3$

10. Which of the following reactions' rate will be **increased** with an increase in temperature?

  I. $CaCO_3(s) + heat \rightarrow CaO(s) + CO_2(g)$

  II. $2Mg(s) + O_2(g) \rightarrow 2MgO(s) + heat$
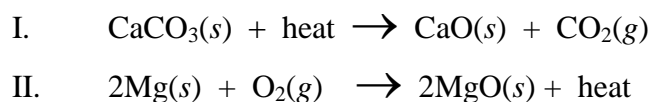
  A. Only I   B. Only II   C. I and II   D. Neither I nor II

11. A solution of lead(II) nitrate is added to a test tube containing a solution of copper(II) sulfate. After the reaction is completed, the student observed a white precipitate and a pink-red solution on top. The white precipitate dissolves upon heating the test tube. What is the identity of the unknown **aqueous** solution?

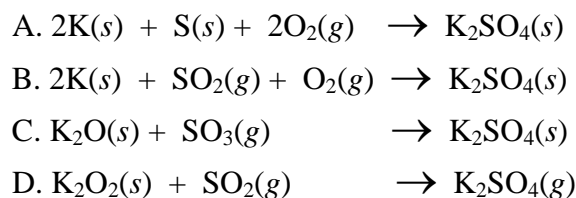 A. $CuSO_4$ B. $CuCl_2$ C. $CoCl_2$ D. $CoSO_4$

12. Which of the 0.010 M aq. solutions has the highest pH?
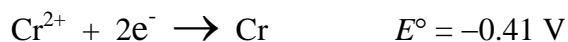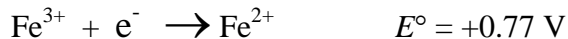 A. $NaHSO_4$ B. $NaHS$ C. Na_2SO_4 D. Na_2S

13. Which substances will be produced at the electrodes during electrolysis of an aqueous solutions of K_2SO_4?

  A. K at the cathode and O_2 at the anode
  B. H_2 at the cathode and O_2 at the anode
  C. H_2 at the cathode and SO_2 at the anode
  D. O_2 at the cathode and H_2 at the anode

14. The enthalpy change, $\Delta H°_f$, of which of the reactions corresponds to the heat of formation of K_2SO_4?

  A. $2K(s) + S(s) + 2O_2(g) \rightarrow K_2SO_4(s)$

  B. $2K(s) + SO_2(g) + O_2(g) \rightarrow K_2SO_4(s)$

  C. $K_2O(s) + SO_3(g) \rightarrow K_2SO_4(s)$

  D. $K_2O_2(s) + SO_2(g) \rightarrow K_2SO_4(g)$

15. The standard reduction potentials are given below:

$$Ag^+ + e^- \rightarrow Ag \qquad E° = +0.80 \text{ V}$$

$$Fe^{3+} + e^- \rightarrow Fe^{2+} \qquad E° = +0.77 \text{ V}$$

$$Cr^{2+} + 2e^- \rightarrow Cr \qquad E° = -0.41 \text{ V}$$
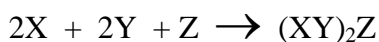
Which of the following ionic species is the **strongest** oxidizing agent?

A. Cr^{2+} 　　　　　 B. Ag^+ 　　　　　 C. Fe^{3+} 　　　　　 D. Fe^{2+}

16. The pH of a 0.1 M solution of a weak monoprotic acid is 4. What is the value of the K_a?
    A. 10^{-3} 　　　　 B. 10^{-5} 　　　　 C. 10^{-7} 　　　　 D. 10^{-9}

17. Given the following experimental data, find the rate law for the reaction:

$$2X + 2Y + Z \rightarrow (XY)_2Z$$

Trial	$[X]_o$	$[Y]_o$	$[Z]_o$	initial rate, Ms^{-1}
1	0.10 M	0.10 M	0.10 M	2.0×10^{-3}
2	0.20 M	0.10 M	0.10 M	4.0×10^{-3}
3	0.20 M	0.30 M	0.20 M	1.2×10^{-2}
4	0.10 M	0.10 M	0.20 M	2.0×10^{-3}

A. $k[X]^2[Y]$ 　　　 B. $k[X][Y]$ 　　　 C. $k[X][Z]^2$ 　　　 D. $k[X][Y]^2$

18. The half-life of a radioactive isotope is found to be 15 minutes. What fraction of the isotope will remain after 2.00 hours?
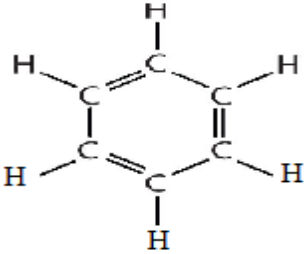
A. 0.0625 　　　　 B. 0.0313 　　　　 C. 0.0156 　　　　 D. 0.00391

19. A chemical engineer wants to recover the Cu^{2+} ions in a waste tank. The tank has a capacity of 10,000 liters and the Cu^{2+} ion concentration is 2.40×10^{-3} mol/L. The electric current applied is 10.0 A. How long will it take to deposit all the copper(II) ions?

A. 11.3 hrs. 　　　　 B. 21.5 hrs. 　　　　 C. 35.6 hrs. 　　　　 D. 129 hrs.

20. A solution of ammonia is titrated with a solution of hydrochloric acid. The correctly chosen indicator will change its color about pH = _____ ?

A. 1 　　　　　 B. 5 　　　　　 C. 7 　　　　　 D. 9

21. The following table depicts the structural formula and the lengths of the carbon-carbon bonds in some organic compounds.

COMPOUND	Formula	carbon-carbon bond length in nm
Benzene		140
Ethylene	$H_2C=CH_2$	134
Acetylene	$H-C\equiv C-H$	120
Allene	$H_2C=C=CH_2$	?

What is the carbon-carbon length in the allene molecule?
    A. 110 nm   B. 120 nm   C. 130 nm   D. 150 nm

22. A student wants to determine the concentration of an unknown $Co(NO_3)_2$ solution. The solution is pale-red color. Which of the following wavelengths, when used as analytical wavelength, will provide the best results ?
   A. 510 nm   B. 610 nm   C. 710 nm   D. 410 nm

23. How many grams of solid NaCl is needed to increase the concentration of a 400.0 g NaCl solution from 18.0% (w/w) to 20.0% (w/w)?
    A. 50.0 g   B. 80.0 g   C. 10.0 g   D. 15.0 g

24. Which of the following oxides is amphoteric?
    A. GeO_2 B. I_2O_5 C. K_2O D. N_2O_5

25. Which of the following figures correctly represents the chemical reaction between 10.0 mL 0.10 M $AgNO_3$ and 10.0 mL 0.20 M NaCl solutions?
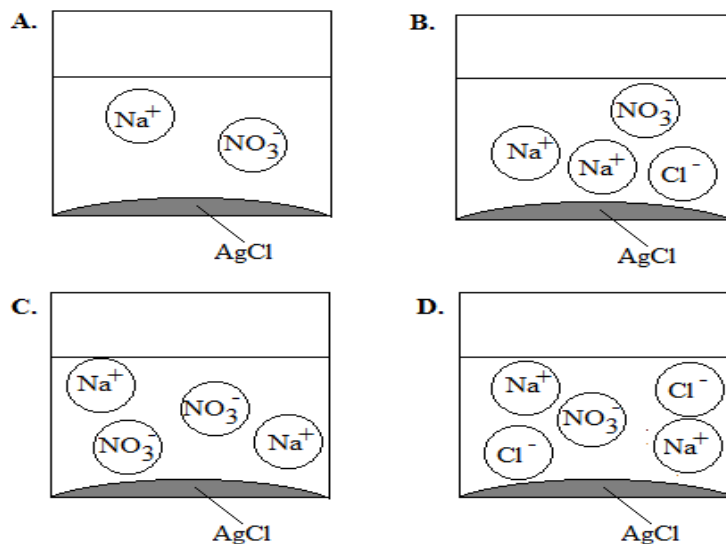
Chemistry II April 2015 Answer Key <u>Yellow test</u>

Date: Thursday April 9, 2015

<u>Record onto the area record the % correct</u> (Corrected)

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